CNS2020 VIRTUAL

MAY 2–5, 2020

Cognitive Neuroscience Society

CNS 2020 Virtual Meeting, May 2-5, 2020

Contents

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Schedule Overview

Saturday, May 2, 2020

12:00 – 1:30 pm	**Opening Ceremonies & Keynote Address —** Origins of Human Cooperation, **Michael Tomasello**, *Duke University and Max Planck Institute for Evolutionary Anthropology*, (Q&A to follow), *Grand Ballroom*
1:30 – 4:30 pm	**Poster Session A**, *Exhibit Hall C*
1:30 – 6:00 pm	Exhibits Open, *Exhibit Hall C*
2:00 – 4:00 pm	**Invited Symposium 1 — Making Sense Out of Big Data in Cognitive Neuroscience,** Randy L. Buckner, Chair, *Back Bay A/B*
▶ 2:00 – 2:04 pm	Introduction
▶ 2:04 – 2:41 pm	**Talk 1: High-Dimensional Structure of Signal and Noise in 20,000 Neuron Recording,** Carsen Stringer
▶ 2:41 – 3:08 pm	**Talk 2: Casual Inference with Big Data Sets,** Konrad Kording
▶ 3:08 – 4:00 pm	**Talk 3: Lessons and Opportunities of Big Data Superstructing in a Virtual World,** Randy L. Buckner
4:30 – 6:00 pm	**Workshop — Neuroaesthetics Social,** *Exhibit Hall C*
4:30 – 6:00 pm	**Data Blitz Session 1**, *Back Bay A/B* **Data Blitz Session 2**, *Back Bay C/D* **Data Blitz Session 3**, *Grand Ballroom*

Sunday, May 3, 2020

10:00 am – 1:00 pm	**Poster Session B**, *Exhibit Hall C*
10:00 am – 5:00 pm	Exhibits Open, *Exhibit Hall C*
10:00 am – 12:00 pm	**Invited Symposium 2 — The Role of Causal Inference for Perceptual Decisions and Adaptive Behavior,** Christoph Kayser, Chair, *Grand Ballroom*
▶ 10:00 – 10:05 am	**Introduction**
▶ 10:05 – 10:28 am	**Talk 1: Inferring Internal Causes of Uncertainty to Improve Decision Making,** Rachel Denison
▶ 10:28 – 10:46 am	**Talk 2: Causal Inference in Reinforcement Learning,** Sam Gershman
▶ 10:46 – 11:12 am	**Talk 3: Causal Inference in Multisensory Perception,** Uta Noppeney
▶ 11:12 – 12:00 pm	**Talk 4: The Persistent Influence of Causal Inference in Multisensory Perception,** Christoph Kayser
12:30 – 1:30 pm	**The Fred Kavli Distinguished Career Contributions in Cognitive Neuroscience Lecture** Hemispheric Organization for Visual Recognition**, Marlene Behrmann**, *Carnegie Mellon University*, *Grand Ballroom*
2:00 – 5:00 pm	**Poster Session C**, *Exhibit Hall C*
3:00 – 5:00 pm	**Symposium 1 — Studying the Mind by Manipulating Brain Networks,** Joel Voss, Chair, *Constitution Ballroom*
▶ 3:00 – 3:07 pm	**Introduction**
▶ 3:07 – 3:30 pm	**Talk 1: Neurostimulation for Flexible Language-Network Redistribution in Healthy and Lesioned Brains,** Gesa Hartwigsen
▶ 3:30 – 3:54 pm	**Talk 2: Network Stimulation to Test the Human Orbitofrontal Cortex Role in Interference-Based Decision Making,** Thorsten Kahnt
▶ 3:54 – 4:15 pm	**Talk 3: Using the Human Brain Connectome to Identify Brain Circuit Targets for Depression Symptoms,** Michael Fox
▶ 4:15 – 5:00 pm	**Talk 4: Stimulating the Hippocampal Network to Test Episodic Memory Mechanisms,** Joel Voss
3:00 – 5:00 pm	**Symposium 2 — Finances and Feelings: The Affective Neuroscience of SES,** Martha Farah, Chair,

	Back Bay A/B
▶ 3:00 – 3:11 pm	**Introduction**
▶ 3:11 – 3:31 pm	**Talk 1:** Neural Correlates of Poverty Observed in the Human Fetal Brain: Implications for Postnatal Wellbeing, Moriah Thomason
▶ 3:31 – 3:53 pm	**Talk 2: SES, Early Experience and Brain Development: Informing a Science of Neurodevelopmental Enhancement,** Joan Luby
▶ 3:53 – 4:16 pm	**Talk 3: Executive and Emotion Regulation Networks Associated with Resilience to Poverty and Early Adversity**, Robin Nusslock
▶ 4:16 – 5:00 pm	**Talk 4: Socioeconomic Disadvantage and the Neuroscience of Mother-Infant Attachment,** Pilyoung Kim
3:00 – 5:00 pm	**Symposium 3 — From Wikipedia Searches to Single Cell Recording: Uncovering the Mechanisms of Information-Seeking,** Tali Sharot, Chair, *Grand Ballroom*
▶ 3:00 – 3:09 pm	**Introduction**
▶ 3:09 – 3:38 pm	**Talk 1: Using Structure to Explore Efficiently,** Eric Schulz
▶ 3:38 – 4:11 pm	**Talk 2**: **Hunters, Busybodies, and the Knowledge Network Building Associated with Curiosity,** Danielle Basset
▶ 4:11 – 4:39 pm	**Talk 3: A Neural Network for Information Seeking,** Ethan Bromberg-Martin
▶ 4:39 – 5:00 pm	**Talk 4: Information-Seeking Impairments in Behavioral Addiction as a Novelty Failure,** Irene Cogliati Dezza
3:00 – 5:00 pm	**Symposium 4 — Development and Plasticity of High-Level Vision and Cognition,** Zeynep Saygin, Chair, Back Bay C/D
▶ 3:00 – 3:05 pm	**Introduction**
▶ 3:05 – 3:31 pm	**Talk 1**: **Connectivity at the Origins of Domain Specificity in the Cortical Face and Place Networks,** Daniel Dilks
▶ 3:31 – 3:49 pm	**Talk 2: Category-Selective Visual Regions Have Distinctive Signatures of Structural Connectivity in Infants,** Rhodri Cusack
▶ 3:49 – 4:05 pm	**Talk 3: Selectivity Driven by Connectivity: Innate Connectivity Patterns of the Visual Word Form Area,** Zeynep Saygin
▶ 4:05 – 5:00 pm	**Talk 4**: **Congenital Blindness Repurposes Visual Cortices for Higher-Cognition and Changes their Connectivity,** Marina Bedny

Monday, May 4, 2020

10:00 am – 1:00 pm	**Poster Session D**, *Exhibit Hall C*
10:00 am – 5:00 pm	Exhibits Open, *Exhibit Hall C*
10:00 am – 12:00 pm	**Symposium 5 — Pressing the Play Button: Sequential Neural Replay of Human Memories,** Eitan Schechtman, Chair, *Constitution Ballroom*
▶ 10:00 – 10:08 am	**Introduction**
▶ 10:08 – 10:28 am	**Talk 1: Neural Mechanisms of Human Episodic Memory Formation Across Spatial Scales,** Kareem Zaghloul
▶ 10:28 – 10:50 am	**Talk 2**: **Forward Reactivation of Sequential Memory Traces During Sleep,** Marit Petzka
▶ 10:50 – 11:19 am	**Talk 3: Neural Replay in Model-Based Learning,** Yunzhe Liu
▶ 11:19 – 11:36 am	**Talk 4: Replay of Human Practice Predicts Early Skill Learning,** Leonardo G Cohen
▶ 11:36 am- 12:00 pm	**Live Panel Discussion via Zoom – Western Hemisphere Schedule Only**
10:00 am – 12:00 pm	**Symposium 6 — Moving from a Deficit-Oriented to a Preventive Model in Education: Examining Neural Correlates for Reading Development,** Tzipi Horowitz-Kraus, Chair, *Back Bay A/B*
▶ 10:00 – 10:05 am	**Introduction**
▶ 10:05 – 10:28 am	**Talk 1: Neurobiological Correlates for Environmental Factors Contributing to Future Reading Abilities,** Tzipi Horowitz-Kraus
▶ 10:28 – 10:54 am	**Talk 2: The Typical and Atypical Reading Brain: How a Neurobiological Framework of Reading Development Can Inform Educational Practice and Policy,** Nadine Gaab
▶ 10:54 – 11:16 am	**Talk 3: Functional and Structural Signatures of Dyslexia Before and After Literacy Instruction,** Michael Skeide

▶ 11:16 – 11:33 am	**Talk 4: Precursors of Difficulties Associated with the Developmental Steps Towards Full Literacy,** Heikki Lyytinen
▶ 11:33 am – 12:00 pm	**Talk 5: Seeking to overcome the dyslexia paradox: brain insights, defining who is at risk for dyslexia and preventive intervention,** Jolijn Vanderauwera
10:00 am – 12:00 pm	**Symposium 7 – Integrating Theory and Data: Using Computational Models to Understand Neuroimaging Data,** Brandon Turner, Chair, *Back Bay C/D*
▶ 10:00 – 10:08 am	**Introduction**
▶ 10:08 – 10:29 am	**Talk 1: Corticostriatal Computations in Learning and Decision Making**, *Michael Frank*
▶ 10:29 – 10:57 am	**Talk 2: Cognitive Computation Using Neural Representations Of Time, Space And Number In The Laplace Domain,** Marc Howard
▶ 10:57 – 11:22 am	**Talk 3: Category Learning as Compression**, ***Bradley Love***
▶ 11:22 am – 12:00 pm	**Talk 4: Probabilistic Linking Functions for Mind, Brain, and Behavior,** Brandon Turner
10:00 am – 12:00 pm	**Symposium 8 – The Meeting of Perception and Memory in the Brain**, Marc Coutanche, Chair, *Grand Ballroom*
▶ 10:00 – 10:32 am	**Introduction** & **Talk 1: Roles of Perceptual and Conceptual Hierarchies in the Formation of Memories,** Marc Coutanche
▶ 10:32 – 11:01 am	**Talk 2: Distinct Profiles of Perception and Memory in High-Level Visual Cortex,** Chris Baker
▶ 11:01 – 11:27 am	**Talk 3: The Reciprocal Link Between Memory and Visual Exploration,** Jennifer Ryan
▶ 11:27 – 11:56 am	**Talk 4: Past Meets Present: Prediction Error Drives Episodic Memory Updating,** Morgan Barense
▶ 11:56 am – 12:30 pm	**Panel Discussion**
12:31 – 12:52 pm	**YIA 1 –** Developmental Tuning Of Action Selection**, Catherine Hartley**, *NYU*, *Grand Ballroom*
12:52– 1:30 pm	**YIA 2 –** Structured Reinforcement Learning**, Samuel J. Gershman**, *Harvard University*, *Grand Ballroom*
2:00 – 3:30 pm	**Special Session, What Makes us Human? Symposium in Honor of Donald T. Stuss**, Brian Levine, Chair, *Grand Ballroom*
▶ 2:00 – 2:15 pm	**Introduction: From Lesions to Networks to Institutions: Don Stuss's Legacy in Cognitive Neuroscience**, B. Levine
▶ 2:15 – 2:37 pm	**Talk 1: Effects of Focal Frontal Lobe Lesions on Attention in Multi-Dimensional Reward-Learning Tasks,** Avinash R. Vaidya
▶ 2:37 – 2:58 pm	**Talk 2: Confabulations and Subjective Truth Value,** Asaf Gilboa
▶ 2:58 – 3:09 pm	**Talk 3: The Quest for Hemispheric Asymmetries Supporting and Predicting Executive Functioning,** Antonino Vallesi
▶ 3:09 – 3:30 pm	**Talk 4: Understanding the Workings of the Hippocampus: Lessons from Ventromedial Prefrontal Cortex,** Shayna Rosenbaum
2:00 – 5:00 pm	**Poster Session E**, *Exhibit Hall C*
4:00 – 5:10 pm	**CNS Trainee Professional Development Panel,** *Constitution Ballroom*

Tuesday, May 5, 2020

10:00 am – 1:00 pm	**Poster Session F**, *Exhibit Hall C*
10:00 am – 5:00 pm	Exhibits Open, *Exhibit Hall C*
10:00 am – 12:00 pm	**Invited Symposium 3 – Contemporary Approaches To Emotion Representations,** Kevin S. LaBar, Chair, *Back Bay A/B*
▶ 10:00 – 10:08 am	**Introduction**
▶ 10:08 – 10:37 am	**Talk 1: Decoding Spontaneous Emotions and Modeling Their Temporal Dynamics from Resting-State fMRI,** Kevin S. LaBar
▶ 10:37 – 11:01 am	**Talk 2: Emotion Schemas are Represented in the Human Visual System: Evidence from fMRI and Convolutional Neural Networks,** Tor D. Wager
▶ 11:01 – 11:23 am	**Talk 3: Mapping the Passions: Insights from Computational and Social Functional Approaches,** Dacher Keltner
▶ 11:23 am – 12:00 pm	**Talk 4: Modelling Dynamic Facial Expressions of Emotion Across Cultures Using Data-Driven Methods,** Rachael E. Jack
10:00 am – 12:00 pm	**Invited Symposium 4 – Novel Approaches to Non-Invasive Brain Stimulation,** Jérôme Sallet, Chair, *Grand Ballroom*
▶ 10:00 – 10:08 am	**Introduction**
▶ 10:08 – 10:38 am	**Talk 1: Noninvasive Deep Brain Stimulation Via Temporally Interfering Electric Fields,** Nir Grossman

- 10:38 – 11:05 am **Talk 2: Probing Decision-Making Circuits in Primates Using Transcranial Ultrasound Neuromodulation,** Jérôme Sallet
- 11:05 – 11:28 am **Talk 3: Ultrasonic Modulation of Higher Order Visual Pathways in Humans,** Chris Butler
- 11:28 am – 12:00 pm **Talk 4: Noninvasive CNS Modulation Using Ultrasound with or without Blood-Brain Barrier Opening,** Elisa Konofagou

12:30 – 1:30 pm **26th Annual George A. Miller Prize in Cognitive Neuroscience Lecture**

Functional Imaging of the Human Brain: A Window into the Architecture of the Mind

Nancy Kanwisher, MIT, Grand Ballroom

2:00 – 4:00 pm **Symposium 9 – Cortical Gradients and Their Role in Cognition**, Daniel Margulies, Chair, *Constitution Ballroom*

- 2:00 – 2:08 pm **Introduction**
- 2:08 – 2:34 pm **Talk 1: The Influence of Brain Structure on Typical and Atypical Brain Function,** Boris Bernhardt
- 2:34 – 2:56 pm **Talk 2: Cortical Somatosensory Hierarchical Gradients,** Noam Saadon-Grosman
- 2:56 – 3:25 pm **Talk 3: A Multisensory Perspective on Primary Cortices,** Micah Murray
- 3:25 – 4:00 pm **Talk 4: Neurocognitive Hierarchies as a State Space for On-Going Thought,** Jonathan Smallwood

2:00 – 4:00 pm **Symposium 10 – Specifics and Generalities: Beyond the Semantic-Episodic Distinction**, Chi Ngo, Chair, *Back Bay A/B*

- 2:00 – 2:07 pm **Introduction**
- 2:07 – 2:32 pm **Talk 1: Generalized Knowledge and Episodic Memory in Development,** Chi Ngo
- 2:32 – 2:58 pm **Talk 2: Memory Specificity and Concept Generalization,** Dagmar Zeithamova
- 2:58 – 3:19 pm **Talk 3: Semantic Knowledge Distorts Episodic Memory: Behavioral and Neural Investigations**, Alexa Tompary
- 3:19 – 4:00 pm **Talk 4: Neural Signatures of Time and Meaning in Categorized Free Recall,** Sean Polyn

2:00 – 4:00 pm **Symposium 11 – Deep Data: The Contribution of Case Studies and Special Populations in the Era of Big Data**, Erez Freud, Chair, *Back Bay C/D*

- 2:00 – 2:04 pm **Introduction**
- 2:04 – 2:26 pm **Talk 1: The Role of the Dorsal Pathway in Object Perception,** Erez Freud
- 2:26 – 2:42 pm **Talk 2: Perception and Action without Hands,** Ella Striem-Amit
- 2:42 – 3:00 pm **Talk 3: Pattern Separation Following Denate Gyrus Lesions,** Shayna Rosenbaum
- 3:00 – 4:00 pm **Talk 4: Direct Electrical Stimulation Mapping of Language Pathways During Awake Brain Surgery,** Bradford Z. Mahon

4:00 – 5:00 pm **Workshop – Need to Know News from NIH about Grant Applications and Opportunities,** *Exhibit Hall C*

2:00 – 5:00 pm **Poster Session G**, *Exhibit Hall C*

Statement on Principles of Community and Code of Conduct

An open exchange of ideas, the freedom of thought and expression, and respectful scientific debate are central to the aims and goals of the Cognitive Neuroscience Society (CNS). CNS stands firmly for an environment that recognizes the inherent worth of every person and group, that fosters dignity, understanding, and mutual respect, and that celebrates diversity. The Governing Board and committee members of CNS endorse a safe, respectful and harassment-free experience for members, speakers/presenters and staff of the CNS.

Harassment and hostile behavior are unwelcome at CNS before, during and after organized lectures and poster sessions. We stand against harassment based on race, gender, religion, age, appearance, national origin, ancestry, disability, sexual orientation, and gender identity, or any other category. Harassment includes degrading verbal comments, deliberate intimidation, stalking, harassing photography or recording, inappropriate physical contact, and unwelcome sexual attention. The policy is not intended to inhibit challenging scientific debate, but rather to promote it by ensuring that all are welcome to participate in a shared spirit of scientific inquiry. These principles apply equally to scientific and social events organized by CNS.

Any concerns should be conveyed to a member of our Diversity, Outreach and Training Committee:
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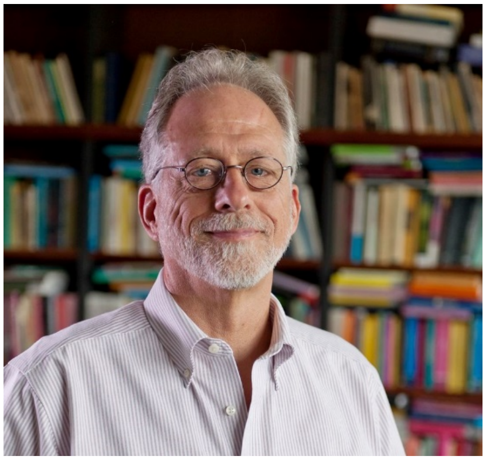
Keynote



Michael Tomasello

Duke University and Max Planck Institute for Evolutionary Anthropology

Keynote Address

Saturday, May 2, 2020, 12:00-1:30 pm, Grand Ballroom

Origins of Human Cooperation

Humans are biologically adapted for cultural life in ways that other primates are not. Humans have unique motivations and cognitive skills for sharing emotions, experience, and collaborative goals (shared intentionality). The motivations and skills involved first emerge in human ontogeny at around one year of age, as infants begin to participate with other persons in various kinds of collaborative and joint attentional activities, including linguistic communication. Our nearest primate relatives understand important aspects of intentional action - especially in competitive situations - but they do not seem to have the motivations and cognitive skills necessary to engage in activities involving collaboration, shared intentionality, and, in general, things cultural.

George A Miller Prize

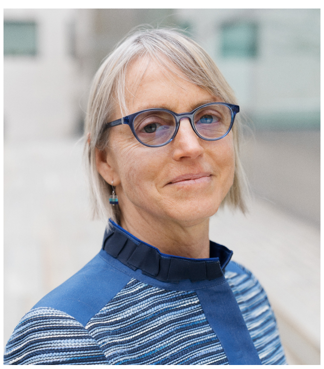
Congratulations to Nancy Kanwisher for being awarded this honor!

Nancy Kanwisher will accept this prestigious award and deliver her lecture on Tuesday, May 5, 2020, 12:30 – 1:30 pm, in the Grand Ballroom

Functional Imaging of the Human Brain: A Window into the Architecture of the Mind

Nancy Kanwisher

McGovern Institute for Brain Research, Department of Brain & Cognitive Sciences, and Center for Brains, Minds, and Machines, MIT.



The last 20 years of brain imaging research has revealed the functional organization of the human brain in glorious detail, including dozens of cortical regions each of which is specifically engaged in a particular mental task, like recognizing faces, perceiving speech sounds, and understanding the meaning of a sentence. Each of these regions is present, in approximately the same location, in essentially every normal person. This initial rough sketch of the functional organization of the brain counts as real progress, giving us a kind of diagram of the major components of the human mind. But at the same time, it is just the barest beginning. Really what our new map of the human brain offers is a vast landscape of new questions. In this talk I will first broadly survey some of the most widely replicated functionally distinctive cortical regions, and then describe ongoing work into three such questions. First, in light of widespread findings that functionally specific cortical regions contain information about "nonpreferred" stimuli, do some patches of cortex really play a highly specific causal role in processing just one class of stimuli? Second, how does all this complex structure, that is so similar across subjects, arise in development? I will discuss (but not answer) a few recent findings about the developmental origins of cortical specificity, including what appears to be a fusiform face area in the ventral visual pathway of congenitally blind people. Third, I will discuss new modelling results that shed light on why we have the particular functionally specific cortical regions we do, and apparently not others, and why, from a computational point of view, functional specificity might be a good design feature for brains in the first place.

About the George A. Miller Prize in Cognitive Neuroscience

The George A. Miller Prize in Cognitive Neuroscience was established in 1995 by the Cognitive Neuroscience Society to honor the innovative scholarship of George A. Miller, whose many theoretical advances have greatly influenced the discipline of cognitive neuroscience. The first ten years of the prize were funded by generous support from the James S. McDonnell Foundation. This year's award is sponsored in part by the Center for Mind and Brain at the University of California, Davis.

Each year the Prize recognizes an individual whose distinguished research is at the cutting-edge of their discipline with realized or future potential, to revolutionize cognitive neuroscience. Extraordinary innovation and high impact on international scientific thinking is a hallmark of the recipient's work.

An annual call for nominations for the George A. Miller Prize is made to the membership of the society. The recipient of the prize attends the annual meeting of the Cognitive Neuroscience Society and delivers the George A. Miller lecture.

Previous Winners of the George A. Miller Lectureship

2019	Earl K. Miller, Massachusetts Institute of Technology
2018	Elizabeth Spelke, Harvard University
2017	Dr. David Van Essen, Washington University in St Louis
2016	Brian Wandell, Isaac and Madeline Stein Family Professor
2015	Patricia Kuhl, Ph.D., University of Washington
2014	Jon Kaas, Ph.D., Vanderbilt University
2013	Fred Gage, Ph.D., The Salk Institute
2012	Eve Marder, Ph.D., Brandeis University
2011	Mortimer Mishkin, Ph.D., NIMH
2010	Steven Pinker, Ph.D., Harvard University
2009	Marcus Raichle, Ph.D., Washington University School of Medicine
2008	Anne Treisman, Ph.D., Princeton University
2007	Joaquin M. Fuster, Ph.D., University of California Los Angeles
2006	Steven A. Hillyard, Ph.D., University of California San Diego
2005	Leslie Ungerleider, Ph.D., National Institute of Mental Health
2004	Michael Posner, Ph.D., University of Oregon
2003	Michael Gazzaniga, Ph.D., Dartmouth College
2002	Daniel Kahneman, Ph.D., Princeton University
2001	William Newsome, Ph.D., Stanford University
2000	Patricia Churchland, Ph.D., University of California, San Diego
1999	Giacommo Rizzolatti, Ph.D., University of Parma, Italy
1998	Susan Carey, Ph.D., New York University
1997	Roger Shepard, Ph.D., Stanford University
1996	David Premack, Ph.D., CNRS, France
1995	David H. Hubel, Ph.D., Harvard Medical School

The Fred Kavli Distinguished Career Contributions Award

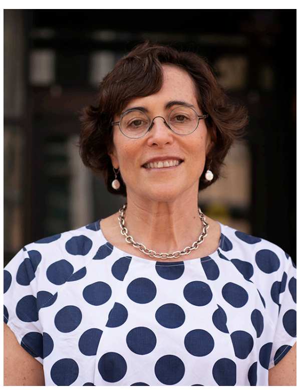
Congratulations to Marlene Behrmann for being awarded this honor!

Marlene Behrmann will accept this prestigious award and deliver her lecture on Sunday, May 3, 2020 from 12:30 – 1:30 pm, in the Grand Ballroom.

Hemispheric Organization for Visual Recognition

Marlene Behrmann

Thomas S. Baker University Professor of Cognitive Neuroscience, Department of Psychology and Neuroscience Institute, Carnegie Mellon University



Despite the similarity in structure, the hemispheres of the human brain have somewhat different functions. A traditional view of hemispheric organization asserts that there are independent and largely lateralized domain-specific regions in ventral occipitotemporal (VOTC), specialized for the recognition of distinct classes of objects. In this talk, I will offer an alternative account of the organization of the hemispheres, with a specific focus on face and word recognition. This alternative account relies on three computational principles: distributed representations and knowledge, cooperation and competition between representations, and topography and proximity. The crux is that visual recognition results from a network of regions with graded functional specialization, that is distributed across both hemispheres. Specifically, the claim is that face recognition, which is acquired relatively early in life, is processed by VOTC regions in both hemispheres. Once literacy is acquired, word recognition, which is co-lateralized with language areas, primarily engages the left VOTC and, consequently, face recognition is primarily, albeit not exclusively, mediated by the right VOTC. I will present psychological and neural evidence from a range of studies conducted with normal adults and children, as well as from cases with neuropsychological deficits and from cases with hemispherectomy, and will also consider evidence that seems incompatible with this account. Last, I will offer suggestions for future investigations whose findings may further refine this account and enhance our understanding of the cerebral hemispheres.

About the Distinguished Career Contributions Award

The Distinguished Career Contributions Award (DCC) was established in 2012 and it has been sponsored by the Fred Kavli Foundation since 2016. This award honors senior cognitive neuroscientists for their sustained and distinguished career, including outstanding scientific contributions, leadership and mentoring in the field of cognitive neuroscience.

An annual call for nominations for the Fred Kavli Distinguished Career Contributions Award is made to the membership of the society. The recipient of the prize attends the annual meeting of the Cognitive Neuroscience Society and delivers the Fred Kavli Distinguished Career Contributions lecture.

Previous Winners of the Distinguished Career Contributions Award

2019	Daniel L. Schacter, Department of Psychology, Harvard University
2018	Alfonso Caramazza, Harvard University
2017	Marcia K. Johnson, Yale University
2016	James Haxby, University of Trento
2015	Marta Kutas, Ph.D., University of California, San Diego
2014	Marsel Mesulam, M.D., Northwestern University
2013	Robert T. Knight, M.D., University of California, Berkeley
2012	Morris Moscovitch, Ph.D., University of Toronto

Young Investigator Award

Congratulations to the 2020 Young Investigator Award Winners!

Congratulations to Catherine Hartley and Samuel J. Gershman for being awarded the 2020 Young Investigator Award.

Catherine Hartley and Samuel J. Gershman will give their award lectures on Monday, May 4, 2020, 12:30 –1:30 pm, in the Grand Ballroom.

YIA special lectures take place on Monday, May 4, 2020, 12:30 – 1:30 pm, in the Grand Ballroom.

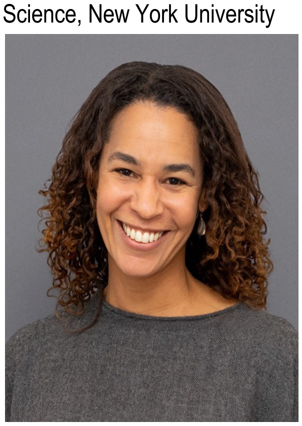
The purpose of the awards is to recognize outstanding contributions by scientists early in their careers. Two awardees, one male and one female, are named by the Awards Committee, and are honored at the CNS annual meeting. Each award includes $500 US to be used by the winners toward travel costs to the meeting, or for any other purpose.

Developmental Tuning of Action Selection

Monday, May 4, 2020, 12:30 – 1:00 pm, Grand Ballroom

Catherine A. Hartley

Assistant Professor, Department of Psychology and Center for Neural Science, New York University



A diverse set of learning, memory, and decision-making processes enable us to respond adaptively to environmental challenges and opportunities. These cognitive processes, supported by dynamic interactions between subcortical and prefrontal circuitry, change markedly from childhood to adulthood. In this talk, I will present work characterizing developmental changes in the cognitive representations and computations engaged to evaluate and select actions as the brain develops. I will discuss how these changes may optimize behavior for an individual's developmental stage and unique life experiences.

Structured Reinforcement Learning

Monday, May 4, 2020, 1:00 –1:30 pm, Grand Ballroom

Samuel J. Gershman

Associate Professor, Department of Psychology and Center for Brain Science, Harvard University

In this talk, I will survey classical ideas about reinforcement learning in the brain, some of their successes, and the challenges they confront when dealing with real-world complexity. The drive to develop computational solutions to these challenges has led to new insights into the functions of dopamine, the hippocampus, and the prefrontal cortex. A common theme is the need for solutions that exploit structure in the environment.

Workshops & Special Events

Title	Date	Time	Location
Neuroaesthetics Social	**Saturday, May 2**	**4:30 – 6:00 pm**	**Exhibit Hall C**
CNS Trainee Professional Development Panel	**Monday, May 4**	**4:00 - 5:00 pm**	**Constitution Ballroom**
Need to Know News from NIH about Grant Applications and Opportunities	**Tuesday, May 5**	**4:00 – 5:00 pm**	**Exhibit Hall C**

NEUROAESTHETICS SOCIAL

Saturday, May 2, 4:30 – 6:00pm, Exhibit Hall C

This social meeting brings together researchers interested in understanding the neural basis of aesthetic responses, such as when artwork, music, dance or landscapes are experienced as beautiful. We will highlight aesthetics research being presented at CNS in a "Data Blitz" session, followed by an open discussion and time to socialize.

CNS TRAINEE PROFESSIONAL DEVELOPMENT PANEL

Monday, May 4, 4:00 – 5:00 pm, Constitution Ballroom

CNSTA Professional Development Panel Organizers: Alexandra Gaynor, (CUNY Graduate Center), Alexander Simon (UC San Francisco) and the CNSTA Committee Officers.

Join the CNSTA 5th Annual Professional Development Panel to learn about the unique career trajectories of cognitive neuroscientists in academia and industry!

Panelists this year are Dr Mariam Aly (Columbia University), Dr. Kara Blacker (Naval Aerospace Medical Research Laboratory), Dr. Amy Janes (Harvard Medical School), Dr. Robert Ross (University of New Hampshire) and Dr. Theodore Zanto (UC San Francisco)

NEED TO KNOW NEWS FROM NIH ABOUT GRANT APPLICATIONS AND OPPORTUNITIES

Tuesday, May 5, 4:00 - 5:00 pm, Exhibit Hall C

Speakers: Kathy Mann Koepke, NICHD/NIH, Dr. Dana Plude, NIA

NIH Program Directors present news you need to find your best research fit for training, career, or research grants; NIH contacts for more guidance; overview of application, review, funding processes. UPDATE! NEED TO KNOW: New FOAs & Notices, BESH research, & clinical trials news. Also find us throughout the meeting.

GSA/PFA Awards

Congratulations to the 2020 winners of the Graduate Student Awards and the Post-Doctoral Fellow Awards. Each winner receives a monetary stipend.

Graduate Student Award Winners

Elvisha Dhamala, *Weill Cornell Medicine in New York City*
Benjamin Gibson, *University of New Mexico*
Heather Hansen, *Ohio State University*
Nicholas Judd, *Karolinska Institutet*
Saima Malik-Moraleda, *Harvard University*
Seokyoung Min, *Yonsei University*
Emily Schwartz, *Boston College*
Jordan Wynn, *Rotman Research Institute, University of Toronto*

Post-Doctoral Fellow Award Winners

Trevor Brothers, *Tufts University*
Matthew Moore, *University of Illinois*
Nicole Petersen, *University of California, Los Angeles*
Justin Riddle, *UNC School of Medicine*
Maya Rosen, *Harvard University*
Elizaveta Solomonova, *McGill University*
Carl Stevens, *University of Arkansas*
Jie Zheng, *Harvard University*
Jennifer Zuk, *Harvard University*

Special Session — Symposium in Honor of Donald T. Stuss

What Makes us Human?

Monday, May 4, 2020, 2:00 - 3:30 pm, Grand Ballroom

Chair: Brian Levine, *Rotman Research Institute*
Speakers: Avinash R. Vaidya, Asaf Gilboa, Antonino Vallesi, Shayna Rosenbaum

Donald T. Stuss was one of the foremost contemporary neuropsychologists, world leader in the neuroscientific study of the prefrontal cortex, and founding director of two leading neuroscience institutes (the Rotman Research Institute and the Ontario Brain Institute). Stuss is most known for his clinical-scientific work on the human prefrontal cortex, starting with his seminal studies of prefrontal lobotomy patients, confabulation, and Capgras syndrome in the late 1970's at the Boston VA and the seminal 1986 volume, The Frontal Lobes (with Frank Benson) and continuing through to the present, highlighting the role of the prefrontal cortex in memory, social cognition, and consciousness. Stuss simultaneously contributed major conceptual advances in the areas of assessment, intra-individual variability, traumatic brain injury, rehabilitation, and neurodegenerative disease. Stuss's science always started with clinical observations and was centered on questions central to humanity, such as how we view ourselves and others and how we successfully function in the world. As a key figure who brought the human prefrontal function into the realm of empirical science, Stuss perpetually challenged orthodoxy with a combination of clinical sensitivity and experimental acumen. This symposium highlights of Stuss's contributions from the perspectives of some of his friends and colleagues across the spectrum of clinical and cognitive neuroscience, neuroimaging, and cognitive neurology.

TALK 1: EFFECTS OF FOCAL FRONTAL LOBE LESIONS ON ATTENTION IN MULTI-DIMENSIONAL REWARD-LEARNING TASKS

Avinash R. Vaidya, Brown University

Donald Stuss described the frontal lobes as the “final frontier of neuropsychology” (Stuss & Levine, 2002). Stuss and many others have struggled with the paradox that lesions to this region often cause major changes in behavior in the real world, but leave classic neuropsychological task performance unaffected. Unlike laboratory settings, life is messy, complex and highly multidimensional. Learning what matters and directing attention to those dimensions is especially challenging when the information we receive from our environment is noisy. In a series of experiments, we investigated the role of sub-regions of the frontal lobes to guiding attention to reward-predictive features in tasks that modelled some of this complexity and noise. Across tasks, we found evidence that damage to the ventromedial frontal lobe reduced attention to stimulus features that were predictive of reward in the long-term and impaired learning about the values of these features. On the other hand, lesions of the left lateral frontal lobe caused greater credit assignment to visually salient but reward-irrelevant stimulus features. We suggest that these frontal lobe sub-regions may be playing distinct roles in solving the problem of learning

TALK 2: CONFABULATIONS AND SUBJECTIVE TRUTH VALUE

Asaf Gilboa, University of Toronto, Toronto Rehabilitation Institute, University Health Network

Self-awareness was central in Donald Stuss’s theoretical understanding of what it is to be human. As is typical to many of his contributions to cognitive neuropsychology, Stuss was able to translate his clinical observations of even the most seemingly bizarre neurological phenomena, such as Capgras syndrome and confabulations, into a systematic hierarchical theory of awareness. Borrowing from William James, Stuss argued that the forceful conviction in false beliefs or false memories that these patients demonstrated was intimately connected to their personal memories and the sense of warmth and immediacy these memories carry. A breakdown in executive functions such as monitoring and decision making was thought to contribute to the perpetuation of these false memories. In other words, self-awareness of requires both a sense of subjectivity and an ability to perceive oneself objectively as others do: “that attribute of the human which not only allows awareness of the self, but also realizes the position of the self within the social milieu” (Stuss & Benson, 1986). In this talk I will present lesion and electrophysiological data that probe the contributions of ventromedial prefrontal cortex to the evolution and perpetuation of confabulation. In the spirit of Stuss's approach to the brain I will emphasize both fractionation of function within the frontal lobes and its interactions with other cortical and subcortical structures to explain how subjective and objective truth values may diverge.

TALK 3: THE QUEST FOR HEMISPHERIC ASYMMETRIES SUPPORTING AND PREDICTING EXECUTIVE FUNCTIONING

Antonino Vallesi, Department of Neuroscience & Padua Neuroscience Center, University of Padova, Italy and Brain Imaging & Neural Dynamics Research Group, IRCCS San Camillo Hospital, Venice, Italy

This talk will address the neurocognitive architecture of two executive functions: criterion-setting – the capacity to flexibly set up and select task rules and associations between stimuli, responses and non-responses, and monitoring – the process of continuously evaluating that task rules are being applied optimally. There is a documented tendency for criterion-setting and monitoring to differentially recruit right and left lateral frontal regions and connected networks, respectively, above and beyond the specific task context. This model, known as the ROBBIA model, initially originated from extensive neuropsychological work leaded by Don Stuss. Novel empirical evidence in favor of this model on both healthy and brain-damaged individuals will also be shown, coming from functional neuroimaging, EEG, individual difference approaches and, again, neuropsychology.

TALK 4: UNDERSTANDING THE WORKINGS OF THE HIPPOCAMPUS: LESSONS FROM VENTROMEDIAL PREFRONTAL CORTEX

Shayna Rosenbaum, York University

It is difficult to make sense of the complexity of prefrontal cortex, an evolutionary newcomer that is needed for seemingly disparate, higher-order cognitive and socioemotional abilities that are not readily detected with standard neuropsychological testing. Donald Stuss embraced the challenge with an approach that integrates astute human observation, macaque cytoarchitecture, and theoretically grounded tasks within a clinical-scientific framework. In doing so, he brought us closer to understanding the nature and extent of functional dissociations and coordination among ventromedial prefrontal cortex (vmPFC) subregions, with the ultimate goal of developing meaningful strategies to help patients compensate for functional loss. Here I present studies that apply this approach to understand the functioning of the hippocampus, a relatively primitive brain structure known for its role in episodic memory. Recent research suggests that the hippocampus plays a role in cognitive abilities beyond episodic memory, including future imagining and decision-making, but the nature and extent of this role remains unclear. Using tests of reward discounting, gambling, and moral reasoning originally developed to assess vmPFC integrity, we show that not all types of future-oriented decisions are affected by hippocampal damage. The results suggest that just as there are multiple forms of memory, there are multiple forms of future thinking, with differential contributions from the hippocampus vs. vmPFC. Findings may inform guide the development of workable interventions to address impaired memory and decision-making.

Data Blitz Sessions

Session #	Date	Time	Location	Chair
Data Blitz Session 1	**Saturday, May 2**	**4:30 – 6:00 pm**	**Back Bay A&B**	**Vishnu Murty**
Data Blitz Session 2	**Saturday, May 2**	**4:30 – 6:00 pm**	**Back Bay C&D**	**Jeffrey Johnson**
Data Blitz Session 3	**Saturday, May 2**	**4:30 – 6:00 pm**	**Grand Ballroom**	**Marian Berryhill**

Data Blitz

A Data Blitz is a series of 5-minute talks, each covering just a bite-sized bit of research. It will offer a fast-paced overview of some of the most exciting research presented at this year's poster sessions.

Data Blitz Session 1

Saturday, May 2, 4:30 – 6:00 pm, Back Bay A&B

Chair: Vishnu Murty, Temple University

Speakers: Lars Hausfeld, Mattia Pietrelli, Anthony Dick, Kaisu Lankinen, Summer Sheremata, Ryan Law, Nikita Agrawal, Rebecca Marks, Yushuang Liu, Megan Zirnstein, Thomas D. Ferguson, Christopher Kelly, Qingfang Liu, Marcela Paola Ovando Tellez, Frank Song

TALK 1: TRACKING OF CONTINUOUS SPEECH IN NOISY AUDITORY SCENES AT 7T FMRI

Lars Hausfeld[1], Elia Formisano[1], [1]Maastricht University - Dept. Cognitive Neuroscience

TALK 2: ARE ATTENTION-RELATED MODULATIONS OF ALPHA-BAND DYNAMICS LOCAL OR GLOBAL?

Mattia Pietrelli[1], Jason Samaha[2], Bradley Postle[1], [1]UW Madison, [2]UC Santa Cruz

TALK 3: THE FRONTAL ASLANT TRACT (FAT) WHITE MATTER MICROSTRUCTURE DIFFERENTIATES YOUNG CHILDREN WITH ADHD FROM TYPICAL CONTROLS

Anthony Dick[1], Dea Garic[1], Paulo Graziano[1], [1]Florida International University

TALK 4: CROSSMODAL MODULATION OF THE INTRACORTICAL DEPTH PROFILE OF BOLD SIGNALS IN AUDITORY CORTEX

Kaisu Lankinen[1, 2], Seppo P. Ahlfors[1,2], Fahimeh Mamashli[1,2], Anna Blazejewska[1, 2], Tommi Raij[3,4], Jyrki Ahveninen[1,2,] [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Shirley Ryan AbilityLab, [4]Northwestern University

TALK 5: CONTIGUOUS LOCATIONS INCREASE RELIABILITY OF PARIETAL MAPS

Summer Sheremata[1], Young Seon Shin[1], [1]Florida Atlantic University

TALK 6: LISTS WITH AND WITHOUT SYNTAX: NEURAL CORRELATES OF SYNTACTIC STRUCTURE

Ryan Law[1], Abu Dhabi Liina Pylkkänen[1], [1]New York University

TALK 7: SPATIOTEMPORAL DYNAMICS OF LEFT INFERIOR FRONTAL GYRUS RECRUITMENT DURING SPONTANEOUS AND CUED SPEECH PRODUCTION

Nikita Agrawal[1], Werner Doyle[1], Orrin Devinsky[1], Adeen Flinker[1], [1]NYU School of Medicine

TALK 8: VWFA FUNCTIONAL CONNECTIVITY FOR PRINT AND SPEECH PROCESSING IN EMERGING READERS

Rebecca Marks[1], Lynn Eickholt[1], Yuuko Uchikoshi[2], Fumiko Hoeft[3], Ioulia Kovelman[1], [1]University of Michigan, [2]University of California, Davis, [3]University of Connecticut

TALK 9: TRACKING LEXICAL CONSOLIDATION OF NOVEL WORD MEANINGS: ERP AND TIME FREQUENCY ANALYSES

Yushuang Liu[1], Janet van Hell[1], [1]The Pennsylvania State University

TALK 10: SUBDIVISIONS OF THE ANTERIOR CINGULATE CORTEX RELATED TO THE INTUITIVE PSYCHOLOGY AND INTUITIVE PHYSICS DICHOTOMY

Ana Navarro-Cebrian, Johns Hopkins University

TALK 11: USING EEG TO INVESTIGATE THE NEURO-MODULATORY SYSTEMS UNDERLYING STRESS AND DECISION MAKING

Thomas D. Ferguson[1], Olave E. Krigolson[1], [1]Centre for Biomedical Research, University of Victoria

TALK 12: CLASSIFYING INDIVIDUALS INTO 'INFO TYPES' BASED ON INFORMATION-SEEKING MOTIVES

Christopher Kelly[1], Tali Sharot[1], [1]UCL

TALK 13: A SPATIO-TEMPORAL ANALYSIS ON NEURAL CORRELATES OF INTERTEMPORAL CHOICE

Qingfang Liu[1], Woojong Yi[1], Brandon Turner[1], [1]The Ohio State University

TALK 14: THE RELATIONSHIP BETWEEN CREATIVITY AND INDIVIDUAL SEMANTIC NETWORK PROPERTIES

Marcela Paola Ovando Tellez, Institut du Cerveau et de la Moelle épinière, Sorbonne University

TALK 15: 1 HOUR OF LOST SLEEP IMPACTS FINANCIAL MARKETS: DAYLIGHT SAVING TIME COMPROMISES FINANCIAL TRADING

Frank Song, UC Berkeley

Data Blitz Session 2

Saturday, May 2, 4:30 – 6:00 pm, Back Bay C&D

Chair: Jeffrey Johnson, University of Missouri

Speakers: Yuchao Wang, Guido Orgs, Livia Tomova, Maeve Boylan, Ashley Frost, Nathan Cashdollar, Bowman Groff, Ana Chkhaidze, Attila Andics, Rose Cooper, Olav Krigolson, Tudar Muntianu, Siamak Sorooshyari, Emma Brown, Kieran Fox(Josef Parvici)

TALK 1: NEURAL CORRELATES OF AESTHETIC ENGAGEMENT WITH LITERATURE

Yuchao Wang[1,2], Franziska Hartung[2], Marloes Mak[3], Roel Willems[3], Anjan Chatterjee[2], [1]Haverford College, [2]Penn Center for Neuroaesthetics, [3]Radboud University Nijmengen

TALK 2: EEG FREQUENCY-TAGGING OF APPARENT BIOLOGICAL MOTION DISSOCIATES ACTION AND BODY PERCEPTION

Guido Orgs[1], Emiel Cracco[2], Goedele van Belle[3], Lisa Quenon[3], Patrick Haggard[3], Bruno Rossion[5], [1]Goldsmiths, University of London, [2]Ghent University, [3]UCL, [5]Université de Lorraine, CNRS, CRAN

TALK 3: NEURAL REPRESENTATION OF SOCIAL CRAVING FOLLOWING ISOLATION IN THE HUMAN BRAIN

Livia Tomova[1], Kim Wang[1], Kay Tye[2], Rebecca Saxe[1], [1]Massachusetts Institute of Technology, [2]Salk Institute

TALK 4: ASSESSING THE RELATIONSHIP BETWEEN ALPHA POWER AND HEMODYNAMIC ACTIVATION DURING EMOTIONAL MENTAL IMAGERY

Maeve Boylan[1], W. Matthew Friedl[1], Harold Rocha[1], Andreas Keil[1], [1]University of Florida

TALK 5: EFFECTS OF INTERACTIVE SOCIAL CONTEXT ON VISUAL ATTENTION TO SOCIAL PARTNERS

Ashley Frost[1], Nohely Gonzalez[1], Brynna Pechous[1], Katherine Warnell[1], [1]Texas State University

TALK 6: RELATIONSHIP OF MOOD, COGNITION AND PHYSICAL ACTIVITY IN DEPRESSION: REMOTE SYMPTOM MONITORING USING WEARABLE TECHNOLOGY

Nathan Cashdollar[1], Francesca Cormack[1], Maggie McCue[2], Caroline Skirrow[1], Jennifer Schuster[2], Nick Taptiklis[1], Emilie Glazer[3], Elli Panagopoulos[3], Tempest Van Shaik[3], Ben Fehnert[3], James King[3], Jenny H Barnett[1], [1]Cambridge Cognition, [2]Takeda Pharmaceuticals USA, [3]CTRL Group

TALK 7: THE DISTINCT ROLES OF PREFRONTAL GABA AND GLUTAMATE/GLUTAMINE IN TWO TYPES OF COGNITIVE CONTROL

Boman Groff[1], Hilary Traut[1], Rebecca Helmuth[1], Harry Smolker[1], Mark Brown[1,2], Hannah Snyder[3], Benjamin Hankin[4], Marie Banich[1], [1]UC Boulder, [2]Anschutz Medical Campus, [3]Brandeis University, [4]University of Illinois Urbana-Champaign

TALK 8: OPPOSITE LATERALIZATION FOR FACE RECOGNITION AND GENDER PERCEPTION

Ana Chkhaidze[1,2], Matthew Harrison[2], Zhiheng Zhou[3], Samantha Lee[2], Lars Strother[2], [1]UC San Diego, [2]University of Nevada, Reno, [3]UC Davis

TALK 9: NOT ALWAYS THE FACE: DIFFERENCES BETWEEN HUMAN AND DOG NEURAL FACE- AND CONSPECIFIC-PREFERENCE

Attila Andics[1], Nóra Bunford[2], Raúl Hernández-Pérez[1], Eszter Borbála Farkas[1], Laura V. Cuaya[1], Dóra Szabó[1], Ádám György Szabó[3], Márta Gácsi[1], Ádám Miklósi[1], [1]ELTE Research Centre for Natural Sciences, [2]MR Research Center, [3]Semmelweis Universit

TALK 10: PROGRESSION FROM FEATURE-SPECIFIC BRAIN ACTIVITY TO HIPPOCAMPAL BINDING DURING EPISODIC ENCODING

Rose Cooper[1], Maureen Ritchey[1], [1]Boston College

TALK 11: USING MOBILE EEG TO ASSESS BRAIN HEALTH AND PERFORMANCE

Olav Krigolson[1], [1]University of Victoria

TALK 12: A GAUSSIAN PROCESS MODEL OF HUMAN ELECTROCORTICOGRAPHIC DATA

Tudor Muntianu[1], Lucy Owen[1], Andrew Heusser[1], Patrick Daly[2], Katherine Scangos[2], Jeremy Manning[1], [1]Dartmouth College, [2]UC San Francisco

TALK 13: PREDICTING DEPRESSION FROM SPEECH RECORDINGS: A MACHINE LEARNING AND FEATURE SELECTION APPROACH

Siamak Sorooshyari[1], Thomas Van Vleet[2], Alit Stark-Inbar[2], Heather Dawes[3], Deanna Wallace[3], Morgan Lee[3], Michael Merzenich[2], Edward Chang[3], Mor Nahum[4], [1]UC Berkeley, [2]Posit Science, [3]UC San Francisco, [4]Hebrew University of Jerusalem

TALK 14: **MILITARY BLAST EXPOSURE AND PTSD ARE ASSOCIATED WITH AGING WHITE MATTER INTEGRITY AND FUNCTIONING**

Emma Brown[1], Anna Etchin[1], William Milberg[1], Regina McGlinchey[1], David Salat[1], [1]VA Boston Healthcare System

TALK 15: LINKING HIERARCHICAL CORTICAL GRADIENTS TO COGNITIVE EFFECTS OF INTRACRANIAL ELECTRICAL STIMULATION IN THE HUMAN BRAIN

Kieran Fox[1], Lin Shi[1], Sori Baek[1], Omri Raccah[1], Brett Foster[2], Srijani Saha[1], Daniel Margulies[3], Aaron Kucyi[1], Josef Parvizi[1], [1]Stanford University, [2]Baylor College of Medicine, [3]Centre National de la Recherche Scientifique

Data Blitz Session 3

Saturday, May 2, 4:30 – 6:00 pm, Grand Ballroom

Chair: Marian Berryhill, University of Nevada, Reno

Speakers: Ian Ballard, Kristina Horne, Poortata(Pia) Lalwani, Justin Fleming, Wei-Tang Chang, Chris McNorgan, Emily Hokett, Jiahe Zhang, Lauren DiNicola, Kevin P. Madore, McNeel Jantzen, Cybelle Smith, Nina Heins, Michael C. Granovetter, Matthew Sachs

TALK 1: THE STRIATAL FEEDBACK RESPONSE REFLECTS GOAL UPDATING

Ian Ballard[1], Mark D'Esposito[1], [1]University of California, Berkeley

TALK 2: DOES COMBINED DECISION-MAKING TRAINING AND TDCS PRODUCE GENERALIZABLE COGNITIVE BENEFITS IN HEALTHY OLDER ADULTS?

Kristina Horne[1], Hannah L. Filmer[1], Jason B. Mattingley[1], Paul E. Dux[1], Zoie Nott[1], [1]University of Queensland

TALK 3: AGE-RELATED DECLINE IN RESTING STATE BRAIN SIGNAL VARIABILITY: CAUSE AND CONSEQUENCES

Poortata (Pia) Lalwani[1], Douglas Garrett[2], Thad Polk[1], [1]University of Michigan, Ann Arbor, [2]Max Planck UCL

TALK 4: SENSORY MODALITY AND INFORMATION DOMAIN MODULATE BEHAVIORAL AND NEURAL SIGNATURES OF WORKING MEMORY INTERFERENCE

Justin Fleming[1], Michelle Njoroge[2], Abigail Noyce[2], Tyler Perrachione[2], Barbara Shinn-Cunningham[3], [1]Harvard University, [2]Boston University, [3]Carnegie Mellon University

TALK 5: FUNCTIONAL ORGANIZATION OF HIPPOCAMPUS IS ALTERED BY ASSOCIATIVE ENCODING AND RETRIEVAL

Wei-Tang Chang[1], Stephanie Langella[1], Weili Lin[1], Kelly Giovanello[1], [1]UNC at Chapel Hill

TALK 6: INTEGRATING MVPA AND CONNECTIVITY IN A MULTIPLE CONSTRAINT NETWORK TO BOOTSTRAP BRAIN MODELS

Chris McNorgan[1], Greg Smith[1], Erica Edwards[1], Jennifer Mosley[1], [1]University at Buffalo

TALK 7: RELATIONSHIPS BETWEEN SLEEP QUALITY AND NEURAL REINSTATEMENT OF ASSOCIATIVE MEMORY IN YOUNG AND OLDER ADULTS

Emily Hokett[1], Soroush Mirjalili[1], Audrey Duarte[1], [1]Georgia Institute of Technology

TALK 8: STRONGER STRUCTURAL CONNECTIVITY IN THE DEFAULT MODE NETWORK IS ASSOCIATED WITH YOUTHFUL MEMORY IN SUPERAGING

Jiahe Zhang[1], Lianne Scholtens[2], Martijn van den Heuvel[2], Brad Dickerson[3], Lisa Barrett[1], [1]Northeastern University, [2]Vrije Universiteit Amsterdam, [3]Massachusetts General Hospital

TALK 9: PARALLEL NETWORKS DISSOCIATE EPISODIC AND SOCIAL FUNCTIONS ACROSS DISTRIBUTED CORTICAL REGIONS WITHIN INDIVIDUALS

Lauren DiNicola[1], Rodrigo Braga[2], Randy Buckner[1], [1]Harvard University, [2]Stanford University

TALK 10: MOMENT-TO-MOMENT AND INDIVIDUAL DIFFERENCES IN SPONTANEOUS LAPSES OF ATTENTION AT ENCODING PREDICT SUBSEQUENT MEMORY

Kevin P. Madore[1], Anna Khazenzon[1], Anthony Norcia[1], Anthony Wagner[1], [1]Stanford University

TALK 11: HIERARCHICAL STATISTICAL LEARNING: BEHAVIORAL, NEUROIMAGING, AND NEURAL NETWORK MODELING INVESTIGATIONS

Cybelle Smith, University of Pennsylvania

TALK 12: THIS SOUNDS GOOD! HURDLING AND TAP-DANCING RE-AFFERENCES ARE PROCESSED DIFFERENTLY IN THE BRAIN

Nina Heins[1], Jennifer Pomp[1], Karen Zentgraf[2], Markus Raab[3], Ricarda Schubotz[1], [1]University of Muenster, Germany, [2]Department of Movement Science and Training in Sports, Inst, [3]German Sport University Cologne

TALK 13: PATIENTS WITH HEMISPHERECTOMIES EVINCE INTACT VISUAL RECOGNITION BEHAVIORS

Michael C. Granovetter[1], Leah Ettensohn[1], Marlene Behrmann[1], [1]Carnegie Mellon University

TALK 14: LEARNING AND REWARD THROUGH A NEW MUSICAL SYSTEM

Matthew Sachs[1], Euan Zhang[1], Dana Walker[1], Psyche Loui[1], [1]Northeastern University

Invited Symposium Sessions

#	Title	Date	Time	Location
1	MAKING SENSE OUT OF BIG DATA IN COGNITIVE NEUROSCIENCE	Saturday, May 2	2:00 – 4:00 pm	Back Bay A/B
2	THE ROLE OF CAUSAL INFERENCE FOR PERCEPTUAL DECISIONS AND ADAPTIVE BEHAVIOR	Sunday, May 3	10:00 am - Noon	Grand Ballroom
3	CONTEMPORARY APPROACHES TO EMOTION REPRESENTATIONS	Tuesday, May 5	10:00 am - Noon	Back Bay A/B
4	NOVEL APPROACHES TO NON-INVASIVE BRAIN STIMULATION	Tuesday, May 5	10:00 am - Noon	Grand Ballroom

Invited Symposium Session 1

MAKING SENSE OUT OF BIG DATA IN COGNITIVE NEUROSCIENCE

Saturday, May 2, 2:00 – 4:00 pm, Back Bay A/B

Chair: Randy L. Buckner, Harvard University

Speakers: Carsen Stringer, Konrad Kording, Randy L. Buckner

This symposium will illustrate both the promises and potential pitfalls of increasing availability of “big data” at many scales that can be used to understand brain and behavioral functions across species. The first two talks will illustrate a range of use cases where very high dimensional data is being used to generate novel insights in the function of neural systems and how these generate behavior. The final talk will illustrate some of the opportunities of big data in the era of physical distancing, and how open data science and online data resources offer a unique means to continue and advance science.

TALK 1: HIGH-DIMENSIONAL STRUCTURE OF SIGNAL AND NOISE IN 20,000 NEURON RECORDINGS

Carsen Stringer, Howard Hughes Medical Institute, Janelia Research Campus

Even in the absence of sensory inputs, the brain produces structured activity, which can be as large as or larger than sensory-driven activity. Using large-scale neural recordings of thousands of neurons in mouse visual cortex, we found that this seconds-long neural variability was driven by brainwide behavioral signals. This behaviorally-driven neural activity continued during visual stimulus presentations, creating variable neural responses to identical visual stimuli. Although large, the ongoing noise did not impair the encoding of stimuli at the population level. We found that oriented stimuli with an orientation difference of less than 1° could be accurately discriminated at >90% correct on a single trial basis. In addition to being accurate, the stimulus-evoked population activity was high-dimensional. The correlation structure across neurons obeyed a power law: the n-th dimension of the correlation matrix contained variance in proportion to 1/n. We developed a theory to explain this
structure based on the assumption that neural responses to stimuli are smooth. A smooth neural code may be robust to small changes in visual stimuli, such as changes in viewpoint or lighting. Using large-scale neural recordings and new analytical techniques, we were able to characterize some of the fundamental features of visual cortical circuits in mice.

TALK 2: CAUSAL INFERENCE WITH BIG DATA SETS

Konrad Kording, University of Pennsylvania

Our datasets are big. But we usually want to ask causal questions. We want to ask how the brain works. Or figure out if one way of treating patients is superior to other ways of treating them. However, most of the approaches that are established in the field focus on correlational data analyses. In my talk I will review causal inference techniques that are useful in the field and that can be adapted to ask a broad range of questions.

TALK 3: LESSONS AND OPPORTUNITIES OF BIG DATA SUPERSTRUCTING IN A VIRTUAL WORLD

Randy L Buckner, Harvard University and Massachusetts General Hospital

The accessibility and opportunities of big data have a special importance in this moment of physical distancing. In the present talk I will tell the story of the brain genomics superstruct project, GSP, a big data effort that emerged in the wake of the 2008 fiscal crisis. “Superstructing” is the act of building upon an existing structure or foundation. What began as a well-resourced local effort to build infrastructure to discover links between genetics, the brain and behavior, was morphed by necessity into a lean and distributed big data community effort. Building upon existing research programs, a rapid neuroimaging acquisition protocol, on-line testing and neuroinformatics tools were deployed to aggregate uniform data from thousands of subjects across twenty laboratories. A large open data resource was achieved that has been used to generate models of cortical network organization, a complete functional map of the human cerebellum, and links between individual differences and behavioral traits. When combined with other efforts and further data integration, genetic associations to brain organization have begun to unravel. The GSP is now just one of numerous data resources openly available to the community. Open data resources provide opportunities to test existing hypotheses, make novel discoveries, and continue educational laboratory activities in a virtual world. Most critically in this moment of dispersion, open data efforts can serve to inspire the next era of discovery and keep the students who will make those discoveries engaged in the scientific process.

Invited Symposium Session 2

THE ROLE OF CAUSAL INFERENCE FOR PERCEPTUAL AND ADAPTIVE BEHAVIOR

Sunday, May 3, 10:00 am - Noon, Grand Ballroom

Chair: Christoph Kayser, Bielefeld University

Speakers: Rachel Denison, Sam Gershman, Uta Noppeney, Christoph Kayser

Adaptive behavior in complex environments requires an understanding of the causal relations between the sensory features arising from the multiple objects surrounding us. This symposium investigates the computational and neural mechanisms underlying sensory causal inference processes from different angles, focusing on the flexible integration of multisensory evidence, the constraints imposed by the available cognitive sources and the implications for adaptive behavior such as learning.

TALK 1: INFERRING INTERNAL CAUSES OF UNCERTAINTY TO IMPROVE DECISION MAKING

Rachel Denison, NYU

Uncertainty arises not only from the properties of sensory input but also from internal causes, such as varying levels of attention. However, it was unknown whether humans appropriately infer and adjust for such cognitive sources of uncertainty during perceptual decision making. We found that, when uncertainty was relevant for performance, human categorization and confidence decisions took into account uncertainty related to attention. Category and confidence decision boundaries shifted as a function of attention in an approximately Bayesian fashion. The observer's attentional state on each trial therefore contributed probabilistically to the decision computation. This ability to infer and use attention-dependent uncertainty is adaptive: it should improve perceptual decisions in natural vision, in which attention is unevenly distributed across a scene.

TALK 2: CAUSAL INFERENCE IN REINFORCEMENT LEARNING

Sam Gershman, Harvard University

The impact of feedback can have different effects on learning depending on one's beliefs about the causal structure of the environment. In particular, belief updating in response to good and bad outcomes can be asymmetric, and this asymmetry is predicted by a Bayesian reinforcement learning model that takes into account hidden causes that mediate between choice and feedback. Consistent with this model, neural learning signals in the striatum appear to be "gated" by causal beliefs. Finally, I will discuss evidence that the ability to use causal knowledge to guide learning emerges over the course of development, and can be dissociated from explicit causal beliefs.

TALK 3: CAUSAL INFERENCE IN MULTISENSORY PERCEPTION

Uta Noppeney, Donders Institute for Brain, Cognition and Behaviour, Radboud University

Our senses are constantly bombarded with myriads of diverse signals. Transforming this sensory cacophony into a coherent percept of our environment relies on solving the causal inference problem - deciding whether signals come from a common cause and should be integrated, or instead be treated independently. Combining psychophysics, fMRI/EEG and computational modelling our results suggest that the brain arbitrates between sensory integration and segregation consistent with the principles of Bayesian Causal Inference by dynamically encoding multiple perceptual estimates at distinct levels of the cortical hierarchy. Only at the top of the hierarchy in anterior parietal cortices were signals integrated weighted by their bottom-up sensory reliabilities and top-down task-relevance into spatial priority maps that take into account the world's causal structure.

TALK 4: THE PERSISTENT INFLUENCE OF CAUSAL INFERENCE IN MULTISENSORY PERCEPTION

Christoph Kayser, Bielefeld University

When combining multi-sensory information, we need to flexibly select and combine cues that arise from a common origin whilst avoiding distraction from irrelevant inputs. We asked how the brain implements such inference process by studying the combination of audio-visual information in ventriloquist-like tasks and how such sensory integration shapes the perception of subsequent unisensory stimuli. Our results unveil a systematic spatio-temporal cascade of the relevant computations, starting with early segregated unisensory representations, continuing with sensory fusion in parietal-temporal regions and culminating as causal inference in the frontal lobe. These findings suggest that inferior frontal regions guide flexible integrative behaviour based on causal inference within a trial, but also point to parietal regions as central for combining sensory evidence over time, such as from trial to trial.

Invited Symposium Session 3

CONTEMPORARY APPROACHES TO EMOTION REPRESENTATIONS

Tuesday, May 5, 10:00 am - Noon, Back Bay A/B

Chair: Kevin S. LaBar, Duke University

Speakers: Kevin S. LaBar, Tor D. Wager, Dacher Keltner, and Rachael E. Jack

Emotions are complex constructs that exert powerful influences over cognition and comportment. Despite progress in understanding select facets of emotional processing, it remains unclear how specific emotions like anger, sadness, or contentment are differentiated in their subjective experience, neurophysiological representation, and social communication. This symposium brings together experts who are addressing this key, unresolved issue in affective science using contemporary, data-driven computational methods that are overturning old debates about the structure of emotions. Kevin LaBar will open the symposium to discuss how machine learning and stochastic modeling tools facilitate the decoding of emotion categories from fMRI data, including spontaneous emotions and their temporal dynamics. Tor Wager will present findings from a convolutional neural network approach to show how schemas of multiple emotion categories arise from distributed codes in the visual hierarchy. Dacher Keltner will combine computational and social functional approaches to map the complex relationships among a variety of emotions elicited by naturalistic stimuli. Finally, Rachael Jack will close the symposium by demonstrating how data-driven modeling provides novel insights into cultural similarity and variation in dynamic facial expressions of emotion, with implications for improving affective communication in social robots.

TALK 1: DECODING SPONTANEOUS EMOTIONS AND MODELING THEIR TEMPORAL DYNAMICS FROM RESTING-STATE fMRI

Kevin S. LaBar, Duke University

Affective states dynamically unfold in the background of ongoing mental activity and are triggered by spontaneous thoughts during mind wandering. The emotion specificity and duration of these states are hypothesized to promote susceptibility to mental health disorders. However, it is challenging to identify emotion-specific signals embedded in resting-state neural data. Furthermore, it is unknown whether the human brain reliably transitions among multiple emotional states at rest and how psychopathology alters these intrinsic affect dynamics. We combined machine learning and stochastic modeling to investigate the chronometry of spontaneous brain activity indicative of six emotions and a neutral state. We derived fMRI information maps of these emotions from our previous decoding study of emotion inductions, and used them to pattern classify the resting-state time series. We showed that the frequency distribution of resting-state classifications across emotion categories predicted individual differences in on-line subjective feelings and off-line mood ratings and personality traits. We investigated the temporal dynamics of spontaneous transitions across these emotions using stochastic modeling and validated results across two population cohorts. Our findings indicate that intrinsic emotional brain dynamics are effectively characterized as a discrete time Markov process, with affective states organized around a neutral hub. The centrality of this network hub is disrupted in individuals with psychopathology, whose brain state transitions exhibit greater inertia and less frequent resetting from emotional to neutral states. These results indicate how the brain signals spontaneous emotions and how alterations in their temporal dynamics contribute to compromised mental health.

TALK 2: EMOTION SCHEMAS ARE REPRESENTED IN THE HUMAN VISUAL SYSTEM: EVIDENCE FROM fMRI AND CONVOLUTIONAL NEURAL NETWORKS

Tor D. Wager, Dartmouth College

Emotions are thought to be canonical responses to situations ancestrally linked to survival or the well-being of an organism. Although sensory elements do not fully determine the nature of emotional responses, they should be sufficient to convey the schema or situation that an organism must respond to. However, few computationally explicit models describe how combinations of stimulus features come to evoke different types of emotional responses, and, further, it is not clear that activity in sensory (e.g., visual) cortex contains distinct codes for multiple classes of emotional responding in a rich way. Here we develop a convolutional neural network that accurately decodes images into 11 distinct emotion categories. We validate the model using over 25,000 images and movies and show that image content is sufficient to predict the category, valence, and arousal of human emotion ratings. In two fMRI studies, we demonstrate that patterns of human visual cortex activity encode emotion category-related model output and can decode multiple categories of emotional experience. Comparing decoding performance across multiple brain regions, we find that emotion schemas are best characterized by distributed codes in the occipital lobe and that redundant information about schemas is contained in other brain systems. These results indicate that rich, category-specific emotion representations are embedded within the human visual system. Further, they suggest that psychological and computational accounts of emotion should explain the sensory qualities that are naturally associated with emotional outcomes, as well as those that are reliably learned through experience and influenced by culture.

TALK 3: MAPPING THE PASSIONS: INSIGHTS FROM COMPUTATIONAL AND SOCIAL FUNCTIONAL APPROACHES

Dacher Keltner, University of California, Berkeley

In this talk I detail convergent insights from computational and social functional approaches to emotion. In doing so, I will introduce a new methodological approach predicated on: the study of vast array of naturalistic stimuli, the sampling of a wide range of emotional states, observer ratings from discrete and dimensional perspectives, and open-ended statistical and data visualization techniques that map complex emotion spaces. Empirical work guided by these methods converges on four ideas. First, more open-ended techniques in studies of facial expression, vocal bursts, prosody, lexical terms, music, and spontaneous experience reveal upwards of 20 distinct states. I will illustrate this with recent studies of awe, compassion, and embarrassment. Second, emotion categories are heterogenous, but in systematic ways. Each emotion category—awe, sympathy, fear, amusement, embarrassment—includes variations in experience and expression. Third, the boundaries between emotion categories are not discrete. Instead, emotion categories such as or love and desire or awe and interest, are bridged by gradients of meaning, which likely account for transitions between emotional states. Finally, discrete emotion categories organize the representation of emotion more so than appraisals of valence and arousal. I will conclude by considering what the methods and findings summarized in the talk mean for the study of emotion-related physiology as well as individual and cultural variations.

TALK 4: MODELLING DYNAMIC FACIAL EXPRESSIONS OF EMOTION ACROSS CULTURES USING DATA-DRIVEN METHODS

Rachael E. Jack, University of Glasgow

Understanding how facial movements communicate emotions has been a source of intense investigation for over a century. However, addressing this question is empirically challenging due to the sheer number and complexity of facial expressions the human face can make. Traditional approaches primarily using theory-driven methods and hypothesis testing, while advancing knowledge, have also restricted understanding including via Western-centric biases. Now, new technologies and data-driven methods developed in interdisciplinary teams alleviate these constraints, giving real traction to this complex task and delivering novel insights. Here, we showcase one such approach that combines social and cultural psychology, vision science, mathematical psychology, and 3D dynamic computer graphics to objectively model dynamic facial expressions of emotions in different cultures. Using this approach, we have provided precise characterizations of what face movements are cross-cultural and culture-specific, and the emotion information they convey including broad dimensional information (e.g., positive, high arousal) and specific (e.g., delighted) emotions. Specifically, we show that four, not six, core expressive patterns are cross-cultural, and that facial expressions transmit signals in an evolving, broad-to-specific structure over time. Our work challenges longstanding dominant views of universality and forms the basis of a new theoretical framework that has the potential to unite different views (i.e., nature vs. nurture; dimensional vs. categorical). Finally, we show direct transference of this knowledge of facial expressions to social robots by providing a generative syntactical model for social face signaling, thus providing new opportunities for Psychology to play a central role in designing digital agents of the future.

Invited Symposium Session 4

NOVEL APPROACHES TO NON-INVASIVE BRAIN STIMULATION

Tuesday, May 5, 10:00 am - Noon, Grand Ballroom

Chair: Jérôme Sallet, INSERM, Lyon, France and University of Oxford, UK

Speakers: Nir Grossman, Jérôme Sallet, Chris Butler, Elisa Konofagou

To understand brain circuits it is necessary both to record and manipulate their activity. The gold standard approach in cognitive neurosciences to attribute a cognitive function to a brain region relies on causation methods. Those methods often invasive are therefore principally used in animal models. Alternative so-called non-invasive approaches despite allowing addressing questions directly about the human brain are often limited by their spatial resolution, or by the brain areas that could be targeted. This symposium will bring together researchers developing new electrical or ultrasound stimulation tools. Innovations could enable targeting deep brain structures, improving spatial resolution or proposing a new approach for neuropharmacological studies. We will aim to show the potential translational approach from animal research to human applications of these novel approaches.

TALK 1: NONINVASIVE DEEP BRAIN STIMULATION VIA TEMPORALLY INTERFERING ELECTRIC FIELDS

Nir Grossman, Imperial College London, UK

Electrical brain stimulation is a key technique in research and clinical neuroscience studies, and also is in increasingly widespread use from a therapeutic standpoint. However, to date all methods of electrical stimulation of the brain either require surgery to implant an electrode at a defined site, or involve the application of non-focal electric fields to large fractions of the brain. We report a noninvasive strategy for electrically stimulating neurons at depth. By delivering to the brain multiple electric fields at frequencies too high to recruit neural firing, but which differ by a frequency within the dynamic range of neural firing, we can electrically stimulate neurons throughout a region where interference between the multiple fields results in a prominent electric field envelope modulated at the difference frequency. We validated this temporal interference (TI) concept via modeling and physics experiments, and verified that neurons in the living mouse brain could follow the electric field envelope. We demonstrate the utility of TI stimulation by stimulating neurons in the hippocampus of living mice without recruiting neurons of the overlying cortex. Finally, we show that by altering the currents delivered to a set of immobile electrodes, we can steerably evoke different motor patterns in living mice.

TALK 2: PROBING DECISION-MAKING CIRCUITS IN PRIMATES USING TRANSCRANIAL ULTRASOUND NEUROMODULATION

Jérôme Sallet, INSERM, Lyon, France and University of Oxford, UK, Co-authors: Jean-Francois Aubry[1], Davide Folloni[2], Lennart Verhagen[2], Nima Khalighinejad[2], Matthew Rushworth[2], [1]Institut Langevin, Paris, France; [1] University of Oxford

Transcranial ultrasonic stimulation (TUS) is an emerging method whereby low-intensity ultrasound is delivered through the skull to brain tissue resulting in reversible disruption of neuronal activity at the targeted site. Although the exact mechanisms by which ultrasound effects neuromodulation are not fully characterized, the goal of this presentation is to show that the technique is safe and can be used to modulate brain activity and behaviour with a good anatomical precision. TUS neuromodulatory effects were measured by examining relationships between activity in each targeted area and the rest of the brain using resting-state functional magnetic resonance imaging (fMRI) collected under anaesthesia. Importantly those targeted regions could either be superficial cortical areas (preSMA, Frontopolar cortex), or deep subcortical structures (Amygdala, Basal Forebrain). With the specific protocol used, dissociable and focal effects on neural activity could not be explained by auditory confounds. Furthermore, offline effects were shown to last for more than two hours post-stimulation. With such long lasting effect, we were able to test in separate experiments for the specific contribution of perigenual ACC to counterfactual reasoning and of the lateral orbitofrontal cortex to credit assignment.

TALK 3: ULTRASONIC MODULATION OF HIGHER ORDER VISUAL PATHWAYS IN HUMANS

Chris Butler, University of Oxford and Imperial College London, UK, Co-authors: Braun V, Blackmore J, Cleveland R
University of Oxford

Transcranial ultrasonic stimulation (TUS) has been used to target primary sensory regions of the human brain. Its effect on higher-order cortical areas has not been studied. Moreover, concerns have recently arisen that TUS effects may be driven indirectly through stimulation of early auditory pathways. We investigated whether TUS can modulate higher-order visual processing both in superficial (middle temporal area (MT)) and deep (fusiform face area (FFA)) regions. We further examined the efficacy of auditory stimulus masking. Magnetic resonance imaging was used to map skull anatomy and functional regions of interest (MT and FFA) for each participant (n=16). Segmented imaging datasets formed the basis of 3D ultrasound simulations to determine transducer placements and source amplitudes. Thermal simulations ensured that temperature rises were <0.5 °C at the target and <3 °C in the skull. TUS (500 kHz, 300 ms 50% duty cycle bursts) was applied to MT or FFA whilst participants performed a visual motion or a face identity detection task. To control for non-specific effects, auditory masking was applied during the tasks. EEG data were collected throughout. Auditory masking reduced subjective stimulation detection to chance level and abolished auditory evoked potentials. Ultrasonic stimulation of MT led to facilitation of visual motion detection in the contralateral hemifield, with no effect upon face identity detection. Stimulation of FFA did not affect visual motion detection performance. We show that TUS can be used in humans to modify behaviour and electrophysiological activity in higher-order visual pathways in a task-specific and anatomically precise manner.

TALK 4: NONINVASIVE CNS MODULATION USING ULTRASOUND WITH OR WITHOUT BLOOD-BRAIN BARRIER OPENING

Elisa Konofagou, Columbia University, NYC

The brain is a formidable frontier for modulation of both itself and for other organs in the body. Over the past several decades, ultrasound has been consistently shown to successfully probe brain activity transcranially. Our group has been studying the noninvasive stimulation and inhibition of the central nervous system both with and without blood-brain barrier opening. When focused ultrasound is applied with intravenously administered microbubbles, the blood-barrier opens and has been shown to improve cognitive performance such as spatial memory in mice and touch accuracy and reaction time in non-human primates, that lasts hours to months after opening. Without BBB opening or microbubbles, our group has shown that focused ultrasound is capable of noninvasively stimulating lateralized paw movement as well as sensory responses such as pupil dilation and eye movement when specific cortical and subcortical regions are targeted, demonstrating that ultrasound can trigger both motor and sensory brain responses. An overview of the aforementioned findings in rodents and non-human primates as well as clinical translation will be presented.

Symposium Sessions

#	Title	Date	Time	Location
1	STUDYING THE MIND BY MANIPULATING BRAIN NETWORKS	Sunday, May 3	3:00 – 5:00 pm	Constitution Ballroom
2	FINANCES AND FEELINGS: THE AFFECTIVE NEUROSCIENCE OF SES	Sunday, May 3	3:00 – 5:00 pm	Back Bay A/B
3	FROM WIKIPEDIA SEARCHES TO SINGLE CELL RECORDING: UNCOVERING THE MECHANISMS OF INFORMATION-SEEKING	Sunday, May 3	3:00 – 5:00 pm	Grand Ballroom
4	DEVELOPMENT AND PLASTICITY OF HIGH-LEVEL VISION AND COGNITION	Sunday, May 3	3:00 – 5:00 pm	Back Bay C/D
5	PRESSING THE PLAY BUTTON: SEQUENTIAL NEURAL REPLAY OF HUMAN MEMORIES	Monday, May 4	10:00 am - Noon	Constitution Ballroom
6	MOVING FROM A DEFICIT-ORIENTED TO A PREVENTATIVE MODEL IN EDUCATION: EXAMINING NEURAL CORRELATES FOR READING DEVELOPMENT	Monday, May 4	10:00 am - Noon	Back Bay A/B
7	INTEGRATING THEORY AND DATA: USING COMPUTATIONAL MODELS TO UNDERSTAND NEUROIMAGING DATA	Monday, May 4	10:00 am - Noon	Back Bay C/D
8	THE MEETING OF PERCEPTION AND MEMORY IN THE BRAIN	Monday, May 4	10:00 am - Noon	Grand Ballroom
9	CORTICAL GRADIENTS AND THEIR ROLE IN COGNITION	Tuesday, May 5	2:00 - 4:00 pm	Constitution Ballroom
10	SPECIFICS AND GENERALITIES: BEYOND THE SEMANTIC-EPISODIC DISTINCTION	Tuesday, May 5	2:00 - 4:00 pm	Back Bay A/B
11	DEEP DATA: THE CONTRIBUTION OF CASE STUDIES AND SPECIAL POPULATIONS IN THE ERA OF BIG DATA	Tuesday, May 5	2:00 - 4:00 pm	Back Bay C/D

Symposium Session 1

STUDYING THE MIND BY MANIPULATING BRAIN NETWORKS

Sunday, May 3, 3:00 – 5:00 pm, Constitution Ballroom

Chair: Joel Voss, Northwestern University

Speakers: Gesa Hartwigsen, Thorsten Kahnt, Michael Fox, Joel Voss

Cognition and emotion rely on large-scale distributed brain networks. However, there is little consensus on how these networks are organized, how their constituent regions interact to achieve function, and other key mechanistic questions. The dominant method for addressing these issues is to measure the natural relationships of activity among network regions while they are engaged by relevant processing demands. A complementary strategy is to utilize more direct functional probes by examining changes in cognition and emotion that result from network perturbations. Speakers in this symposium will discuss recent advances in this area using a network-based framework for noninvasive brain stimulation. They will describe new insights from experiments that use stimulation to probe the network basis of language, decision making, mood, and memory. Across all of these areas, the network-based stimulation framework has yielded strikingly specific, predictable, and reliable influences on targeted networks and their associated functions. Further, there are clear applications of these findings for the treatment of neurologic and psychiatric symptoms that result from network damage and dysfunction. By bringing together researchers using this approach to investigate different functional domains, we hope to foster discovery of general principles governing network control by brain stimulation and of general mechanisms by which brain networks accomplish cognition and emotion.

TALK 1: NEUROSTIMULATION FOR FLEXIBLE LANGUAGE-NETWORK REDISTRIBUTION IN HEALTHY AND LESIONED BRAINS

Gesa Hartwigsen, Max Planck Institute for Human Cognitive and Brain Sciences

Language is sustained by large-scale networks in the human brain. Brain lesions such as stroke often severely affect language function and network dynamics. However, the adaptive potential of the brain to compensate for lesions is poorly understood. In this talk, I will present novel evidence on the potential for short-term reorganization in the healthy and lesioned language network. First, I will show that ?virtual lesions? induced by neurostimulation to key language areas in the healthy brain increase the functional contribution of neighbouring language areas and domain-general control regions. Secondly, I will present a new study emphasizing the adaptive role of homologous right-hemispheric areas in the lesioned language network. As a main finding, perturbation of the left posterior prefrontal cortex in patients with lesions in the left temporo-parietal cortex selectively delayed phonological decisions and decreased task-related activity. The individual response delay was correlated with the upregulation of the lesion homologue, reflecting compensation for the disruption. Moreover, stronger individual tract integrity of the right superior longitudinal fascicle was associated with lesser impairment. These results provide evidence for functional and structural underpinnings of plasticity in the lesioned language network, and a compensatory role of the right hemisphere. I will integrate these data into a model for flexible redistribution in the language network, arguing that compensation for brain lesions may occur both within process-specific language networks and across networks for different cognitive functions. Finally, I will illustrate how this framework can be used to advance stimulation-based treatment of language disorders.

TALK 2: NETWORK STIMULATION TO TEST THE HUMAN ORBITOFRONTAL CORTEX ROLE IN INTERFERENCE-BASED DECISION MAKING

Thorsten Kahnt, Northwestern University Feinberg School of Medicine

Research across species has shown that the orbitofrontal cortex (OFC) is important for decision making. However, it is less clear what specific computations are carried out in this region that make it so important for this function. Recent work from our lab and others has shown that OFC activity is correlated with expectations about specific outcomes. Here we present evidence that these specific expectations are required for decisions that are based on inferred or simulated outcomes, as opposed to behavior that can be based on direct experience alone. Because of its anatomical location, the OFC is not directly accessible to transcranial magnetic stimulation (TMS). However, previous work suggests that TMS affects brain activity not only locally at the stimulation site but also in areas that are functionally connected to the stimulated region. In our experiments, we apply continuous theta burst stimulation (cTBS) to stimulation sites in lateral PFC that are individually selected to be maximally functionally connected to the OFC. We show that such OFC-targeted cTBS selectively disrupts choices that require subjects to infer outcomes, without affecting choices that can be based on direct experiences alone. These behavioral deficits are related to cTBS-induced decreases in the functional connectivity between the OFC and its cortical network. These findings demonstrate the feasibility of indirectly targeting human OFC using TMS and suggest that the OFC contributes to decision making by representing a cognitive map of the task environment that can be used to simulate outcomes when direct experience is missing.

TALK 3: USING THE HUMAN BRAIN CONNECTOME TO IDENTIFY BRAIN CIRCUIT TARGETS FOR DEPRESSION SYMPTOMS

Michael Fox, Harvard Medical School

Therapies that directly target brain circuits have the potential to treat medication-refractory psychiatric symptoms such as depression. However, antidepressant response to surgical lesions, deep brain stimulation (DBS), and transcranial magnetic stimulation (TMS) has been highly variable across different patients. This variability has resulted in modest overall effect sizes and failed clinical trials. However, variability also provides an opportunity to identify optimal therapeutic targets for specific symptoms, symptom clusters, and disorders. Specifically, incidental variability in the precise location of each patient's treatment site can be mapped to underlying brain circuits using a wiring diagram of the human brain termed the human connectome. I will describe how this approach can be applied to brain lesions, DBS sites, and TMS sites to identify better brain circuit targets for depression. Recent findings suggest that individualized targeting can be used to tease apart distinct circuits that affect distinct symptom clusters when treated with TMS. In one study, TMS of one target was associated with improvement in dysphoric symptoms, such as sadness and anhedonia, whereas another target was associated with improvement in anxiety and somatic symptoms. These findings indicate that circuit-based approaches for influencing brain function can yield remarkably specific outcomes even for complex mood disorders. This supports the use of such methods for personalized neuromodulatory therapies as well as for investigations into the brain basis of mood and emotion.

TALK 4: STIMULATING THE HIPPOCAMPAL NETWORK TO TEST EPISODIC MEMORY MECHANISMS

Joel Voss, Northwestern University Feinberg School of Medicine

Episodic memory depends on the hippocampus and its coordination with a distributed network of interconnected structures. Recent findings indicate that this hippocampal network can be modulated using network-targeted transcranial magnetic stimulation. This offers the powerful opportunity to directly test hypothesized functional properties of the hippocampal network by measuring the memory changes that occur in response to stimulation. I will describe the progress that has been made in this area to date. Increases in fMRI activity correlation due to stimulation predict corresponding increases in episodic memory ability, indicating that successful performance relies on the interregional coordination of hippocampal network activity. Furthermore, distinct hypothesized posterior-medial and anterior-temporal functional network components are differentially modulated by stimulation, thereby demonstrating their functional independence. The prominent hypothesis that hippocampal network coordination for memory occurs via the synchronization of activity in the theta-frequency band has also been supported by network-targeted stimulation, which more robustly influences hippocampal network activity and memory when delivered using theta patterns versus non-theta patterns. Finally, I will describe our recent work using theta-patterned stimulation during simultaneous fMRI scanning to measure the immediate impact of stimulation on the hippocampus and its role in the network-wide effects of stimulation. Collectively, these findings suggest that it is possible to cause highly specific changes in episodic memory by appropriately targeting portions of the hippocampal network with noninvasive stimulation, yielding new insights regarding brain mechanisms of memory.

Symposium Session 2

FINANCES AND FEELINGS: THE AFFECTIVE NEUROSCIENCE OF SES

Sunday, May 3, 3:00 - 5:00 pm, Back Bay A/B

Chair: Martha Farah, University of Pennsylvania

Speakers: Moriah Thomason, Joan Luby, Robin Nusslock, Pilyoung Kim

Depression is twice as common at the lowest income levels than at the highest. Stands to reason, you might say; no need for neuroscience to understand why. But people who are poor during childhood and become more affluent as adults continue to be at elevated risk. It appears that early life socioeconomic status (SES) influences brain development in ways that have lifelong effects on our emotional responses to positive and negative events and to social situations, as well as our ability to regulate our emotions. This impacts rates of psychopathology, especially affective disorders, and also levels of well-being within the healthy population. It does so by mechanisms that begin prenatally and operate in postnatal life under the influence of factors such as stress and parenting practices. The neural differences associated with SES are even associated with parents' feelings and behaviors toward the next generation, their own children. In this symposium we will hear from four leaders in the affective neuroscience of SES, whose work spans brain activity in prenatal life, early childhood, later childhood to adulthood, and parent-child processes. While covering different periods of life, the presentations will be unified by a number of common themes: psychosocial and physiological stress, limbic and prefrontal systems and networks, and positive feedback loops operating within individuals and across generations. A final discussion will solicit thoughts from the speakers and the audience about ways of breaking cycles of disadvantage and despair and promoting well-being for all.

TALK 1: NEURAL CORRELATES OF POVERTY OBSERVED IN THE HUMAN FETAL BRAIN: IMPLICATIONS FOR POSTNATAL WELLBEING

Moriah Thomason, NYU/Langone Medical Center

Prenatal poverty is associated with increased risk for preterm birth, intrauterine growth restriction, neonatal/infant death, and also cognitive and affective regulation in childhood. Here, we address whether prenatal poverty relates to formation of fetal brain circuitry that will support emotion processing in the future. An important target for research is identification of the earliest emergence of socioeconomic status (SES)-related differences in the human brain and their implications for postnatal behavior and wellbeing. We obtained functional MRI data in more than 100 normally-developing human fetuses from primarily low SES families and tested whether amygdala whole brain connectivity relates to familial SES. We observed reduced amygdala connectivity to prefrontal cortex, posterior insula, and cerebellum, and increased local connectivity in fetuses of families with the lowest SES. Some of these differences predict childhood abilities, including self-regulation. Future research confirming that system-level brain organization in utero is altered in fetuses of low SES mothers could motivate new lines of research into physiological processes and chemical and/or epigenetic pathways by which maternal resources program the human central nervous system in the womb.

TALK 2: SES, EARLY EXPERIENCE AND BRAIN DEVELOPMENT: INFORMING A SCIENCE OF NEURODEVELOPMENTAL ENHANCEMENT

Joan Luby, Washington University

There is increasing evidence for the effects of early experiences of poverty, adversity and nurturance on childhood brain development, a problem we have studied at the Early Emotional Development Lab at Washington University. These effects are known to be enhanced during sensitive periods when neural architecture is maximally informed by the environment for adaptation to future expected experiences. Evidence for sensitive periods for cognitive enhancement prior to the age of 2 have been inferred in experimental studies in humans and we have shown sensitive periods for maternal support on hippocampal development in longitudinal studies. Our data and others, find regional specificity of experiences of both adversity and nurturance on brain regions associated with children's affective functioning and the timing of exposures show that there is both timing and regional specificity to these effects. These findings along with others from the extant literature, as well as the need for new targeted investigations in developing humans and animal models, will be considered to inform a new science of early childhood neurodevelopmental enhancement. Such a model could be feasibly used in primary care settings to optimize neurodevelopment. This could be done by providing clear guidelines for when it is most important to protect developing children from certain forms of adversity and when it is most important for them to experience enhancement through nurturance and stimulation. The resulting neurodevelopmental enhancement model would be a feasible public health application of findings on adversity, brain development and affective functioning.

TALK 3: EXECUTIVE AND EMOTION REGULATION NETWORKS ASSOCIATED WITH RESILENCE TO POVERTY AND EARLY ADVERSITY

Robin Nusslock, Northwestern University

Individuals exposed to early-life adversity, including being raised in a family of low socioeconomic status, are vulnerable to emotional and physical problems across the lifespan. However, not everyone exposed to adversity is affected, which raises an important question: what enables some to remain healthy whereas others deteriorate? We first test the hypothesis that heightened activity in the brain's central executive network (CEN), which regulates emotions and limbic reactivity, might reflect a neurobiological marker of resilience. We enrolled 218 urban youth and characterized their exposure to neighborhood violence. Cardiometabolic health and resting state functional connectivity (rsFC) were assessed. As expected, higher neighborhood violence was associated with greater cardiometabolic problems, but only among individuals who displayed lower rsFC in the CEN. We next examined whether receiving supportive parenting during adolescence helps strengthen connectivity in the CEN and an emotion regulation network (ERN) while growing up in poverty. In a sample of African Americans (N = 119) living in the rural South, poverty status and receipt of supportive parenting were assessed during adolescence and rsFC was assessed using fMRI at age 25. As predicted, more years spent living in poverty presaged less CEN and ERN rsFC among young adults who received low levels of supportive parenting, but not among those who received high levels of such parenting. Collectively this suggests that heightened central executive and emotion regulation tendencies may help protect individuals from the consequences of early-life adversity and that supportive parenting can help foster these tendencies in the face of such adversity.

TALK 4: SOCIOECONOMIC DISADVANTAGE AND THE NEUROSCIENCE OF MOTHER-INFANT ATTACHMENT

Pilyoung Kim, University of Denver

Socioeconomic disadvantage such as poverty can increase distress levels, which may make low-income mothers more vulnerable to difficulties in the transition to parenthood. Cumulative risk, exposure to multiple stressors, is one of the main environmental mechanisms by which socioeconomic disadvantage is associated with negative brain and psychological functioning. Cumulative risk has also been linked to negative postpartum outcomes including harsh parenting, which can further influence how socioeconomic disadvantage may be transmitted to the next generation. Thus, the goal of the current study was to investigate whether cumulative risk may disrupt the neural and behavioral development of mother-infant attachment. We examined the association of cumulative risk with the brain response to infant cries and maternal behaviors, in a sociodemographically diverse sample (42% low income) of first-time mothers (N=53). Cumulative risk across socioeconomic (low income, financial stress, food insecurity), physical environment (substandard housing, noise, crowding), and psychosocial (marital dissatisfaction, violence, troubles with social services) domains was associated with reduced brain response to infant cries compared to white noise in several regions including the right insula/inferior frontal gyrus and superior temporal gyrus. Reduced activation in these regions was further associated with lower maternal sensitivity observed during a mother-infant interaction recorded at a home visit. The findings demonstrate that exposure to multiple stressors that are associated with socioeconomic disadvantage may be associated with reduced brain response to an infant's cry in brain regions that are important for emotional and social information processing, and associated with increased difficulties in developing positive mother-infant relationships.

Symposium Session 3

FROM WIKIPEDIA SEARCHES TO SINGLE CELL RECORDING: UNCOVERING THE MECHANISMS OF INFORMATION-SEEKING

Sunday, May 3, 3:00-5:00 pm, Grand Ballroom

Chair: Tali Sharot, University College London

Speakers: Eric Schulz, Danielle Basset, Ethan Bromberg-Martin, Irene Cogliati Dezza

People spend a substantial amount of time seeking out information (e.g., asking questions, reading, internet browsing). The human pursuit of knowledge drives intellectual development, is integral to social interactions, crucial for learning and decision-making. An important research challenge is understanding how people decide what they want to know. As massive amounts of information are becoming available to people this challenge is more pertinent today than ever. Despite the central role of information-seeking to human behavior research on information-seeking has been surprisingly limited in comparison to other domains of human cognition and behavior, but has been experiencing revitalization in recent years. This symposium will showcase some of the most recent discoveries in this domain. The presented studies aim to uncover the computational rules and neural mechanisms that support information-seeking as well as individual differences in information-seeking strategies and the relationship between these strategies and mental health. The symposium brings together speakers from different disciplines including psychology, neuroscience and computer science, to provide new insight into information-seeking and its neural basis. Eric Schulz will characterize human strategies for information-seeking in complex environments; Danielle Bassett will present a study looking at people's Wikipedia searches that reveals how people create knowledge networks; Ethan Bromberg-Martin will present evidence for a neural network mechanism of information-seeking; Irene Cogliati Dezza will present evidence for information-seeking alterations in psychopathology; Tali Sharot will conclude by presenting a theory of the motives that drive information-seeking and describe potential applications of this work for assessing mental health.

TALK 1: USING STRUCTURE TO EXPLORE EFFICIENTLY

Eric Schulz, Harvard University

Many types of intelligent behavior can be framed as a search problem, where an individual must explore a vast set of possible actions, while carefully balancing the exploration-exploitation dilemma. Under finite search horizons, optimal solutions are normally unobtainable, yet humans and other animals regularly manage to solve these problems gracefully. How do they accomplish this? We propose that two simple principles can explain this: generalization over features and uncertainty-guided exploration. Together these form a model that learns from past observations to generalize to similar options and seeks out uncertainty eagerly in order to gain more information about the search space. This model can be used to predict participant's search behavior in a complex multi-armed bandit task. Its parameter estimates can also be used to gain meaningful insights into developmental differences in generalization and directed exploration. Furthermore, we can use this model to describe customers' purchasing decisions in large-scale data set (1.6 million orders) online food delivery website. Finally, I will end by describing ongoing work that puts this model to a test in a multi-armed bandit task with rats, in which we find similar principles influencing animals' motor variability.

TALK 2: HUNTERS, BUSYBODIES, AND THE KNOWLEDGE NETWORK BUILDING ASSOCIATED WITH CURIOSITY

Danielle Basset, University of Pennsylvania

The information gained when practicing curiosity promotes well-being over extended timescales. The open-ended and internally driven nature of curiosity, however, makes characterizing the diverse styles of information seeking that accompany it a daunting endeavor. A recently developed historicophilosophical taxonomy of curious practice distinguishes between the collection of disparate, loosely connected pieces of information and the seeking of related, tightly connected pieces of information. With this taxonomy, we use a novel knowledge network building framework of curiosity to capture styles of curious information seeking in 149 participants as they explore Wikipedia for over 5 hours spanning 21 days. We create knowledge networks in which nodes consist of distinct concepts (unique Wikipedia pages) and edges represent the similarity between the content of Wikipedia pages. We quantify the tightness of each participants' knowledge networks using graph theoretical indices and use a generative model of network growth to explore mechanisms underlying the observed information seeking. We find that participants create knowledge networks with small-world and modular structure. Deprivation sensitivity, the tendency to seek information that eliminates knowledge gaps, is associated with the creation of relatively tight networks and a relatively greater tendency to return to previously-visited concepts. We further show that there is substantial within-person variability in knowledge network building over time and that building looser networks than usual is linked with higher than usual sensation seeking. With this framework in hand, future research can quantify the information collected during curious practice and examine its association with well-being.

TALK 3: A NEURAL NETWORK FOR INFORMATION SEEKING

Ethan Bromberg-Martin, Washington University

Do you want to know what your future holds? Humans and animals often express a strong desire to seek information about the properties of uncertain future rewards, even when there is no way for them to use this information to influence the outcome. However, little is known about the neuronal mechanisms that sustain information seeking. In particular, how does the brain anticipate opportunities to gain information and generate the motivation to pursue them? I will present evidence that these cognitive and motivational processes are served by a novel population of information-anticipatory neurons in an anatomically connected network including the anterior cingulate cortex, dorsal striatum and ventral pallidum. We trained monkeys to perform tasks which yield probabilistic juice rewards and which offer opportunities to gaze at visual cues: either informative cues that perfectly predict future reward outcomes or non-informative cues that do not predict future outcomes. We found that a substantial proportion of neurons in the network have strong and selective information-anticipatory activity: ramping activity that anticipates the moment the animal expects to gain information to resolve uncertainty about future rewards. Moment-to-moment fluctuations in their activity predict the animal's future information-anticipatory gaze shifts, and pharmacological perturbation of the basal ganglia nuclei that contain these neurons causally interferes with information seeking. Our results demonstrate a cortico-basal ganglia pathway for seeking information about future events, in parallel with the well-known pathways for seeking primary rewards like food and water. I will discuss the implications for theories of motivation, learning, and decision making.

TALK 4: INFORMATION-SEEKING IMPAIRMENTS IN BEHAVIORAL ADDICTION AS A NOVELTY FAILURE

Irene Cogliati Dezza, University College London

Information-seeking is an important aspect of human cognition that supports healthy functioning of decision-making and goal-directed processing. Despite its adaptive and ubiquitous role in human daily activities, we have rather limited understanding on the mechanisms subtending information-seeking in both healthy individuals and in psychopathologies. Here, we sought to formalize the computational basis of healthy information-seeking, as well as how those components could be compromised in behavioral addiction. We investigate and model human behavior using a novel variant of a classical decision-making task and a novel computational model. This approach allows us to dissociate the relative contributions of information and reward on decision-making, as well as the influence of novelty and general uncertainty. Overall, we found that healthy subjects were motivated by both information gain and reward gain in their choices. In contrast, problem gamblers showed a decreased reliance on information gain as a consequence of a failure in representing novelty. This finding both sheds light on the computational mechanisms underlying healthy human choice behavior, and how they go awry in an addictive population without the confound of illicit substance consumption. Methodologically, this work offers promising novel experimental and computational approaches to study the mechanisms underlying reward-based learning and decision-making in both healthy and pathological populations.

Symposium Session 4

DEVELOPMENT AND PLASTICITY OF HIGH-LEVEL VISION AND COGNITION

Sunday, May 3, 3:00 – 5:00 pm, Back Bay C/D

Chair: Zeynep Saygin, The Ohio State University

Speakers: Daniel Dilks, Rhodri Cusack, Zeynep Saygin, Marina Bedny

What determines the development and plasticity of cortical specialization? Recent evidence points to connectivity as the general mechanism that underlies this specialization. Daniel Dilks introduces evidence of adult-like functional connectivity of face and place networks in infants. Face networks show biases in connectivity with foveal primary visual cortex (V1) while place networks show connectivity with peripheral V1. Rhodri Cusack also finds evidence of adult-like structural connectivity of face and place networks in infants but further shows that tool networks are not adultlike and undergo prolonged maturation until 9 months of age. Zeynep Saygin shows that another highly experience-dependent visual region, the visual word form area (VWFA), already shows privileged functional connectivity with language areas at birth. These three studies suggest a connectivity-based mechanism to earmark functional specialization as well as a role for experience in further shaping connectivity and specialization. Marina Bedny directly explores the plasticity that occurs with experience and finds that congenitally blind individuals have distinct regions within 'visual' cortex that are selective to higher-cognitive domains. Remarkably, these regions show preferential functional connectivity with prefrontal areas that have analogous task-based responses, suggesting that connectivity constrains functional specialization even in cases of large-scale reorganization due to atypical experience. Together, these presentations suggest that early-developing or innate connectivity provides a scaffold for functional specialization of cortex, and constrains how experience may shape this functional specialization.

TALK 1: CONNECTIVITY AT THE ORIGINS OF DOMAIN SPECIFICITY IN THE CORTICAL FACE AND PLACE NETWORKS

Daniel D. Dilks, Emory University

It is well established that the adult brain contains a mosaic of domain-specific networks. But how do these domain-specific networks develop? Here we tested the hypothesis that the brain comes prewired with connections that guide the development of particular domain-specific networks. Using resting-state fMRI in the youngest sample of newborn humans tested to date, we found that cortical networks that will later develop strong face selectivity (including the proto occipital face area and fusiform face area) and scene selectivity (including the proto parahippocampal place area and retrosplenial complex) by adulthood, already show adult-like patterns of functional connectivity in as little as 27 days of age. We further asked why these networks always develop selectivity for faces and scenes, respectively, and not for other domains (e.g., scene selectivity in regions that are typically face selective, and vice versa), and found that the proto face and scene networks show differential functional connectivity to primary visual cortex (V1), with face regions biased toward foveal V1, and scene regions biased toward peripheral V1. Given that faces are almost always experienced at the fovea, while scenes always extend across the entire periphery, these distinct inputs may place powerful constraints on the function that each system will ultimately take on. Taken together, these results strongly support the hypothesis that innate connectivity shapes the development of the cortical face and scene processing networks, providing novel evidence for what may be a general mechanism of the origins of domain-specific networks.

TALK 2: CATEGORY-SELECTIVE VISUAL REGIONS HAVE DISTINCTIVE SIGNATURES OF STRUCTURAL CONNECTIVITY IN INFANTS

Rhodri Cusack, Trinity College Dublin

By four months, infants can form categories of similar-looking objects, but it is unclear when they begin to make the rich cross-modal, motoric and affective associations that are characteristic of adult visual categories. These associations are thought to be encoded by long-range brain connectivity and are reflected in the distinctive signature of connectivity of each category-selective region in the ventral visual stream. Category-selective ventral visual regions are already functioning in young infants, but their long-range connectivity has not been investigated. Therefore, we used MRI diffusion tractography to characterize the connectivity of face, place and tool regions in 1-9 month infants. Using a linear discriminant classifier, we found that the face and place regions had adult-like connectivity throughout infancy, but the tool-network underwent significant maturation until 9 months. This suggests that the face and place regions have long-range connectivity that is either innately specified or learned in the first months of infancy, while the more protracted development of the tool network is consistent with it developing as motor function develops, and infants learn to reach. This emerging long-range connectivity could reflect young infants developing category-specific rich associations.

TALK 3: SELECTIVITY DRIVEN BY CONNECTIVITY: INNATE CONNECTIVITY PATTERNS OF THE VISUAL WORD FORM AREA

Zeynep M. Saygin, The Ohio State University

The human brain is a patchwork of different functionally specialized areas. What determines this functional organization of cortex? One hypothesis is that innate connectivity patterns shape functional organization by setting up a scaffold upon which functional specialization can later take place. We tested this hypothesis here by asking whether the visual word form area (VWFA), an experience-driven region that only becomes selective to visual words after gaining literacy, was already connected to protolanguage networks in neonates scanned within one week of birth. We found that neonates showed adult-like functional connectivity, and observed that i) the VWFA connected more strongly with frontal and temporal language regions than regions adjacent to these language regions (e.g., frontal attentional demand, temporal auditory regions), and ii) language regions connected more strongly with the putative VWFA than other adjacent ventral visual regions that also show foveal bias (e.g. fusiform face area, FFA). Object regions showed similar connectivity with language areas as the VWFA but not with face areas in neonates, arguing against prior hypotheses that the region that becomes the VWFA starts out with a selectivity for faces. These data suggest that the location of the VWFA is earmarked at birth due to its connectivity with the language network, providing novel evidence that innate connectivity instructs the later refinement of cortex.

TALK 4: CONGENITAL BLINDNESS REPURPOSES VISUAL CORTICES FOR HIGHER-COGNITION AND CHANGES THEIR CONNECTIVITY

Marina Bedny, Johns Hopkins University

A growing body of evidence suggests that intrinsic connectivity patterns constrain the functional specialization of cortex. Are these constraints compatible with large-scale functional change as a result of experience? We tested the hypothesis that in blindness different parts of visual cortex are incorporated into distinct higher-cognitive networks using task-based and resting-state data. Congenitally blind (N=23), adult-onset blind (N=10) and blindfolded sighted controls (N=18) took part in three higher-cognitive tasks that activate different fronto-parietal networks. Each task had multiple difficulty levels: 1) auditory sentence processing (grammatically complex vs. simpler sentences) 2) solving math equations of varying difficulty and 3) non-verbal executive go/no-go task (frequent go, infrequent go, no-go). In congenitally blind individuals, different networks within visual cortex preferentially responded to linguistic, numerical and non-verbal go/no-go tasks and showed task-specific sensitivity to cognitive load. Responses were larger in congenitally blind than in sighted and adult-onset blind participants. Congenital blindness was also associated with functional connectivity changes: all occipital networks tested showed reduced resting-state correlations with sensorimotor and auditory areas and enhanced correlations with prefrontal cortices. Furthermore, each occipital network showed preferential enhancements with prefrontal areas that have analogous task-based responses (i.e. language-responsive visual areas showed preferential correlations with language-responsive prefrontal areas). Blindness enables visual cortices to develop selective higher-cognitive responses and changes resting-state connectivity. These findings suggest that intrinsic connectivity constraints are compatible with dramatic functional change as a result of experience.

Symposium Session 5

PRESSING THE PLAY BUTTON: SEQUENTIAL NEURAL REPLAY OF HUMAN MEMORIES

Monday, May 4, 10:00 am - Noon, Constitution Ballroom

Chair: Eitan Schechtman, Northwestern University

Speakers: Kareem Zaghloul, Marit Petzka, Yunzhe Liu, Leonardo G Cohen

Offline reactivation of memory-related neural patterns is thought to contribute to long-term memory evolution. In rodents, sequential reactivation of neuronal ensembles - conventionally termed 'replay' - has been primarily observed in hippocampal place cells and has been linked to memory consolidation and the planning of future actions. The same replay phenomenon has not yet been observed in humans. Identifying parallel physiological phenomena in humans would be an important advance for understanding neurocognitive mechanisms of memory. Progress towards that goal has recently been achieved using different paradigms and methods, including EEG, MEG, fMRI, and ECoG. This symposium will discuss some of these novel results, all emerging within the past year, that expose several underlying themes, including temporal compression of neural sequences and links to subsequent performance. These demonstrations of replay-like mechanisms in the human brain, taken together, reveal various similarities and differences between human and non-human reactivation. Exploring these avenues could pave the way toward deeper insights into the role of reactivation of sequential neural patterns in memory consolidation, planning, and decision making.

TALK 1: NEURAL MECHANISMS OF HUMAN EPISODIC MEMORY FORMATION ACROSS SPATIAL SCALES

Kareem Zaghloul, National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD

Episodic memory relies upon our ability to retrieve the memory of individual events that we have experienced at a particular time and place. The hippocampus and structures in the medial temporal lobe (MTL) play a critical role in this process by representing relations between memories and the spatiotemporal context within which they occur. A parallel line of research, however, has demonstrated that successful episodic memory retrieval involves recovering neural representations that were present in the cortex when memories were first experienced. This has led to the hypothesis that the hippocampus and MTL may promote episodic memory retrieval through a dialogue with the cortex that facilitates the ability to recover these neural representations. Here we explore this hypothesis by examining neural signals directly captured from the human brain across multiple spatial scales as participants perform a verbal episodic memory task. We show that patterns of neural activity at both the larger mesoscopic scale of intracranial EEG (iEEG) electrodes and at the smaller microscale of single units in the temporal lobe cortex are reinstated when memories are successfully retrieved. Moreover, we show that that such reinstatement of cortical activity is locked to the occurrence of coordinated oscillatory activity between the temporal lobe cortex and structures in the MTL. Together, these data suggest a mechanistic framework through which neural activity in the MTL can promote memory retrieval by initiating the replay of patterns of neural activity in the cortex.

TALK 2: FORWARD REACTIVATION OF SQUENTIAL MEMORY TRACES DURING SLEEP

Marit Petzka, School of Psychology and Centre for Human Brain Health, University of Birmingham, UK

Our ability to remember past events relies on the re-emergence of learning patterns during sleep. In humans, previous studies focused on simple paired-associate learning. However, episodic memories tend to contain multiple, sequentially experienced elements. Indeed, animal studies have provided evidence for reactivation of learning sequences (replay) and suggest that sequential reactivation occurs in a compressed and forward manner. To date, little is still known about the temporal dynamics of sequential memory reactivation during sleep in humans. Here, we applied targeted memory reactivation (TMR) to cue previously learned sequences of object-face-scene triplets during a post-learning nap using high-density electroencephalography (EEG). Behavioural results confirm that encoding took place sequentially, as the conditional probability to correctly retrieve a face without remembering the following scene was higher than correctly retrieving a scene without remembering the preceding face ($p < .001$). Importantly, memory performance for sequences that were cued during the nap was higher compared to sequences not cued ($p = .014$), establishing that TMR for sequences was successful. To capture sequential reactivation, a multiclass LDA classifier was trained on an independent localizer dataset (visual perception of objects, faces and scenes) during wakefulness and validated on sleep data in response to target cues. During sleep, classifier evidence for the emergence of face representations peaked after 800ms cue onset. Most interestingly, classifier evidence for scene representations peaked 600ms after the evidence for face representations, reflecting the order in which the sequences were encoded. Together, our findings reveal forward replay of previously learned memory traces during sleep.

TALK 3: NEURAL REPLAY IN MODEL-BASED LEARNING

Yunzhe Liu, Wellcome Trust Centre for Neuroimaging, University College London, UK

Humans exhibit remarkably flexible behaviour. Such flexibility is thought possible because the brain builds internal models of the world (i.e., cognitive map). How the brain represents, updates and use the world model to support flexible behaviour remains a central question in neuroscience. I will show evidence suggesting neural sequential replay plays a crucial role in representing, updating and generalizing the world model in humans. By building pattern classifiers of MEG sensor activity for each visual stimulus we detected their sequential reactivation during rest. These sequences recapitulated known features of neural replay in rodents and reflected correctly re-assembled orderings, rather than experienced trajectories. The forward replay of a correctly re-assembled sequence transitioned to that of reverse replay when a sequence was rewarded. We provide further evidence that neural pre-play is a manifestation of abstract structure knowledge. The representation of neural replay is factorized so that a sensory code of object representations was preceded 50 ms by structural code (i.e., sequence position and sequence identity) to allow for fast structural generalization to novel situations. When such a replay mechanism goes wary, it explains key cognitive deficits in psychiatric disorder, like Schizophrenia. I will also show evidence that neural sequential replay supports episodic memory retrieval, model-based planning and decision-making at the trial-by-trial basis. The direction of sequential replay can be flexibly adjusted to suit the current task goal. Together, the evidence suggests a crucial role of sequential replay underlying human cognition.

TALK 4: REPLAY OF HUMAN PRACTICE PREDICTS EARLY SKILL LEARNING

Leonardo G Cohen, National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD

Neural replay, spatiotemporal brain activity associated with task performance during rest, has been reported during sleep and linked to overnight memory consolidation. Wakeful replay contributes to memory formation in rodents (1) but its role in relation to skill formation or even presence in the context of human motor practice is not known. Here, we analyzed data collected in 31 subjects (2) who learned a sequence of keypresses with the non-dominant left hand. Training consisted of 36 alternating practice and rest periods (10 seconds each) lasting a total of 12 minutes. MEG recordings were obtained to assess resting-state and task-induced brain activity dynamics. Support vector machine (SVM) classifiers were constructed for individual key-press events during practice and then used to identify replay of sequence-related MEG dynamics during wakeful rest periods (3). Replay was assessed over sixteen different timescales (25-2500ms) pertaining to biologically relevant replay durations (4). Replay events were observed as early as the first rest period, remained present over the 36 rest periods and for at least 5-minutes after the end of practice. Optimal replay duration was 50-100ms, with a majority of subjects showing peak replay rates at 75ms durations. Replay of the trained sequence during rest periods prior to performance asymptote predicted rapid offline consolidation of the new skill. Source analysis identified a distributed medial temporal and sensorimotor network underlying wakeful neural replay. We conclude that motor practice elicits sustained neural replay during wakeful rest intervals that predict early skill learning.

Symposium Session 6

MOVING FROM A DEFICIT-ORIENTED TO A PREVENTIVE MODEL IN EDUCATION: EXAMINING NEURAL CORRELATES FOR READING DEVELOPMENT

Monday, May 4, 10:00 am - Noon, Back Bay A/B

Chair: Tzipi Horowitz-Kraus, Cincinnati Children's Hospital

Speakers: Tzipi Kraus, Nadine Gaab, Heikki Lyytinen, Michael Skeide, Jolijn Vanderauwera

Reading is a cultural invention and needs to be explicitly taught. Learning to read leads to high-level plasticity in a number of neural circuits, including vision, language and executive functions which makes it a great model to study experience-dependent plasticity in the developing brain. However, 3-10% of children struggle with reading acquisition, which continues into adulthood and poses future academic, socio-economic and mental health challenges in life. The etiology of reading difficulty is thought to lie within the dynamic interplay of genetic risk factors and environmental as well as cutural influences. In this symposium we will discuss the developmental trajectories and corresponding structural and functional neural circuits of learning to read starting at the pre-reading stage. Functional and structural MRI, Diffusion tensor imaging and EEG data obtained from English, German, Finnish, Hebrew and Dutch speaking children will be presented to provide a wide overview of the various factors influencing typical and atypical reading development in children worldwide. Furthermore, we will provide an overview about genetic and environmental factors that can influence experience-dependent plasticity during the process of learning to read. This includes a discussion of familial risk and its role in a multi-risk model as well as the role of home literacy environment and screen exposure time over the time course of learning to read. Similarities and differences across languages and orthographies as well as between a variety of different neuroimaging modalities will be discussed.

TALK 1: NEUROBIOLOGICAL CORRELATES FOR ENVIRONMENTAL FACTORS CONTRIBUTING TO FUTURE READING ABILITIES

Tzipi Horowitz-Kraus The Educational Neuroimaging Center, Faculty of Education in Sciences and Technology

Environment has a major contribution to children’s reading abilities. Home literacy environment and joint storytelling may be helpful for future reading abilities. On the other hand, screen exposure time may minimize the time children spend reading. Neuroimaging studies have demonstrated the involvement of executive functions, visual processing and language networks, all support future reading abilities, in young children listening to stories. However the same networks may be engaged during screen exposure as well. In a series of studies, we examined the neurobiological correlates for home literacy environment and of screen exposure, focusing on executive functions, language and visual processing in young children. The relationship between home literacy vs screen exposures with the activation and connectivity of neural circuits supporting these networks in preschoolers and school-age children was examined using functional MRI and EEG. Results demonstrate the recruitment of visual processing and executive functions networks, as well as white matter tracts related to these abilities both crucial for reading, in preschoolers and school-age children during a resting-state and task conditions with increased screen time. Similar regions were positively correlated with increased home reading environment. We conclude that screen exposure competes with neural circuits originally used for reading and narrative comprehension and therefore, exposure to screens should be monitored carefully. We also suggest that children exposed less to home literacy environment and to increased screen time may eventually have a reduced reading ability.

TALK 2: THE TYPICAL AND ATYPICAL READING BRAIN: HOW A NEUROBIOLOGICAL FRAMEWORK OF READING DEVELOPMENT CAN INFORM EDUCATIONAL PRACTICE AND POLICY

Nadine Gaab, Harvard Medical School, Boston USA

Various developmental disorders are diagnosed in early childhood, but divergent trajectories of brain development may already be present in preschool, at birth or prenatally. Here we will present results from our longitudinal studies which investigate whether observed functional and structural brain differences associated with reading impairments and developmental dyslexia are already present in infants and preschoolers, how they develop over time, and which aspects of these functional and structural differences are prospectively associated with subsequent language and reading outcome. We will further introduce a multiple deficit model that illustrates reading impairment as an outcome of multiple risks and protective factors interacting within and across genetic, neural, cognitive, and environmental levels from infancy to adolescence. Additionally, we will place a special emphasis on new findings from our longitudinal studies that characterize neural protective and compensatory mechanisms in young children at a heightened risk but who subsequently develop typical language and reading skills. Understanding the early developmental trajectories of language and reading skills, behaviorally and in the brain, will allow for better understanding of the etiological basis of reading impairments and will help inform early screening, identification and remediation practices. Finally, current and potential implications of these findings for contemporary challenges in the field of developmental cognitive neuroscience as well as for education and clinical practice in general, are discussed.

TALK 3: FUNCTIONAL AND STRUCTURAL SIGNATURES OF DYSLEXIIA BEFORE AND AFTER LITERACY INSTRUCTION

Michael Skeide, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Developmental dyslexia, a severe deficit in literacy learning, is one of the most common neurodevelopmental learning disorders. Yet, it is not well understood whether existing accounts of dyslexia capture potential causes of the deficit or consequences of reduced reading experience. Here, we followed a cohort of 32 children from preliterate to school age using functional and structural magnetic resonance imaging techniques. Based on reading and spelling tests administered at the end of second grade, these children were classified as dyslexics (N=16, age range preliterate age: 5.1-6.4 years, age range school age: 8.0-9.1 years, 5 female, 11 male) and controls (N=16, age range preliterate age: 5.0-6.0 years, age range school age: 7.11-8.11 years, 7 female, 9 male). This longitudinal design allowed us to disentangle potential neural predispositions for developing dyslexia from differences in literacy experience. In our sample, dyslexia reveals itself already at a preliterate age from differences in auditory cortex gyrification ($F(1,24)=9.64$, $p=0.0048$; FWE-corrected; Î·2 =0.19) and downstream connectivity (resting state functional connectivity: $F(1,24) = 14.73$, $P = 0.0009$, Î·2 = 0.32; streamline density: $F(1,24) = 15.16$, $P = 0.003$, Î·2 = 0.39) within the speech processing system. Our results support the notion that dyslexia may be related to subtle early cortical formation defects altering auditory cortex folding and hampering speech processing.

TALK 4: PRECURSORS OF DIFFICULTIES ASSOCIATED WITH THE DEVELOPMENTAL STEPS TOWARDS FULL LITERACY

Heikki Lyytinen, University of Jyväskylä , Finland

The Jyväskylä Longitudinal study of Dyslexia has documented the developmental steps learners have to take to reach full literacy and the bottlenecks which may make it difficult. The first step prepares learner to acquire the basic reading skill. At least in a fully transparent writing environment consistent at grapheme-phoneme level it is easy to understand that a potential bottleneck is the difficulty one may face in differentiating the phonemes from each. To learn the basic reading skill, one had to learn to connect the letter/grapheme representing each of the phonemes. Thus e.g. n, m and l are acoustically so close that differentiation is difficult. Thus, it is not any surprise that it is auditory sensitivity which is needed. Children at familial risk for dyslexia resulting from a parent with dyslexia were observed to have about fifty-fifty likelihood of ending to face dyslexia. Mismatch negativity observed at age 3-5 days of life fails to show up among that half of infants who ended facing dyslexia 10 years later. The next step, learning to comprehend written material, observed on the basis of PISA measures at age 15 was shown up being related to the development of spoken language. Children at familial risk whose expressive and receptive language was late at the age of 2.5 years ended up facing severe problems in reading comprehension 12 years later.

TALK 5: SEEKING TO OVERCOME THE DYSLEXIA PARADOX: BRAIN INSIGHTS, DEFINING WHO IS AT RISK FOR DYSLEXIA AND PREVENTIVE INTERVENTION

Jolijn Vanderauwera, Université catholique de Louvain, Belgium, Harvard Medical School, USA; KU Leuven, Leuven, Belgium

To date, as the definition implies, dyslexia is typically diagnosed when a child demonstrates severe and persistent reading failure. However, reading intervention has been demonstrated to be most effective early in a child's development, at the start of reading acquisition. Hence, by the time a child receives specific therapy, the most effective time for intervention has already passed, called the "dyslexia paradox". In this talk we will present research in Dutch speaking children that fits with the aim to overcome the dyslexia paradox. First, the development of the neuroanatomical reading network in children with (a risk for) dyslexia will be presented. We followed a cohort of 87 children from kindergarten till Grade 5, of whom half of the participants had an elevated risk for developing dyslexia. Diffusion MRI results and the relation to the children's reading development will be discussed at a pre-reading, early reading and advanced reading time point, showing that white matter deviances in important language and reading tracts precede the onset of formal reading instruction. Second, in order to provide preventive intervention, there is a need to define which children are at largest risk for developing dyslexia. The cognitive profiles of children at risk for dyslexia will be presented for the Dutch language, a fairly transparent language, based on screening in kindergarten (n = 1225). Finally, we will emphasize our recent findings on preventive intervention for dyslexia. This study comprised a three-month tabled-based intervention in kindergartners at cognitive risk for dyslexia (n = 120). The neurocognitive effects of the tablet-based intervention are discussed relative to an active and passive control group.

Symposium Session 7

INTEGRATING THEORY AND DATA: USING COMPUTATIONAL MODELS TO UNDERSTAND NEUROIMAGING DATA

Monday, May 4, 10:00 am - Noon, Back Bay C/D

Chair: Brandon Turner, The Ohio State University

Speakers: Michael J. Frank, Marc W. Howard, Bradley C. Love, Brandon M. Turner

Our understanding of cognition has been advanced by two traditionally non-overlapping and non-interacting groups. Mathematical psychologists rely on behavioral data to evaluate formal models of cognition, whereas cognitive neuroscientists rely on statistical models to understand patterns of neural activity, often without any attempt to make a connection to the mechanism supporting the computation. Both approaches suffer from critical limitations as a direct result of their focus on data at one level of analysis (cf. Marr, 1982), and these limitations have inspired researchers to attempt to combine both neural and behavioral measures in a cross-level integrative fashion.

The importance of solving this problem has spawned several entirely new theoretical and statistical frameworks developed by both mathematical psychologists and cognitive neuroscientists. In this symposium, we will highlight a few of these efforts both at a methodological and application level.

TALK 1: CORTICOSTRIATAL COMPUTATIONS IN LEARNING AND DECISION MAKING

Michael Frank, Brown University

The basal ganglia and dopaminergic systems are well studied for their roles in reinforcement learning and reward-based decision making. Much work focuses on 'reward prediction error' (RPE) signals conveyed by dopamine and used for learning. Computational considerations suggest that such signals may be enriched beyond the classical global and scalar RPE computation, to support more structured learning in distinct sub-circuits ('vector RPEs'). Such signals allow an agent to assign credit to the level of action selection most likely responsible for the outcomes, and hence to enhance learning depending on the generative task statistics. I will first describe the computational models spanning levels of analysis from implementation to function. I will then present evidence across species and methods -- from fMRI and EEG in humans to calcium imaging of striatal dopamine terminals in rodents -- that RPE signals are modulated by instrumental task demands, in accordance with vector RPEs.

TALK 2: COGNITIVE COMPUTATION USING NEURAL REPRESENTATIONS OF TIME, SPACE AND NUMBER IN THE LAPLACE DOMAIN

Marc Howard, Boston University

Memory for the past makes use of a record of what happened when—a function over past time. Time cells in the hippocampus and temporal context cells in the entorhinal cortex both code for events as a function of past time, but with very different receptive fields. Time cells in the hippocampus can be understood as a compressed estimate of events as a function of the past. Temporal context cells in the entorhinal cortex can be understood as the Laplace transform of that function, respectively. Other functional cell types in the hippocampus and related regions, including border cells, place cells, trajectory coding, splitter cells, can be understood as coding for functions over space or past movements or their Laplace transforms. More abstract quantities, like distance in an abstract conceptual space or numerosity could also be mapped onto populations of neurons coding for the Laplace transform of functions over those variables. Quantitative cognitive models of memory and evidence accumulation can also be specified in this framework allowing constraints from both behavior and neurophysiology. More generally, the computational power of the Laplace domain could be important for efficiently implementing data-independent operators, which could serve as a basis for neural models of a very broad range of cognitive computations.

TALK 3: CATEGORY LEARNING AS COMPRESSION

Bradley Love, UCL

How do we learn to categorise novel items and what is the brain basis of these acts? For example, after a child is told an animal is a dog, how does that experience shape how she classifies future items? In this talk, I will discuss work using model-based fMRI analyses to understand how people learn categories from examples. Results indicate that the medial temporal lobe (MTL), including the hippocampus, plays an important role in both learning and recognition. Succesful cognitive models, which explain both behavioural and fMRI data, learn to selectively weight (i.e., attend) to stimulus aspects that are task relevant. This form of weighting, or top-down attention, can be viewed as a compression process. I will discuss how the medial prefrontal cortex (mPFC) and the hippocampus coordinate to build low-dimensional representations of learned concepts, as well as how the dimensionality of visual representations along the ventral stream is altered by the learning task.

TALK 4: PROBABILISTIC LINKING FUNCTIONS FOR MIND, BRAIN, AND BEHAVIOR

Brandon M. Turner, The Ohio State University

The link between mind, brain, and behavior has mystified philosophers and scientists for millennia. Scientists who study cognition infer underlying processes either by observing behavior (e.g., response times, percentage correct) or by observing neural activity. These two types of observations have traditionally supported two separate lines of study. The first is led by cognitive modelers, who rely on behavior alone to support their computational theories. The second is led by cognitive neuroimagers, who rely on statistical models to link patterns of neural activity to experimental manipulations, often without any attempt to make a direct connection to an explicit computational theory. Recent progress has been made by forming statistical associations between manifest variables of the brain (e.g., EEG, fMRI) and manifest variables of behavior (e.g., response times, accuracy) through hierarchical latent variable models (Turner et al., 2018). Within this framework, one can make inferences about the mind in a statistically principled way, such that complex patterns of brain-behavior associations drive the inference procedure. In this talk, I will discuss a recent approach called joint modeling that mutually constrains what we learn about the cognitive process from both the computational model and the neurophysiology. The central idea of this approach is to use the information in the neurophysiology to enhance or guide what the cognitive model says about the cognitive process of interest. I will highlight the utility of this approach from a methodological perspective as well as summarize a few key applications.

Symposium Session 8

THE MEETING OF PERCEPTION AND MEMORY IN THE BRAIN

Monday, May 4, 10:00 am - Noon, Grand Ballroom

Chair: Marc Coutanche, University of Pittsburgh

Speakers: Marc Coutanche, Chris Baker, Jennifer Ryan, Morgan Barense

Perception and memory are intrinsically linked. Perceptual processes influence which information enters memory, and existing memories influence how we process perceptual input. This symposium will examine questions that speak to how and where perception and memory meet in the brain. The speakers will each tackle this topic in a unique way, giving an opportunity to identify shared cognitive and neural principles. In the first talk, Marc Coutanche will ask how information at distinct perceptual and conceptual levels can predict encoding success, and how levels of ventral stream reactivation affect memory outcomes, using behavior, fMRI, and convolutional neural networks. Next, Chris Baker will present fMRI findings that address the different levels of granularity that are elicited in high-level visual cortex during memory encoding and recall, revealing a spatial organization associated with recall. We will then move onto Jennifer Ryan, who will discuss how visual exploration and hippocampal binding processes are inherently linked, drawing on findings from behavioral, neuropsychological, neuroimaging, and computational modeling methods. Finally, Morgan Barense will present behavioral and neuroimaging studies of predictive coding, a continuous bridge between memory and current perceptual input, to ask how prediction errors at naturalistic event boundaries affect episodic memory updating. With overlapping goals but different perspectives, we hope to identify commonalities that can shed light on these issues, while raising new questions.

TALK 1: ROLES OF PERCEPTUAL AND CONCEPTUAL HIERARCHIES IN THE FORMATION OF MEMORIES

Marc Coutanche, University of Pittsburgh

A visual stimulus is represented at multiple levels across the human visual system: from low-level visual properties to high-level meaning. What roles do these levels play in memory formation? I will present results from several recent investigations that address this question. First, I will discuss a study that used convolutional neural networks to identify how early and later stages of the visual hierarchy help predict whether an image will be encoded into memory. Findings from two behavioral and one fMRI experiment suggest images are more likely to be successfully remembered when they are discriminable at early visual levels, but more similar at higher visual levels, where the relevant stage depends on the use of single or multiple semantic categories. Second, I will present findings from an fMRI study of how pattern reactivation of novel concepts relates to memory outcomes. Here, participants were introduced to image word associations for novel rare animals, and were then asked to retrieve the associations one month later, each during an fMRI scan. The results suggest that the degree of reactivation of item and taxonomic-category (e.g., 'mammal') information within different regions of the ventral stream, relates to distinct memory outcomes. Together, these findings suggest that different perceptual and conceptual levels play important and distinct roles in achieving successful memory performance.

TALK 2: DISTINCT PROFILES OF PERCEPTION AND MEMORY IN HIGH-LEVEL VISUAL CORTEX

Chris Baker, National Institute of Mental Health

High-level visual cortex has been characterized by the presence of category-selective regions that respond preferentially to certain classes of stimuli (e.g. scenes, faces, objects). During memory recall, these regions are commonly thought to exhibit similar responses to those observed during perception, although these studies often focus on limited stimulus properties. In an item-based fMRI recall task, we investigated the nature of representations elicited during encoding and memory recall in category-selective regions by decoding multiple levels of information. Stimuli were trial unique and ranged in granularity from broad stimulus class (scenes, objects) to types of objects or scenes (e.g. natural, manmade) to individual sub-categories (e.g. living room, cupcake). While we find that the patterns of response in object and scene-selective cortex do contain information about recalled items that resembles that during encoding, this information tends to be quite coarse allowing decoding of stimulus class (objects versus scenes) but not other stimulus dimensions that are detectable during encoding. Further, we observed segregation within category-selective cortex between those voxels showing strongest effects during encoding and those during recall. Finally, in a whole-brain analysis, we observed the strongest similarity between encoding and recall in regions anterior to the category-selective cortex. These results highlight key differences in representational structure and spatial distribution between encoding and recall. More generally, these results are consistent with our prior work suggesting systematic relationships between regions engaged during perception and those engaged during recall throughout high-level visual cortex.

TALK 3: THE RECIPROCAL LINK BETWEEN MEMORY AND VISUAL EXPLORATION

Jennifer Ryan, Rotman Research Institute, Baycrest

The oculomotor and hippocampal memory systems interact in a reciprocal manner, on a moment-to-moment basis. Memory influences ongoing viewing behavior by increasing the efficiency of active vision. Conversely, eye movements serve to accumulate information from the visual world, contributing to the formation or updating of coherent memory representations. Eye movements may also contribute functionally to memory retrieval by reconstructing the rich, vivid, spatiotemporal details from memory. These interactions are mediated by the vast structural and functional links between the two systems. Findings from human and non-human animals, using behavioral, neuropsychological, neuroimaging, and computational modeling methods, will be highlighted to show that visual exploration and hippocampal binding processes are inherently linked, and that such an exploration-binding link is altered with hippocampal dysfunction.

TALK 4: PAST MEETS PRESENT: PREDICTION ERROR DRIVES EPISODIC MEMORY UPDATING

Morgan Barense, University of Toronto

How does the brain link past, present, and future? The concept of predictive coding provides a framework that bridges memory and perception. We draw on past experience to make predictions, and then compare those predictions to present perceptual input. This comparison process allows the brain to segment continuous experience, learn from error, and adaptively integrate new information into memory. Converging evidence from animals and humans has implicated prediction error, or surprise, as a key mechanism that renders established memories malleable. We developed a naturalistic paradigm to elicit prediction error during memory reactivation. To create surprising event boundaries, we interrupted narrative videos immediately before the expected conclusion. Through a series of behavioral and neuroimaging studies, we demonstrated that prediction errors at event boundaries allow episodic memories to be destabilized and updated with new, semantically relevant information. The effect of prediction error on memory was critically time-dependent, consistent with reconsolidation theory. Using fMRI, we showed that trial-wise neural activity in the hippocampus, ventral tegmental area, and angular gyrus was related to prediction error and memory updating. Our findings support the idea that the brain switches between internal and external modes of information processing. After an event boundary, internally-oriented processing (e.g., pattern completion, replay) strengthens episodic memory. However, surprising or salient perceptual input triggers a switch to externally-oriented processing. After a surprising event boundary, the hippocampus is primed to integrate new details into memory. Broadly, our findings showcase the dynamic interplay between perception and memory, through the overarching framework of predictive coding.

Symposium Session 9

CORTICAL GRADIENTS AND THEIR ROLE IN COGNITION

Tuesday, May 5 17, 2:00 – 4:00 pm, Constitution Ballroom

Chair: Daniel Margulies, CNRS

Speakers: Boris Bernhardt, Noam Saadon-Grosman, Micah Murray, Jonathan Smallwood

While cortical areas have long been considered the building blocks of cortical processing, an emerging perspective suggests cortical functions are mediated along spatial gradients of organization. Cortical gradients provide a general framework for describing a global hierarchy that spans different processing streams, and establishes a mechanism for the large-scale structure of the cerebral cortex to enable sensory integration and diverse forms of cognition. We will address this topic through talks describing different implications and challenges for a gradient-based model of cortical organization and its role in cognition: How are different features of cortical connectivity and microstructure organized along gradients, and how does their deviation in disease account for atypical function? How do sensory topographies impact on the cortical layout within association cortex? How can we reconcile a global hierarchy of 'primary sensory-motor to higher-order cognitive functions' with the observation of that primary cortical areas also demonstrate multisensory properties? And what is the role of large-scale cortical gradients in enabling the dynamics underlying distinct mental states? The four 25-minute presentations will be followed by a 20-minute moderated discussion and Q&A from the audience.

TALK 1: THE INFLUENCE OF BRAIN STRUCTURE ON TYPICAL AND ATYPICAL BRAIN FUNCTION

Boris Bernhardt, Montreal Neurological Institute, McGill University

Neuroscience has the potential to explain how brain function arises from its underlying structure, and how brain dysfunction emerges from diseases associated with structural abnormalities. My talk will overview new work from the lab that analyzed cortex-wide microstructural coordination in humans, and that derived novel measures of structural wiring and hierarchies via advanced modeling of multimodal MRI data. Leveraging post-mortem histological and transcriptomic techniques, we could furthermore show that these microstructural hierarchies derived from in vivo imaging reflect underlying cytoarchitecture and gene expression patterns. Studying large cohorts of healthy individuals as well as patients with structural brain anomalies, our work furthermore shows that new models of structural wiring can make robust predictions of typical as well as atypical functional connectivity and dynamics. Our results advance our understanding of how microstructural properties produce a hierarchical cortical wiring scheme that governs large-scale functional gradients and signal flow in cortical areas.

TALK 2: CORTICAL SOMATOSENSORY HIERARCHICAL GRADIENTS

Noam Saadon-Grosman, Shahar Arzy, Yonatan Loewenstein, Hebrew University

Multiple body maps in different cortical areas characterize information processing in the cortex. Additionally, electrophysiological studies in non-human primates have demonstrate hierarchical relationship between several somatosensory-responsive regions. However, a large-scale understanding of cortical somatosensory processing directions, analogous to the dorsal and ventral streams in the visual cortex, has been lacking. Therefore, we set out to characterize somatosensory hierarchies in the entire cortical representation. We applied phase-encoded bilateral full-body light touch stimulation under functional MRI. We quantified selectivity, a measure of the specificity of the response to a preferred body-part (the fMRI equivalent of neuronal receptive field), as well as the response's laterality, a measure of the dominance to contralateral response. Incorporating multi-modal cortical parcellation, we defined gross anatomical regions and computed selectivity and laterality along four spatial axes originating from the central sulcus. Our results suggest somatosensory hierarchical gradients that follow three anatomically distinct directions: parietal (from the central sulcus posteriorly in the lateral-parietal lobe), frontal (from the central sulcus anteriorly in the frontal) and medial (inferiorly and anteriorly in the medial wall). We propose that as in the visual domain, these directions are streams of somatosensory information processing.

TALK 3: A MULTISENSORY PERSPECTIVE ON PRIMARY CORTICES

Micah M. Murray, University Hospital Center and University of Lausanne

The turn of the 21st century introduced evidence dramatically changing our conception of functional brain organization and cortical gradients. Anatomic evidence in non-human primates showed that primary cortices were directly (i.e. monosynaptically) interconnected. Some even proposed that the whole neocortex is essentially multisensory in nature. In this talk, I will overview our efforts to provide evidence in humans that primary cortices are indeed fundamentally multisensory and play an active role in multisensory processes and perception. This evidence is provided from a full pallet of human brain imaging, mapping, and stimulation methods. First, there is both convergence and integration occurring within primary visual and auditory cortices at early post-stimulus stages. Second, these processes are behaviourally relevant, can be linked with excitability changes, and impact perceptual outcome. Third and more generally, early-latency multisensory processes extending from primary to lateral-occipital regions play a direct role in recognition memory. Finally, we extend such findings to show how multisensory processes across the lifespan are tethered to global cognition and its breakdown, providing a potential access point for screening and treatment. Together, these data underscore how multisensory research and its applications in basic, clinical, and applied research is changing long-held models of graduated functional brain organization.

TALK 4: NEUROCOGNITIVE HIERARCHIES AS A STATE SPACE FOR ON-GOING THOUGHT

Jonathan Smallwood, University of York

Our experience is not always focused on events in the outside world, we often focus internally on self-generated mental content. Understanding the neural basis of these different patterns of ongoing thought requires understanding how the cortex leverages the constraints imposed by its organisation to produce different neurocognitive states. This talk considers evidence that uses machine learning, experience sampling and neural activity to establish that neurocognitive hierarchies can provide a coordinate space for understanding different modes of neurocognitive operation. In particular, these studies suggest that different types of states can fall at either extreme of a dimension resembling how the brain responds to task demands. These results establish that neural hierarchies provide a flexible coordinate space within which to understand the dynamics of unconstrained thought, and demonstrate neural patterns resembling the brain's response to external task demands, capture important aspects of self-generated experience.

Symposium Session 10

SPECIFICS AND GENERALITIES: BEYOND THE SEMANTIC-EPISODIC DISTINCTION

Tuesday, May 5, 2:00 – 4:00 pm, Back Bay A/B

Chair: Chi Ngo, Max Planck Institute for Human Development

Speakers: Chi Ngo, Dagmar Zeithamova, Alexa Tompary, Sean Polyn

An adaptive memory has to serve both the need to construct generalized knowledge across experiences to optimally guide behaviors in novel situation, and the need to keep individual episodes distinctive to minimize interference. These functions are thought to rely on distinct memory systems. The former underscores an appreciation of the commonalities across overlapping experiences, whereas the latter retains the specificity and distinctiveness of individual episodes. These two memory systems are inextricably intertwined and exert joint influences on behavior. However, generalized knowledge and episodic memory have often been investigated in separate lines of research. The work presented in this symposium will characterize the bidirectional influences between generalized knowledge and memory of specific instances from the neural and behavioral levels of analyses. The presentations will cover a set of central questions: (1) when do generalized knowledge and episodic memory emerge in early development; (2) how neural representations of specific instances and generalized knowledge representations may emerge across learning, and how categorization decisions are supplemented by memory for specific experiences; (3) how the structure of prior knowledge explains the extent of distortions in episodic retrieval; and (4) how categorical structure influences both behavioral performance and neural signals during free recall. Collectively, our symposium will include some of the newest and most exciting work in this line of research by integrating theories drawn from developmental science, cognitive neuroscience, and neurocomputational science, and with methods ranging from behavioral, computational, functional magnetic resonance, and transcranial magnetic stimulation approaches.

TALK 1: GENERALIZED KNOWLEDGE AND EPISODIC MEMORY IN DEVELOPMENT

Chi Ngo, Max Planck Institute for Human Development, Berlin

Young children display prodigious capacities to extract generalized knowledge about the environment and to build strong semantic memory and yet they have difficulty remembering specific events. This observation predicts a developmental lead-lag relation between constructing schematic knowledge and episodic memory. However, past research has primarily studied these processes in isolation and focused on different age windows, creating critical blind spots in our understanding of the relative emergence of generalization and episodic memory. Here, we directly tested the prediction of developmental precedence of generalization over episodic memory. We administered a novel task that allowed for assessing generalization and episodic memory in children aged 4-8 and young adults with common stimuli and task demands. Participants learned a series of events, some of which shared commonalities with one another (e.g., Tabaluga was seen in different contexts, paired with different musical instruments each time). Generalization was operationalized as the ability to make a novel inference based on the series (e.g., Tabaluga would choose a novel musical instrument over objects from other semantic categories). Episodic memory was operationalized as detailed memories of the individual episodes, probed at different levels context binding, item conceptual and perceptual precision. Although generalization and episodic specificity both improved with age, generalization performance exceeded some aspects of episodic specificity early in life. Crucially, generalization did not depend on memories of individual episodes, suggesting that generalization does not arise from abstraction over episodic memories in early development.

TALK 2: MEMORY SPECIFIC AND CONCEPT GENERALIZATION

Dagmar Zeithamova, University of Oregon

Concept learning and episodic memory have been typically studied in distinct lines of research, assumed to rely on different memory representations and competing memory systems. In contrast, a single system view of concept learning assumes that concept generalization relies on specific representations formed by the episodic memory system and the existence of generalized representations is not necessary. To resolve between these views, we conducted a series of studies using two experimental paradigms that allow for simultaneous tracking of specific and generalized representations in the brain and behavior. One set of studies used binary-dimension stimuli well suited to fitting formal categorization models that assume reliance on specific vs. generalized concept representations respectively. Model predictions derived from behavior were related to brain activation. The results showed both specific and generalized concept representations emerging across learning in distinct loci, both contributing to categorization performance. The second set used face blend stimuli well suited for behaviorally testing both face-specific memory and category generalization. Neural pattern similarity analysis revealed neural representations of specific faces as well as category-level (generalized) representations that emerged across learning. Together, these findings demonstrate the existence of generalized concept representations in brain and behavior, but also reveal how categorization decisions are supplemented by memory for specific exemplars, reconciling competing theories of concept representation.

TALK 3: SEMANTIC KNOWLEDGE DISTORTS EPISODIC MEMORY: BEHAVIORAL AND NEURAL INVESTIGATIONS

Alexa Tompary, University of Pennsylvania

Retrieval is not a veridical recapitulation of past events, but instead an imperfect recombination of event-specific details and other general knowledge. Integrating these sources of information may improve the signal of a memory, but introduce systematic errors if there are discrepancies between them. However, it remains unclear how the structure of semantic knowledge, like category typicality, biases new episodic memories. We predicted that typical (compared to atypical) category members would be more prone to bias by prior knowledge. In a series of behavioral experiments, participants encoded and retrieved image-location associations. Most members of a category (e.g. birds) were located near each other, but some typical and atypical category members were in random locations. Critically, we used a continuous retrieval measure of location memory to develop two measures: error, a measure of episodic specificity, and bias towards other category members, a measure of the influence of semantic knowledge. First, location memory was more precise for images that were spatially consistent with their category membership. Second, retrieval of typical category members was more biased towards category neighbors, relative to atypical members. Both effects replicated across multiple experiments and were disrupted when images were not arranged by category. This suggests that episodic retrieval is supported both by event-specific details and prior knowledge, and the structure of this knowledge explains the extent of distortions in memory. An ongoing experiment applying transcranial magnetic stimulation to the left anterior temporal lobe will clarify whether these sources of information are underpinned by distinct neural mechanisms.

TALK 4: NEURAL SIGNATURES OF TIME AND MEANING IN CATEGORIZED FREE RECALL

Sean Polyn, Vanderbilt University

During memory search, generalized semantic knowledge interacts with episodic memories of recent experience. We examine these interactions in the categorized free-recall task. In this task, participants study a series of items drawn from taxonomic categories associated with distinct neural signatures (celebrities, landmarks, and objects), and then recall these items in whatever order they come to mind. These interactions reveal themselves in the behavioral dynamics of the task: Participants produce recall sequences that simultaneously display strong temporal organization (whereby successively produced responses tend to come from nearby list positions) and semantic organization (whereby successively produced responses tend to be meaningfully related). These interactions are also revealed in the task's neural dynamics: Category-specific neural patterns can be tracked during both study and recall periods, and these patterns show integrative effects, whereby information about the category identity of items from the recent past persists in the neural signal. We have developed a neurocognitive modeling framework to explain these neural and behavioral dynamics. The model describes how semantic information can be integrated into a representation of temporal context, and predicts the representational structure of neural activity and the organizational effects observed during recall. We use this framework to infer the representational structure of memories for the study experience, and the nature of the executive processes guiding search through these memories. Finally, I'll describe recent behavioral and neuroimaging experiments in which we use a distraction task to disrupt temporal and category integration, which has corresponding effects on both recall behavior and task-related neural signals.

Symposium Session 11

DEEP DATA: THE CONTRIBUTION OF CASE STUDIES AND SPECIAL POPULATIONS IN THE ERA OF BIG DATA

Tuesday, May 5, 2:00 – 5:00 pm, Back Bay C/D

Chair: Erez Freud, York University

Speakers: Erez Freud, Ella Striem-Amit, Shayna Rosenbaum, Bradford Z. Mahon

Classic neuropsychological case studies helped found the field of cognitive neuroscience, showing which cognitive faculties can be dissociated from one another, and contributing to the discovery differentiated processing streams. However, given the benefits of big datasets and large sample sizes for reliability, do case studies and the research of small unique populations still have a role in the future of the field? This symposium highlights patient and population research across action, perception, memory, and language, illustrating the benefits of well-characterized deep individual data to cognitive neuroscience. Talks will challenge the dissociation of action and perception in vision, by inspecting the role of the dorsal stream in object recognition; explore the role of hand motor experience for tool and action representations in individuals born without hands; explore the language pathways using direct electrical stimulation mapping in awake brain surgery; and inspect the role of the hippocampus in pattern separation across modalities and content domains. Across the four content domains that are discussed, causal evidence resulting from case studies and special populations places firm constraints on plausible theoretical distinctions. These allow for the generation of new hypotheses about the brain and mind, which, in turn, can be further examined in large datasets.

TALK 1: THE ROLE OF THE DORSAL PATHWAY IN OBJECT PERCEPTION

Erez Freud, York University

According to the two visual pathways hypothesis, the ventral visual pathway promotes vision-for-perception, while the dorsal pathway promotes vision-for-action. Seminal single-cases neuropsychological investigations supported this functional dissociation. However, accumulating evidence challenges this binary distinction and suggests that regions in the dorsal pathway derive object representations that might play a functional role in object perception. In my talk, I will discuss evidence from psychophysical, kinematic and neuroimaging studies with visual agnosia patients that were aimed to explore the nature of object representations in the dorsal pathway. The results from these studies highlight (a) the plausible role of the dorsal pathway in object perception, (b) the interplay between shape representations derived by the ventral and the dorsal pathway and (c) the association between the developmental trajectories of vision-for-perception and vision-for-action. Together, these findings are consistent with the view that object perception is not the sole product of ventral pathway computations, but instead relies on a distributed network of regions.

TALK 2: PERCEPTION AND ACTION WITHOUT HANDS

Ella Striem-Amit, Georgetown University

Our hands are at the core of our action system, affecting our representation of both actions and manipulable objects, such as tools. But what role do the hand motor features themselves, or our experience using them, play in these representations? I will present a series of fMRI experiments addressing this question by investigating individuals born without hands, who use their feet to perform everyday actions. These works revealed representations abstracted from the hand-specific features, as well as representations affected by motor knowledge and experience. First, I will present findings showing typical processing for visual hand images and actions, regardless of motor experience. Second, I will present findings showing the effect of the absence of motor use knowledge for some common objects which the dysplasics cannot use, affecting a distributed system integrating different attributes of object knowledge. Third, I will present findings related to action execution, which reveal a gradient between body-part selective regions and effector-invariant regions, allowing exploration of the different levels of abstractness in representing actions. Finally, I will discuss the benefits of the special populations, congenitally deprived of experience in specific manners to address the causal role of experience in shaping our brain and mind, drawing parallels across studies of people born blind, deaf or without hands.

TALK 3: PATTERN SEPARATION FOLLOWING DENTATE GYRUS LESIONS

Shayna Rosenbaum, York University

Healthy older adults and individuals with hippocampal compromise experience a notable decline in episodic memory. These memory problems may be due to difficulties discriminating highly similar inputs belonging to separate, yet overlapping, events into discrete episodes at encoding, a process known as pattern separation. Pattern separation in humans is often estimated behaviourally with visual recognition tests in which participants must select previously studied everyday objects from visually and conceptually similar lures and from dissimilar foils. However, the types of stimuli, domains, processes, and representations it impacts remain unclear. To what extent do presumed deficits in pattern separation extend to modalities other than vision, such as audition? Within vision, is it more evident for one class of stimuli, such as scenes, than another, such as faces? Is the extent of the deficit affected by prior knowledge? To address these issues, I will present a series of studies involving a unique individual with bilateral lesions to the dentate gyrus, a region of the hippocampus strongly associated with pattern separation. A first set of studies involve tasks requiring discrimination of novel auditory stimuli within memory and perception. I will then describe how categorical perception, which refers to greater differentiation of stimuli at a perceived boundary compared to within boundaries, might relate to pattern separation. Findings from this work illustrate how the study of single cases continue to contribute to hypotheses and theories that may steer the field in new directions.

TALK 4: DIRECT ELECTRICAL STIMULATION MAPPING OF LANGUAGE PATHWAYS DURING AWAKE BRAIN SURGERY

Bradford Z. Mahon, Carnegie Mellon University

An emerging approach for understanding the neural substrates of speech processing emphasizes integrated functional analysis of cortical regions, major white matter pathways, and behavioral consequences of lesions to those structures. Language mapping with direct electrical stimulation in awake neurosurgery patients undergoing removal of brain tumors offers a powerful approach for testing hypotheses about the cortical and subcortical systems critical for language processing. I describe a case series in which the first patient was tested with detailed neuropsychological testing pre- and post-operatively, and the second patient was studied using cortical and subcortical electrical stimulation mapping during awake brain surgery. Both patients had gliomas in the dominant frontal lobe. The first patient experienced a reduction in verbal fluency subsequent to partial resection of the Frontal Aslant Tract, which connects the pre-supplementary motor cortex with the inferior frontal gyrus. Motivated by those findings, we designed a novel test of speech fluency that was administered during the awake portion of the second patient's surgery. We found that electrical stimulation of the Frontal Aslant Tract specifically disrupted speech fluency, leaving lexical access and articulatory processes intact. The findings are interpreted in the context of the hypothesis that the Frontal Aslant Tract mediates the integration of syntagmatic relations among words with positional level planning.

Poster Schedule

Poster sessions are scheduled for Saturday-Tuesday in Exhibit Hall C in the virtual meeting. The presenting author must be present during the assigned session to respond to questions via Chat. Your poster booth will be available during the entirety of the virtual meeting and the on-demand hours. This is to allow attendees to view posters outside the formal session times.

Poster Session	Date	Session
A	Saturday, May 2	1:30 pm – 4:30 pm EDT
B	Sunday, May 3	10:00 am – 1:00 pm EDT
C	Sunday, May 3	2:00 pm – 5:00 pm EDT
D	Monday, May 4	10:00 am – 1:00 pm EDT
E	Monday, May 4	2:00 pm – 5:00 pm EDT
F	Tuesday, May 5	10:00 am – 1:00 pm EDT
G	Tuesday, May 5	2:00 pm – 5:00 pm EDT

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Saturday, May 2	1:30 pm – 6:00 pm
Sunday, May 3	10:00 am – 5:00 pm
Monday, May 4	10:00 am – 5:00 pm
Tuesday, May 5	10:00 am – 5:00 pm

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