COSYNE 2016

cosyne.org

WORKSHOPS

Snowbird, UT

Feb 29–Mar 1

COSYNE 2016 Workshops

Snowbird, UT
Feb 29–Mar 01, 2016

Organizers:
Claudia Clopath
Alfonso Renart

COSYNE 2016 Workshops

Feb 29–Mar 01, 2016

Snowbird, Utah

Monday, February 29, 2016	Organizer(s)	Location
1.1 Am I attending the right workshop? Certainty and confidence in decision-making – Day 1	M Peters R Coen-Cagli J Drugowitsch	*Wasatch*
1.2 Recurrent spiking neural networks - dynamics, learning, computation	B DePasquale O Barak B D Huh RM Memmesheimer	*Golden Cliff*
1.3 Biophysical principles of brain oscillations and their meaning for information processing-Day 1	C Anastassiou G Kreiman S Jones	*Maybird*
1.4 Sloppy models in systems neuroscience	T O'Leary	*Superior A*
1.5 Sensorimotor learning through multi-dimensional spaces	M Golub A Degenhart	*Magpie B*
1.6 Neural bases of executive flexibility	T Buschman R B Ebitz	*White Pine*
1.7 Computational models of cognitive, social, and affective processing	S Bishop A Collins	*Superior B*
1.8 The avian brain as a guide to hierarchical temporal structures	N Kadakia A Daou	*Magpie A*
1.9 Dimensionality reduction for the analysis and interpretation of high-dimensional neural datasets	M Aoi A Charles J Pillow	*Primrose A*

Workshop Co-Chairs	Email
Alfonso Renart, Champalimaud	alfonso.renart@neuro.fchampalimaud.org
Claudia Clopath, Imperial College	c.clopath@imperial.ac.uk

Maps of Snowbird are on page 5 of this booklet.

COSYNE 2016 Workshops

Feb 29–Mar 01, 2016

Snowbird, Utah

Tuesday, March 01, 2016	Organizer(s)	Location
2.1 Am I attending the right workshop? Certainty and confidence in decision-making – Day 2	M Peters R Coen-Cagli J Drugowitsch	*Wasatch*
2.2 Timescales of dynamics in neuronal networks	A Akrami A El Hady	*Golden Cliff*
2.3 Biophysical principles of brain oscillations and their meaning for information processing – Day 2	C Anastassiou G Kreiman S Jones	*Maybird*
2.4 Form and function of choice-related feedback signals in decision making	A Stocker	*Superior A*
2.5 Recent innovations in attention research: Linking models, mechanisms, and behavior	B Odegaard	*Magpie B*
2.6 Toward the real world: Naturalistic experiments and analysis	P Lawlor J Glaser	*White Pine*
2.7 Recent advances in activity-dependent plasticity	RC Froemke P Munro	*Superior B*
2.8 Computations of the dorsomedial prefrontal cortex	J Brown	*Magpie A*
2.9 Coding, correlations, and the dimensionality of neural activity	R Engelken G Mongillo F Wolf	*Primrose A*

Workshop Co-Chairs	Email
Alfonso Renart, Champalimaud	alfonso.renart@neuro.fchampalimaud.org
Claudia Clopath, Imperial College	c.clopath@imperial.ac.uk

Maps of Snowbird are on page 5 of this booklet.

Schedule

Each workshop group will meet in two sessions from ~8–11am and from 4.30–7.30pm.

Workshop summaries and schedules are available starting on page 6 of this booklet.

Transportation

Marriott Downtown to Snowbird: Free shuttle provided for registered attendees (first shuttle leaves @ 4pm, last @ 5pm on Sunday, 28 Feb 2016).

Snowbird to Salt Lake City Airport:

Shuttle can also be arranged at Snowbird, or online at:

https://store.snowbird.com/ground_transport/

Further information about transportation to/from Snowbird is available at:

http://www.snowbird.com/about/maps/

For further information on transportation or other logistics please contact Denise Acton (cosyne.meeting+denise@gmail.com).

Discounted workshop rates

Snowbird walk up rate: $85

Equipment rental coupons available at the registration desk: 30% off

Pick up at the Cliff ticket window (level 1 of the Cliff Lodge next to the ski rental shop) or at the ticket window on the top level of the Snowbird Center (the plaza deck).

Spa facility discount for Cosyne guests: $12.50/day

Meals included with registration

Breakfast (Day 1 and Day 2) - The Cliff Ballroom

Dinner (Day 2) - The Cliff Ballroom

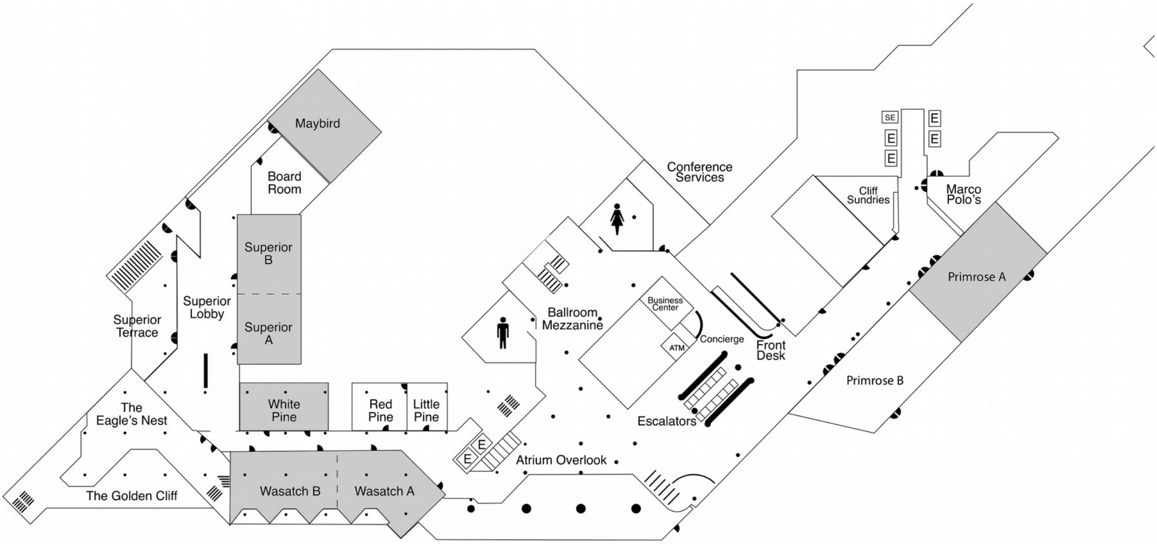
Coffee breaks during morning and afternoon sessions

Snowbird wi-fi

SSID:	Cosyne
Password:	snowbird16

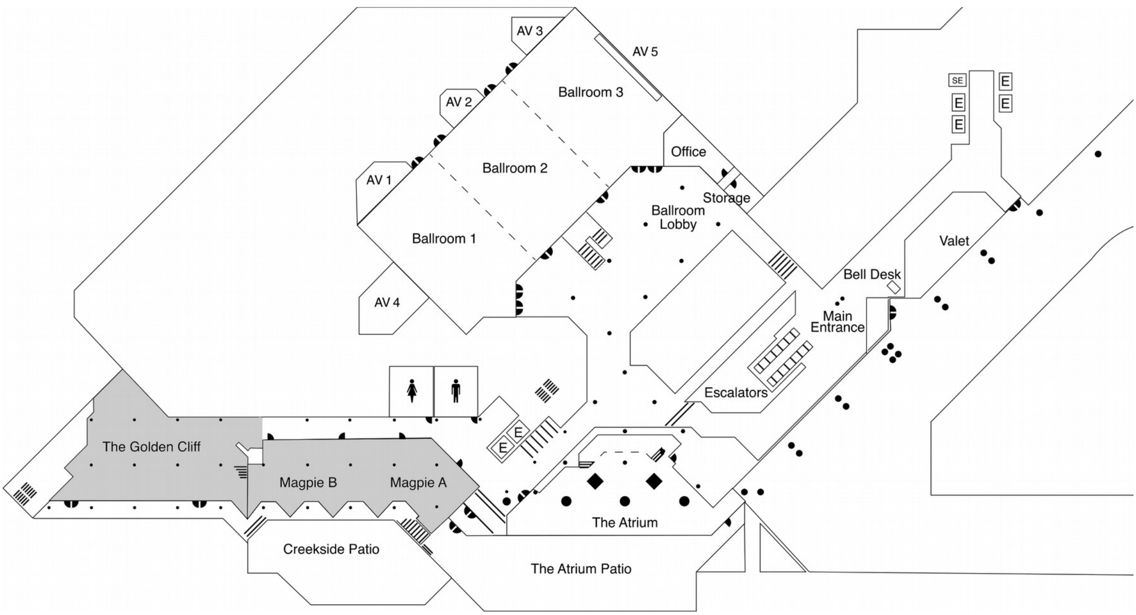
The Cliff Lodge – Level C (Upstairs)

Wasatch (A+B), Superior A, Superior B, Maybird, White Pine, Primrose A



The Cliff Lodge – Level B (Downstairs)

Golden Cliff, Magpie A, Magpie B



1.1 Am I attending the right workshop? Certainty and confidence in decision-making – Day 1

Monday, February 29, 2016

Organizers:

Megan Peters, Ruben Coen-Cagli, Jan Drugowitsch

The state and structure of the world are often noisy and ambiguous, making us doubt about the appropriate course of action. Making the right decision involves evaluating the probability of several possible scenarios and outcomes. Such probabilistic inference requires representing uncertainty about the sensory and cognitive variables of interest, and leads to choices, thoughts, and actions that are endowed with a sense of confidence. Even though a large body of recent work has focused on certainty and confidence, there is still little agreement on what these terms exactly refer to, and how they should be measured and investigated.

Furthermore, despite a growing body of evidence that human and animal decision-makers are efficient at handling uncertainty – such that uncertainty needs to be an integral component of neural processes – some fundamental questions remain unanswered. Do humans and animals deal with uncertainty in the best possible way, and if not, why do they deviate from optimality? What is the relation between neural representations of uncertainty, decisions, and decision confidence? Is there a single or multiple loci of representation of these quantities?

The workshop will bring together speakers from across disciplines to address these open questions. It highlights issues of definition and representation in the first day, and uses of certainty and confidence and their optimality on the second day.

Day 1, organized by Jan Drugowitsch and Ruben Coen-Cagli

The aim of this session is to accomplish a more coherent view on certainty and confidence in decision making, as well as to discuss future experimental directions, modeling challenges, and open questions. Topics range from existing approaches to study certainty and confidence from a normative perspective, together with well-defined theoretical frameworks, over behavioral evidence for certainty and confidence in the context of such frameworks, to experimental findings on putative neural correlates of either concept. Furthermore, probabilistic computation for complex real-life tasks outside of the laboratory will be presented from the machine learning perspective.

1.1 Am I attending the right workshop? Certainty and confidence in decision-making – Day 1

Wasatch

Morning session

8.20–8.25a	Introduction
8.25–9.00a	*Alexandre Pouget,* Confidence and certainty: distinct probabilistic quantities for different goals
9.00–9.35a	*Roozbeh Kiani,* The role of perceptual certainty in adaptive regulation of behavior
9.35–9.50a	Coffee break
9.50–10.25a	*Sophie Deneve,* Circular inference, psychosis and the excitatory/inhibitory balance
10.25–11.00a	*Alan Yuille,* The need for uncertainty

Afternoon session

4.10–4.45p	*Fanny Cazettes,* Representation of sensory reliability in the sound localization system of the owl
4.45–5.20p	
5.20–5.55p	*Cristina Savin,* Neural representations of uncertainty: the right tool for the right job
5.55–6.15p	Coffee break
6.15–6.50p	*Jan Drugowitsch,* The role of confidence in learning optimal decisions
6.50–7.25p	*Adam Kepecs,* Signatures of statistical decision confidence in subjective behavioral reports and neural activity

1.2 Recurrent spiking neural networks - dynamics, learning, computation

Monday, February 29, 2016

Organizers:

Brian DePasquale, Omri Barak, Ben Dongsung Huh, Raoul-Martin Memmesheimer

Recurrent neural networks (RNNs) are powerful models for understanding and modeling computation and representation in populations of connected neurons. Continuous variable or “firing-rate” type models have been trained to perform many behavioral tasks from systems neuroscience by only specifying input-output relations. The activity of the resulting networks can be compared to that measured in experiments and thus provides a window into information processing and dynamic computation in the brain. Recurrent spiking networks are an important step toward biological realism and general methods for constructing spiking models that perform behavioral tasks have recently been developed. While there has been progress understanding the dynamic and computational properties of such networks, much remains to be explained, especially in the case of spiking networks.

Our workshop seeks to integrate recent advances in understanding dynamics in both continuous variable and spiking RNNs and their relationship to learning and computation in these systems. The workshop will focus on the fundamental concepts of each study without being overly technical. It will use interactive discussions to better understand how these concepts relate to one another. The emphasis of the workshop will be on spiking networks, but relevant results from rate networks will also be discussed. We hope that at the conclusion of the workshop, a more holistic and unified perspective on the successes and future directions of RNN research in both experimental and theoretical neuroscience will emerge.

1.2 Recurrent spiking neural networks - dynamics, learning, computation

Golden Cliff

Each talk is followed by 15min discussion

Morning session	Moderators: Brian DePasquale and Raoul-Martin Memmesheimer
8.00–8.10a	Organizers, Introduction
8.10–8.25a	*Christian Machens,* Learning to represent signals spike by spike
8.40–8.55a	*Sophie Denève,* Spike coding balanced networks
9.10–9.25a	*Raoul-Martin Memmesheimer,* Learning versatile computations with recurrent spiking neural networks
9.40–10.00a	Coffee break
10.00–10.15a	*Ben Dongsung Huh,* Learning slow timescale dynamics with spiking networks vs rate networks
10.30–10.45a	*Brian DePasquale,* Using firing-rate dynamics to train recurrent spiking neural networks
11.00–11.30a	Morning session recap and discussion
Afternoon session	Moderators: Omri Barak and Ben Dongsung Huh
4.00–4.15p	*David Hansel,* On spikes, rates and chaos
4.30–4.45p	*Merav Stern,* Multiple fluctuation timescales in partially structured networks
5.00–5.15p	*Srdjan Ostojic,* From spiking to rate networks, and back: dynamics and learning
5.30–6.00p	Coffee break
6.00–6.15p	*Xiao-Jing Wang,* Excitatory-inhibitory recurrent neural networks for cognitive tasks: A simple and flexible framework
6.30–6.45p	*Jochen Triesch,* Self-organization and learning in recurrent spiking neural networks
7.00–7.15p	*Omri Barak,* Local dynamics in trained recurrent neural networks
7.30–8.00p	Workshop conclusions

1.3 Biophysical principles of brain oscillations and their meaning for information processing—Day 1

Monday, February 29, 2016

http://klab.tch.harvard.edu/academia/conferences/Cosyne_Workshop_2016.html

Organizers:

Costas Anastassiou, Gabriel Kreiman, Stephanie Jones

Oscillatory activities such as theta (~4-8 Hz), alpha (~7-14Hz), beta (~12-30 Hz) or gamma (~30–80 Hz) have been hypothesized to coordinate neural functioning within and across brain areas. Flexible cooperation among local and distant cell assemblies is thought to underlie the efficacy of cortical performance and, as such, is an essential ingredient of cognition. What are the underlying neural mechanisms supporting such oscillations and how do these mechanisms dictate characteristics of rhythmic activity? How do rhythms manifest in terms of recorded signals and associated time series? How are the rhythms correlated with behavior and are they causally important? More specifically, oscillations are typically monitored via extracellular voltage (Ve) recordings (either from an individual location or from multiple locations). Understanding the link between sub-cellular, cellular and circuit dynamics giving rise to Ve-signals expressing such oscillations is paramount towards understanding how the biophysics underlying rhythms ultimately impact behavior. In this workshop we seek to address how the brain elicits oscillations at the cellular and circuit level, how these mechanisms translate to recorded signals, and how such oscillations give rise to high-level functioning.

This topic is very timely as in the last decade or so new technologies such as high-density silicon probes and 2-photon imaging have allowed concurrent monitoring of hundreds or even thousands of neurons in living and behaving animals. As such, we have entered an era where mechanisms of communication within and across brain areas can be interrogated at their cellular level – oscillations and rhythmic activity are a primary candidate for obtaining such network communication. Based on the aforementioned our goal is to organize a workshop bringing together worldwide experts to discuss the origin and function of oscillations given the newest findings and technologies. To the best of our knowledge, there has been no COSYNE-workshop in the past dealing with this subject and, thus, we expect a large audience. Furthermore, we strived to invite speakers of different backgrounds (theoretical, computational and experimental) whose research interests cover a range of scales (micro, meso and macro) and levels of description (bottom-up, top-down, etc.) We firmly believe that this workshop will be an important contribution and of interest to participants of a range of backgrounds interested to find out about brain oscillations and associated signals but also mechanisms of communication useful to the brain, in general.

1.3 Biophysical principles of brain oscillations and their meaning for information processing—Day 1

Maybird

Morning session	**Biophysics and computational models of neural rhythms**
8.00–8.45a	*William Stanely Anderson,* Modeling techniques for studies of brain oscillations
8.45–9.30a	*Gaute Einevoll,* What can the local field potential (LFP) tell us about the cortical network activity?
9.30–10.15a	*Stephanie Jones,* Biophysically principled computational modeling of human MEG/EEG signals reveals novel mechanisms of neocortical rhythms and their meaning for function
10.15–11.00a	*Matthew Larkrum,* TBD

Afternoon session	**Role of oscillations in intra and inter area communication**
4.30–5.15p	*Daniel Gibson,* Brief beta bursts abounding in behaving brain
5.15–6.00p	*Miles Whittington,* Spike 'replay' during gamma rhythms in models of wake and NREM sleep: A role for GABA(B) receptor-mediated synaptic plasticity
6.00–6.45p	*Xiao-Jing Wang,* Layer-specific and frequency-dependent feedforward vs feedback signaling in a large-scale model of monkey cortex
6.45–7.30p	Panel discussion

1.4 Sloppy models in systems neuroscience

Monday, February 29, 2016

Organizer: Timothy O'Leary

A central theme in systems neuroscience is finding a way to sensibly analyze and model large, complex datasets that describe neural activity. The models that are appropriate for capturing the dynamics of such data often have many parameters. Sloppiness is an analytic property of multiparameter systems that simultaneously accounts for flexible and reproducible behavior of biological systems as well as the difficulty of identifying system parameters, and has become a central principle in systems biology. Remarkably, the neuroscience community is largely unaware of the concept of sloppiness even though it has important implications for modeling and data analysis in systems neuroscience. Nonetheless, some researchers have already exploited and studied sloppiness in various neural systems. This workshop brings together systems neuroscientists and theorists that span the theme of sloppy models from the foundational theory, to models of specific neural circuits and systems, to cutting edge experimental findings that will likely benefit from the sloppy model perspective.

What is sloppiness? Briefly, sloppiness means that the sensitivity of a system to changes in its underlying parameters is large in relatively few directions in parameter space. Moreover, the directions usually have components from many of the parameters. For example, the output of a large neural circuit might be highly sensitive to specific combinations of changes in multiple synaptic strengths, yet relatively insensitive to other combinations. The sensitive combinations are called ‘stiff’ and the less sensitive directions (that make up the majority of directions) are called ‘sloppy’. Since systems neuroscience is concerned with understanding how a system as a whole behaves in terms of experimentally accessible parameters, such as single-unit firing rates or synaptic connectivity, sloppiness is of critical relevance and importance to this field, and of interest to experimentalists as well as theorists.

1.4 Sloppy models in systems neuroscience

Superior A

Morning session

8:00–8:05a	Introduction
8:05–8:45a	*Ben Machta,* Fundamental theory and principles of sloppiness
8:45–9:30a	*Jacob Davidson,* Determining the robust and sloppy features of a neural integrator circuit's connectivity matrix
9:30–10:15a	*Dagmara Panas,* Variability and constraints in spontaneous neuronal network remodeling
10:15–11:00a	*Nathalie Rochefort,* Behavioral state modulation of inhibitory circuit activity is context-dependent in mouse primary visual cortex

Afternoon/evening session

4:30–5:15p	*Florian Engert,* Distributed neural architectures for binocular visuomotor transformations in the larval zebrafish
5:15–6:00p	*Christopher Harvey,* Variability in parietal cortex activity dynamics during navigation-based decision tasks"
6:00–6:45p	*Dhruva Raman,* Nonlocal Properties of Model Structure, Sloppiness, Unidentifiability, and their Detection
6:45–7:30p	*Timothy O'Leary,* The sloppy regulation hypothesis
7:30–8:00p	Discussion & conclusion

1.5 Sensorimotor learning through multi-dimensional spaces

Monday, February 29, 2016

Organizers:
Matt Golub, Alan Degenhart

Sensorimotor learning involves a suite of complex processes coordinated across the sensory and motor systems. Traditionally, progress toward understanding these processes has been made by analyzing single-neuron recordings and low-dimensional behavioral measurements. However, in order to gain insight into structure-based and network-level mechanisms, it may be essential to study learning at the level of multi-dimensional spaces to reveal information which may not be identifiable at the lower-dimensional level. To this end, researchers have begun to utilize multi-dimensional approaches, including large-scale recordings of neural, muscle, and behavioral activity, to enable discoveries about learning and the brain. Identifying the relationships, if any, between these different multi-dimensional spaces and approaches may greatly aid our understanding of the intricacies of sensorimotor learning.

In this workshop, we seek to bring together experimentalists and theorists interested in the study of sensorimotor learning from multi-dimensional perspectives. We will discuss new approaches for studying learning which leverage recent advances in recording technologies and computational techniques. What relationships can we identify between the multi-dimensional spaces of neurons, muscles, and behaviors? What elements of learning that have been difficult to study in the past might now become accessible? Finally, what are the limitations we have yet to overcome? The workshop format will consist of presentations by invited speakers, followed by a panel discussion during which speakers will attempt to identify and address some of the key challenges to the field.

1.5 Sensorimotor learning through multi-dimensional spaces

Magpie B

Morning session

8.00–8.05a	Opening remarks
8.05–8.45a	*Shaul Druckmann,* Dimension specific computation: coding and non-coding spaces in cortical preparatory activity.
8.45–9:25a	*Matt Golub,* Population-level changes in neural activity during learning.
9.25–9.40a	Coffee break
9.40–10.20a	*Samuel Sober,* Nonlinear Bayesian computations for vocal learning.
10.20–11.00a	*Nicholas Hatsopoulos,* Emergence of functional connectivity in motor cortical ensembles during long-term exposure to a brain-machine interface.

Afternoon session

4.30–5.10p	*Takaki Komiyama,* Motor cortex dynamics during motor learning.
5.10–5.50p	*Robert Scheidt,* Facilitation and interference during learning of multi-dimensional motor skills.
5.50–6.20p	Coffee break
6.20–7.00p	*Jose Carmena,* Large-scale neural circuit dynamics during neuroprosthetic skill learning.
7.00–7.30p	Panel discussion and closing remarks

1.6 Neural bases of executive flexibility

Monday, February 29, 2016

Organizers:
Tim Buschman, R Becket Ebitz

Executive flexibility is our ability to make different responses to the same stimulus depending on the situation or task demands. This allows us to act intelligently in complex and dynamic environments. Recent advances in large scale neuronal recording and data analytic techniques have yielded new insights into the neural bases of executive flexibility, highlighting how control processes flexibly route incoming information into a response.

Executive flexibility has historically been studied separately in many different domains of systems and cognitive neuroscience – by researchers and theorists who are interested in how conflicts are resolved in sensory processing or action selection or how the brain flexibly switches between task sets. Critically, traditional divisions between domains have hindered a holistic view of executive flexibility as a distributed, dynamic process that necessarily affects each level of the sensorimotor transformation.

Here, we propose to bring together theorists and researchers interested in flexibility at many levels. Our goal is to overcome historical divisions and begin to develop a unified view of the fundamental neural motifs that underlie executive flexibility. Our speaker list includes a mixture of first and last authors in order to foster an open forum for conversation and encourage novel perspectives and synthesis. Although many speakers will focus on the potential (and challenge) of large-scale population recordings for understanding executive flexibility, we anticipate that this workshop will be of general interest to anyone interested in how the brain might flexibly map stimuli to responses.

1.6 Neural bases of executive flexibility

White Pine

Each talk is 25 minutes long, followed by 10-15 minutes for discussion.

Morning session

8.05–8.40a	*Doug Ruff,* Multiarea approaches to studying attention
8.45–9.20a	*Tatiana Engel,* Selective modulation of cortical state during spatial attention
9.25–9.40a	Coffee break
9.40–10.15a	*Stefano Fusi,* Weird neurons for flexible representations
10.20–10.55a	*Tim Buschman,* Flexible networks through synchronous oscillations

Afternoon session

4.30–5.05p	*Athena Akrami,* Contextual working memory - how trial history interacts with sensory memory
5.10–5.45p	*Mark Stokes,* Neural dynamics of in prefrontal cortex for working memory
5.50–6.10p	Coffee break
6.10–6.45p	*Jon Wallis,* What is the role of prefrontal cortex in working memory?
6.50–7.25p	*Matt Chafee,* Synaptic interactions and circuit dynamics for executive control – toward a primate model of human neuropsychiatric disease

1.7 Computational models of cognitive, social, and affective processing

Monday, February 29, 2016

Organizers:

Sonia Bishop, Annie Collins

Computational approaches are widely used to study different aspects of cognitive function – from associative learning and decision-making to attention and working memory. However the fields of social and affective science have been slower to adopt computational approaches, particularly with regards to work in human subjects. Over the last few years this has begun to change, with potentially exciting consequences for our understanding of the mechanisms underlying social and affective behaviours, and their disruption in various disease states.

The aim of this workshop is to illustrate how computational models of cognitive processing can be extended or adapted to investigate the mechanisms underlying social and affective information processing. Specifically, we profile recent work by members of the community using computational models of associative learning, working memory, decision-making, and spatial navigation to address novel questions pertaining to affective and social processing. In addition, we highlight how findings from these studies can inform us about (i) healthy function, (ii) altered function in different disease states and (iii) changes in function across development.

We believe that the topic addressed by this workshop is an important one as computational approaches have only very recently begun to be applied to questions of affective and social processing in humans. This not only offers to bring a new level of rigor to these areas of investigation but has important potential societal and clinical implication as well. The workshop will provide an opportunity to bring together graduate, postdoctoral and faculty members within the field of computational neuroscience who are interested in applying computational approaches to address the mechanisms underlying affective and social processing. The workshop will be split into morning and afternoon sessions with time being set aside for discussion aimed at integrating findings and theoretical perspectives across typically distinct areas of investigation (e.g. social and spatial navigation; impaired learning about aversive outcomes in anxiety and risk-taking in adolescence).

1.7 Computational models of cognitive, social, and affective processing

Superior B

Morning session

8.00–8.05a	*Sonia Bishop*, Introduction
8.05–8.35a	*Ifat Levy,* Processing of uncertainty in adolescence, aging and mental illness.
8.35–9.05a	*Sonia Bishop,* Learning to avoid aversive outcomes: trait anxiety and impoverished use of environmental volatility
9.05–9.30a	Coffee break
9.30–10.00a	*Eran Eldar,* The interaction between mood and learning: function and dysfunction
10.00–10.30a	*Claire Gillan,* Compulsivity is a trans-diagnostic trait characterized by deficits in model-based reinforcement learning
10.30–11.00a	Discussion

Afternoon session

4.00–4.05p	*Anne Collins,* Introduction
4.05–4.35p	*Angela Yu,* A rational inference, learning, and decision-making model of inhibitory control in healthy behaviour and stimulant abuse.
4.35–5.05p	*Anne Collins,* Interactions between executive functions and reinforcement learning in healthy adults and patients with Schizophrenia.
5.05–5.30p	Coffee break
5.30–6.00p	*Howard Eichenbaum,* Cognitive maps of memory space
6.00–6.30p	*Daniela Schiller,* A hippocampal map for social navigation
6.30–7.00p	Discussion

1.8 The avian brain as a guide to hierarchical temporal structures

Monday, February 29, 2016

Organizers:

Nirag Kadakia, Arij Daou

Many important goal-directed complex behaviors, such as driving a car or playing the piano, are composed of sequence of actions that are executed with high precision. These actions originate in the neuronal control elements that encode temporally precise behavioral sequences, often doing so via remarkably elegant and robust dynamics.

Songbirds, such as zebra finches, are ideal model organisms to study neuronal representations exhibiting temporal codes and sequence generation; the motor sequence that controls the birdsong is one of the most precisely time-locked temporal sequences known to-date in nature. These temporal sequences are reflected in brief songbird vocalizations; they are highly stereotypical, robust, and temporally precise, and often consist of indivisible sub-units comprising larger sequences. Different parts of the brain may control different timescales of the behavior, in a hierarchical fashion, and it is of broad interest in neural modeling and physiology how neural circuitry can produce such behavior that is both temporally precise and modular, important first steps in understanding the development of communication and language in more sophisticated organisms. Recent insights into the connectomes of the avian vocal control centers, the acoustical structure of these sequences, and the role of auditory feedback give strong clues into how hierarchical temporal sequences can be robustly produced by neural circuits.

The workshop aims to bring together computational neuroscientists and neurophysiologists who are interested in bridging the gap between behavioral aspects—here we emphasis vocalization, but also including other sensory input, motor commands, etc.—and network activity. The songbird provides an ideal template for doing so.

1.8 The avian brain as a guide to hierarchical temporal structures

Magpie A

Morning session

8.00–8.15a	*Nirag Kadakia, Arij Daou,* Opening remarks
8.15–9.05a	*Todd Troyer,* Relationships between syllable features, timing and sequences in Bengalese finch song: Implications for motor coding
9.05–9.55a	*Dezhe Jin,* The syntax of birdsong and its neural mechanism
9.55–10.10a	Coffee break
10.10–11.00a	*Tim Gentner,* Machine learning approaches to understanding complex acoustic signals and neural responses

Afternoon session

4.30–5.20p	*Rich Mooney,* Distributed networks for vocal timing
5.20–6.00p	*Arij Daou,* Intrinsic plasticity 'set point', network stability, and sensory feedback processing as an early error detection mechanism in the HVC of Zebra finches
6.00–6.15p	Coffee break
6.15–7.05p	*Nirag Kadakia,* Data assimilation for nonlinear parameter estimation in multiple-timescale neurons
7.05–7.15p	*Nirag Kadakia, Arij Daou,* Closing remarks

1.9 Dimensionality reduction for the analysis and interpretation of high-dimensional neural datasets

Monday, February 29, 2016

Organizers:

Mikio Aoi, Adam Charles, Jonathan Pillow

A critical step for understanding the increasingly large and complex sets of neural measurements made possible by recent advances in neural recording technology is to find meaningful and tractable methods for reducing dimensionality. Dimensionality reduction methods are increasingly crucial both for determining the degrees of freedom guiding neural activityand behavior, and for producing efficient algorithms that can summarize the data into more easily analyzable forms. In order to demonstrate the central role that dimensionality reduction has played and will continue to play in neural data analysis, we propose a workshop to discuss the mathematical and algorithmic advances in dimensionality reduction as well as the breadth of applications where such techniques have been used. Key questions we aim to address include:

• What are the best methods for finding low-dimensional structure in high-dimensional data?

• How can dimensionality-reduction algorithms be made computationally tractable for scaling to big datasets?

• What is the relationship between dimensionality reduction and latent dynamical models?

• How might large neural populations leverage the low-dimensionality of the information they transmit? What areas of the brain exhibit such behavior?

• Can low dimensional models be leveraged to create more effective experimental procedures or measurement devices?

1.9 Dimensionality reduction for the analysis and interpretation of high-dimensional neural datasets

Primrose A

Morning session	Moderator: Adam Charles
8.00–8.30a	*Byron Yu,* Dimensionality reduction of neural population activity during sensorimotor control
8.30–9.00a	*Bingni Wen Brunton,* Extracting spatio-temporal coherent structures with dynamic mode decomposition
9.00–9.30a	Coffee break
9.30–10.00a	*Mikio Aoi,* Interpreting population responses with Bayesian targeted subspace selection
10.00–10.30a	*Christopher Rozell,* Exploiting the low-dimensional structure of dynamical system attractors
10.30–11.00a	*Anne Churchland,* TBA
Afternoon session	Moderator: Mikio Aoi
4.30–5.00p	*Joshua Glaser,* TBA
5.00–5.30p	*Christian Machens,* Demixed PCA, new and improved, with some applications
5.30–6.00p	Coffee break
6.00–6.30p	*Tatyana Sharpee,* Dimensionality reduction for natural stimuli
6.30–7.00p	*Maneesh Sahani,* TBA
7.00–7.30p	*John Cunningham,* Statistical testing for structured neural population recordings

2.1 Am I attending the right workshop? Certainty and confidence in decision-making – Day 2

Tuesday, March 01, 2016

Organizers

Megan Peters, Ruben Coen-Cagli, Jan Drugowitsch

The state and structure of the world are often noisy and ambiguous, making us doubt about the appropriate course of action. Making the right decision involves evaluating the probability of several possible scenarios and outcomes. Such probabilistic inference requires representing uncertainty about the sensory and cognitive variables of interest, and leads to choices, thoughts, and actions that are endowed with a sense of confidence. Even though a large body of recent work has focused on certainty and confidence, there is still little agreement on what these terms exactly refer to, and how they should be measured and investigated.

Furthermore, despite a growing body of evidence that human and animal decision-makers are efficient at handling uncertainty – such that uncertainty needs to be an integral component of neural processes – some fundamental questions remain unanswered. Do humans and animals deal with uncertainty in the best possible way, and if not, why do they deviate from optimality? What is the relation between neural representations of uncertainty, decisions, and decision confidence? Is there a single or multiple loci of representation of these quantities?

The workshop will bring together speakers from across disciplines to address these open questions. It highlights issues of definition and representation in the first day, and uses of certainty and confidence and their optimality on the second day.

Day 2, organized by Megan Peters

The aim of this session is to evaluate evidence for whether and how certainty and confidence are computed and used optimally versus when heuristic strategies may better describe behavior. As will be comprehensively explored in Day 1, many normative (i.e., Bayesian) models of perceptual decision-making rest on the assumption that the brain represents incoming evidence in a probabilistic manner, judging both the perceptual decision and confidence on the basis of these representations. However, recent behavioral evidence suggests that this may not always be the case, with ongoing debate as to whether confidence and perceptual decision depend on the same or different neuronal information. Furthermore, evidence for a single versus multiple loci of uncertainty representation remains equivocal. Talks on this day will present these and other similar issues concerning optimality and neural loci of certainty and confidence.

2.1 Am I attending the right workshop? Certainty and confidence in decision-making – Day 2

Wasatch

Morning session	**Circuit interactions across states and behaviors**
8.20–8.25a	Introduction
8.25–9.00a	*Saleem Nicola,* Proximity biases choice: how control of the vigor of rewarded approach by the nucleus accumbens might contribute to optimal foraging
9.00–9.35a	*Marc Sommer,* Neural activity in primate frontal cortex related to the monitoring and control of decisions
9.35–9.50a	Coffee break
9.50–10.25a	*Angela Yu,* Mismatched decision confidence and accuracy: Does it matter?
10.25–11.00a	*Ariel Zylberberg,* Probing the mechanisms of confidence with stochastic stimuli

Afternoon session	**Modulating neural circuits during behavior**
4.30–5.05p	*Megan Peters,* Separable calculations underlie decisions and confidence judgments
5.05–5.40p	*Florent Meyniel,* A normative account of the sense of confidence during probabilistic learning
5.40–5.55p	Coffee break
5.55–6.30p	*Wei Ji Ma,* Quantitative modeling of explicit confidence ratings
6.30–7.05p	TBA
7.05–7.30p	Discussion

2.2 Timescales of dynamics in neuronal networks

Tuesday, March 01, 2016

Organizers:

Athena Akrami, Ahmed El Hady

Systems neuroscience concerns itself with understanding the mechanisms by which cognitive functions emerge from coordinated neuronal activities. The complexity of neuronal dynamics poses a challenge to dissecting the emergence of cognitie functions at different levels of brain organization. Neuronal dynamics show structured fluctuations at many spatiotemporal scales, with seemingly nontrivial contributions from distinct underlying mechanisms. Of particular importance is that neurons show a wide range of timescales in response to stimulations so that different parts of a network respond with disparate temporal dynamics. Such diversity is observed both when comparing timescales across brain areas and among cells within local populations. Little is known about the mechanisms by which neuronal networks are capable of producing such diverse temporal dynamics, and consequently the way in which such dynamics is recruited into various behaviors. Recently, there has been a burgeoning interest in the timescales of neurl dynamics motivating the need for a focused workshop that gathers experimental and theoretical neuroscientists, across multiple sub-disciplines. The workshop will address the following questions:

1. How differential dynamics can be manifested in the timescales of fluctuations in single neuron spiking activity.

2. How timescales, from milliseconds to several seconds, can emerge mechanistically from single cells and populations of neurons.

3. How neuronal activities are shaped on multiple timescales producing temporally multiplexed codes

4. How the brain processes and adapts to the temporal statistics of the environment

5. How neuronal subpopulations with distinct set of short or long timescales can be selectively recruited according to the behavioural demands.

This workshop will bring together a number of experimental and theoretical neuroscientists who are actively working on exploring different aspects of neuronal temporal dynamics. Our aim is to integrate theoretical and experimental, human and non-human studies across different level of brain organization, in order to understand the functional significance of temporal dynamics in neuronal populations.

2.2 Timescales of dynamics in neuronal networks

Golden Cliff

Morning session

8.00–8.05a	*Ahmed El Hady, Athena Akrami,* Introduction
8.05–8.35a	*Omri Barak,* Marginal stability and dynamic timescales in single neuron excitability.
8.35–9.05a	*Uri Hasson,* Topographic mapping of a hierarchy of temporal receptive windows
9.05–9.35a	*Xiao-Jing Wang,* Local versus global reservoirs of neuronal operation timescales
9.35–10.00a	Coffee break
10.00–10.30a	
10.30–11.00a	*Biyu Jade He,* Multiple time scales in arrhythmic brain activity and the implications for natural stimuli processing

Afternoon session

4.00–4.30p	*Ben Scott,* Dynamics of sensory memory during perceptual decision-making
4.30–5.00p	*Dimitris Pinotsis,* What can neural rhythms tell us about brain function
5.00–5.30p	*Brent Doiron,* The space and time of neuronal variability in balanced cortical circuits
5.30–6.00p	Coffee break
6.00–6.30p	*Stefano Fusi,* The computational role of multiple timescales in memory systems
6.30–7.00p	*Jeff Hawkins,* How pyramidal neurons can learn variable order sequences across multiple timescales
7.00–7.30p	Discussion

2.3 Biophysical principles of brain oscillations and their meaning for information processing — Day 2

Tuesday, March 01, 2016

http://klab.tch.harvard.edu/academia/conferences/Cosyne_Workshop_2016.html

Organizers:

Costas Anastassiou, Gabriel Kreiman, Stephanie Jones

Oscillatory activities such as theta (~4-8 Hz), alpha (~7-14Hz), beta (~12-30 Hz) or gamma (~30–80 Hz) have been hypothesized to coordinate neural functioning within and across brain areas. Flexible cooperation among local and distant cell assemblies is thought to underlie the efficacy of cortical performance and, as such, is an essential ingredient of cognition. What are the underlying neural mechanisms supporting such oscillations and how do these mechanisms dictate characteristics of rhythmic activity? How do rhythms manifest in terms of recorded signals and associated time series? How are the rhythms correlated with behavior and are they causally important? More specifically, oscillations are typically monitored via extracellular voltage (Ve) recordings (either from an individual location or from multiple locations). Understanding the link between sub-cellular, cellular and circuit dynamics giving rise to Ve-signals expressing such oscillations is paramount towards understanding how the biophysics underlying rhythms ultimately impact behavior. In this workshop we seek to address how the brain elicits oscillations at the cellular and circuit level, how these mechanisms translate to recorded signals, and how such oscillations give rise to high-level functioning.

This topic is very timely as in the last decade or so new technologies such as high-density silicon probes and 2-photon imaging have allowed concurrent monitoring of hundreds or even thousands of neurons in living and behaving animals. As such, we have entered an era where mechanisms of communication within and across brain areas can be interrogated at their cellular level – oscillations and rhythmic activity are a primary candidate for obtaining such network communication. Based on the aforementioned our goal is to organize a workshop bringing together worldwide experts to discuss the origin and function of oscillations given the newest findings and technologies. To the best of our knowledge, there has been no COSYNE-workshop in the past dealing with this subject and, thus, we expect a large audience. Furthermore, we strived to invite speakers of different backgrounds (theoretical, computational and experimental) whose research interests cover a range of scales (micro, meso and macro) and levels of description (bottom-up, top-down, etc.) We firmly believe that this workshop will be an important contribution and of interest to participants of a range of backgrounds interested to find out about brain oscillations and associated signals but also mechanisms of communication useful to the brain, in general.

2.3 Biophysical principles of brain oscillations and their meaning for information processing — Day 2

Maybird

Morning session	**Neural rhythms and cognition**
8.00–8.45a	*Tim Buschman,* Neural dynamics of cognitive control
8.45–9.30a	*Lucia Melloni,* Perceptual inference and neural oscillations: Predicting ‘what’ and ‘when’
9.30–10.15a	*Bijan Pesaran,* Functional inhibition gates eye-hand coordination
10.15–11.00a	*Gabriel Kreiman,* Neural rhythms underlying interactions during flexible rule learning

Afternoon session	**Causal roles of neural rhythms**
4.30–5.15p	*Laura Colgin,* Spatial sequence coding differs during slow and fast gamma rhythms in the hippocampus
5.15–6.00p	*Costas Anastassiou,* Signals, systems, psyche
6.00–6.45p	*Josh Siegle,* Optogenetic control of rhythmic spike patterns in hippocampus and cortex
6.45–7.30p	Panel discussion

2.4 Form and function of choice-related feedback signals in decision making

Tuesday, March 01, 2016

Organizer:
Alan Stocker

Making decisions is a core responsibility of biological brains. It is an elaborate process in a world where there are many options and plenty of uncertainty. How such decisions are formed through the integration and evaluation of uncertain (sensory) evidence has been well studied. Yet in most of these studies decisions are considered the result of an independent feedforward process that ends when the decision is reached. Recent physiological experiments, however, have revealed that decision signals are fed back and modulate neural responses in early sensory areas of the brain. Similarly, recent psychophysical studies have shown that preceding decision outcomes can affect the formation of a subject's current perceptual decision. These results suggest that choice-related feedback signals may play an important role in the decision making process.

The goal of the workshop is to establish progress in our understanding of the role of these feedback signals. A select group of experimental and theoretical neuroscientists using a wide range of different approaches will share their latest results, with the hope that through the discussion in the workshop new ideas and hypotheses about the purpose of choice-related feedback signals in decision making will emerge.

The workshop addresses a timely topic and will be of interest to a broad audience of systems neuroscientists including people who are interested in a holistic view of decision making, neuroscientists with a general interest in the relationship between neural activity and behavior, and more theoretically minded neuroscientists that are interested in the computational functions of the brain.

2.4 Form and function of choice-related feedback signals in decision making

Superior A

Morning session

8.30–8.45a	Introduction
8.50–9.20a	*Hendrikje Nienborg,* Using serial dependencies in neural activity and behavior to explore choice-related top down signals in V2
9.30–10.00a	*Rich Krauzlis,* Interactions between cortical and subcortical signals
10.10–10.40a	Coffee break
10.40–11.10a	*Robbe Goris,* Dissociation between choice formation and choice-related activity in macaque visual cortex

Afternoon session

4.30–5.00p	*Ralf Haefner,* The role and effect of top-down signals in a probabilistic inference framework
5.10–5.40p	*Tobias Donner,* Decision-related arousal shapes cortical state and choice behavior
5.50–6.10p	Coffee break
6.10–6.40p	*Noam Brezis,* Decisions reduce sensitivity to subsequent information
6.50–7.20p	*Alan Stocker,* Choice dependent perceptual biases
7.20p	Discussion

2.5 Recent innovations in attention research: Linking models, mechanisms, and behavior

Tuesday, March 01, 2016

Organizer:

Brian Odegaard

In the last decade, a tremendous amount of effort has been exerted to investigate attention using neurophysiological, computational, and behavioral paradigms. Recent research has increased knowledge about how attention is implemented in the brain by investigating the role of subcortical structures such as the superior colliculus and pulvinar, evaluating the relationship between fMRI bold signals and attentional states, and investigating the links between attention's modulation of single neuron recordings and behavioral performance. In addition to these efforts, a number of intriguing models have recently been formulated in an attempt to computationally characterize attention's role in visual perceptual processing, including the normalization model of attention, Bayesian models of attention, advanced saliency map models of attention, and others. Thus, the field finds itself at a critical juncture where researchers implementing different paradigms and investigative approaches must dialogue and collaborate to address important, outstanding questions on attention.

In this workshop, we aim to discuss (1) recent findings/ideas/motifs from both behavioral and computational investigations of attention, and (2) relevant neurophysiological findings to address the following questions, as well as others that may arise following presentations:

1. What are the mechanisms by which attention improves perception? Is it by increasing the signal to noise ratio in neuronal responses, changing decision thresholds by altering cortico-striatal connections, or both?

2. If normalization is a widespread computation in the brain, how far can we extend this modeling framework to account for attention?

3. If perceptual behavior varies due to suboptimal inference, where does attention exert its effects in the inference process?

4. Can current computational theories help us distinguish between existing theories of attention (i.e. limited resources vs. selection/different weighting)?

5. Do the mechanisms of attention revealed by simple visual paradigms generalize to how attention may operate in real-world settings and search tasks?

By addressing questions such as those listed above, we hope that participants emerge from this workshop with a more thorough understanding of what attention is, how it impacts neuronal computation in both cortical and subcortical regions, and how current questions about attention can be addressed by future experiments.

2.5 Recent innovations in attention research: Linking models, mechanisms, and behavior

Magpie B

Each talk is followed by 10min discussion

Morning session

8.00–8.15a	*Brian Odegaard,* Welcome and Introduction
8.15–8.35a	*Jacqueline Gottlieb,* Attention and decisions
8.45–9.05a	*Miguel Eckstein,* Spatial attention with synthetic cues and real scenes
9.15–9.30a	Coffee break
9.30–9.50a	*Marisa Carrasco,* How attention affects visual perception
10.00–10.20a	*Ruth Rosenholtz,* Attention: What have we learned by studying peripheral vision?
10.30–10.50a	*Douglas Ruff,* Multiarea approaches to studying attention

Afternoon session

4.30–4.50p	*Richard Krauzlis,* Subcortical mechanisms in spatial attention
5.00–5.20p	*James Bisley,* Revisiting the neural mechanism(s) of visual attention
5.30–5.50p	Coffee break
5:50–6.10p	*Michael Halassa,* Thalamic inhibition as a mechanism for attentional allocation
6.20–6.40p	*Mark Stokes,* Distinct control mechanisms for target facilitation and distractor inhibition
6.50–7.10p	*Michael Cohen,* Searching for object categories is linked to a widespread representational structure across higher-level visual cortex
7.20–7.30p	Final comments, Discussion

2.6 Toward the real world: Naturalistic experiments and analysis

Tuesday, March 01, 2016

Organizers:

Pat Lawlor, Josh Glaser

Neuroscientists ultimately aim to understand how the brain operates in natural conditions. This is becoming increasingly possible due to advances in technology (e.g. wireless recording and virtual reality). However, scientific progress is often made by making small changes in tightly controlled experiments. There is thus a tradeoff between complexity and interpretability of experimental designs.

This workshop will broadly address how neuroscientists are able to derive understanding from complex, naturalistic, experiments. The workshop will survey naturalistic work being done in multiple subdisciplines of neuroscience (vision, movement, audition, olfaction). It will discuss the technical and analysis challenges that have been (and still need to be) overcome. Lastly, the workshop will discuss the general question of when naturalistic experiments are useful, and when they are not. What should be the relationship between classical and naturalistic experiments?

This workshop will provide valuable information for a broad range of neuroscientists. Experimentalists will be interested by the discussion of new experiments and technology that enables these experiments. Computational neuroscientists will be interested by the discussion of techniques for analyzing complex data. Ultimately, it will bring together neuroscientists across many subdisciplines to discuss common approaches and challenges.

2.6 Toward the real world: Naturalistic experiments and analysis

White Pine

Each talk is followed by 10min discussion

Morning session

8.10–8.20a	Introduction
8.20–8.40a	*Corey Ziemba,* Titrating naturalness: linking physiology and perception with controlled naturalistic stimuli
8.50–9.10a	*Jay Gottfried,* The natural landscape of odors in the brain
9.20–9.40a	Coffee break
9.40–10.00a	*Pip Coen,* How analyzing natural behavior can reveal the computations underlying acoustic communication in Drosophila
10.10–10.30a	*Jenny Groh,* When N is greater than one: Multiplexing in the bsrain
10.40–11.00a	General Discussion

Afternoon session

4.30–4.50p	*Paul Nuyujukian*, Towards a freely moving model for motor systems neuroscience
5.00–5.20p	*Pavan Ramkumar,* On the computational complexity of movement sequence learning
5.30–6.00p	Coffee break
6.00–6.20p	*Jorn Diedrichsen*, From the natural statistics of movement to the structure of neural representations
6.30–6.50p	*Jack Gallant*, Why NOT to do naturalistic experiments: Problems and limitations of naturalistic experiments and how to address them
7.00–7.30p	General Discussion

2.7 Recent advances in activity-dependent plasticity

Tuesday, March 01, 2016

Organizers:
Robert C Froemke, Paul Munro

Since Hebb articulated his Neurophysiological Postulate in 1949 up to the present day, the relationships between synapse modification, neuronal activity, and behavioral changes have been the subject of enormous interest. Laboratory studies have revealed phenomena such as LTP, LTD, and STDP. Theoretical developments have both inspired studies and been inspired by them in an effort to reveal the biological principles that underlie learning and memory.

The intent of the workshop is to foster communication among researchers in this field. The workshop is intended to be of interest to experimentalists and modelers studying plasticity from the neurobiological level to the cognitive level. The workshop is targeted toward researchers in this area, aiming to bring together a 50/50 mix of experimental results and theoretical ideas, with a particular focus on studies that connect synaptic plasticity to changes in network dynamics and behavior.

2.7 Recent advances in activity-dependent plasticity

Superior B

Morning session

8.00–8.40a	*Blake Richards,* Sensory inputs and GABAergic signals promote both permissive and instructive plasticity in vivo
8.50–9.20a	*Gabriel Ocker,* Training and spontaneous reinforcement of Hebbian assemblies by spike timing
9.20–9.30a	Coffee break
9.30–10.10a	*Gul Dolen,* Social reward: basic mechanisms and autism pathogenesis
10.10–10.50a	*Bianca J Marlin,* Oxytocin, excitatory-inhibitory balance, and maternal behavior
10.50–11.30a	*Harel Shouval,* TBD

Afternoon session

4.30–5.10p	*Julijana Gjorgjieva,* Homeostatic activity-dependent tuning of recurrent networks for robust propagation of activity
5.10–5.50p	*Julie Haas,* Electrical synapse plasticity: a theme and variations
5.50–6.00p	Coffee break
6.00–6.40p	*Anthony Holtmaat,* Mechanisms for LTP in the mouse barrel cortex
6.40–7.20p	*Sandegh Nabavi,* Synaptic tagging and capture: from synapses to behavior

2.8 Computations of the dorsomedial prefrontal cortex

Tuesday, March 01, 2016

Organizer:

Joshua Brown

The dorsomedial prefrontal cortex, and especially the anterior cingulate cortex, has been the focus of many computational theories of cognitive control and decision-making, including reinforcement learning, cost/benefit analysis, conflict resolution, foraging, risk avoidance, and strategy selection. A number of new computational principles and models have been proposed to account for various empirical effects, but what is needed is (1) a conversation among existing computational proposals; (2) a discussion of how existing computational models might inform future experimentation; and (3) how current empirical results might constrain current computational theories.

A number of new empirical findings make this a timely topic. Recent EEG, fMRI, and animal studies have highlighted a theme of surprise signals as a significant unifying principle. At the same time, the theme of control signals has emerged as a principle by which dorsomedial prefrontal cortex drives reward seeking, effortful behavior, risk avoidance, foraging, and switching. To what extent can these varying perspectives be reconciled? Conversely, are there distinct functional and anatomical subregions that provide distinct cognitive functions? What are the computational mechanisms by which the different functions interact?

This one-day workshop will bring into conversation a variety of computational and empirical perspectives on the computational role of the dorsomedial prefrontal cortex, including studies of decision-making, cognitive control, and performance monitoring across multiple species, empirical methods including new opto- and chemo-genetic findings, and modeling perspectives. As such, the workshop will be of interest to those interested in higher cognition, decision-making, and cognitive control.

2.8 Computations of the dorsomedial prefrontal cortex

Magpie A

Morning session

8.00–8.05a	Welcome and introduction
8.05–8.30a	*Clay Holroyd,* Toward a unified model of anterior cingulate cortex function
8.30–8.55a	*Joshua Brown,* Hierarchical prediction errors in medial prefrontal cortex
8.55–9.10a	Discussion
9.10–9.40a	Coffee break
9.40–10.05a	*Etienne Koechlin,* Adaptive control in the medial and lateral prefrontal cortex
10.05–10.30a	*Jill O'Reilly,* Control of uncertainty in cortical representations by anterior cingulate cortex
10.30–11.00a	Discussion

Afternoon session

4.30–4.55p	*Jim Cavanagh,* Dissociated circuit motifs: multiple mechanisms for control
4.55–5.20p	*Ilana Witten,* A descending projection from the medial prefrontal cortex impacts and encodes social behavior
5.20–5.35p	Discussion
5.35–6.00p	Coffee break
6.00–6.25p	*Nils Kolling,* Neural signals in human foraging and dynamic choice
6.25–6.50p	*Mark Laubach,* Feeding, foraging, and the rostral medial frontal cortex
6.50–7.15p	*Jan Wessel,* A fronto-basal ganglia mechanism for the Suppression of behavior and cognition after surprising events
7.15–7.30p	Discussion

2.9 Coding, correlations, and the dimensionality of neural activity

Tuesday, March 01, 2016

Organizers:

Rainer Engelken, Gianluigi Mongillo, Fred Wolf

Sensory inputs and motor commands are encoded and processed by the coordinated activity of neuronal populations in the cortex. Over the last two decades, theories of population coding have provided a basic understanding of some underlying computational principles. In particular, they have identified the interplay between selectivity (heterogeneity) and the structure of the correlations as the main factor determining the representational power of distributed population codes. Population coding theories, however, are largely silent about the cellular and network mechanisms responsible for the generation of the selectivity and the correlations. More recently, considerable efforts have been devoted to the characterization of information-theoretical aspects of the microscopic dynamics of biologically-constrained network models operating e.g. in the balanced regime. Theory has been successful in relating key aspects of those dynamics - such as their dimensionality, the selectivity and the bandwidth of the network responses, the structure of the correlations – to single-cell properties and synaptic organization. Nevertheless, a full understanding of how these dynamic properties impact population coding is still missing.

The goal of this workshop is to make contact between computational aspects of population coding and the properties of the underlying microscopic network dynamics. We will bring together theoreticians and experimentalists to address a most fundamental question in neuroscience, that is, how large networks encode information and what are the factors ultimately limiting their capacity. In particular: How is the dimensionality of neural dynamics constrained by pairwise correlations? Which experimental paradigms will be powerful enough to verify/falsify population coding theories based on low-dimensional latent variables?

The topic of the workshop is timely. Recent years have seen a surge of interest in developing theoretical concepts and tools to characterize collective network dynamics at a finer detail than granted by low-dimensional mean-field descriptions. At the same time, technological advances in multiple cell recordings, calcium imaging and optogenetics provide reliable tools to measure and manipulate the activity of large neural circuits in awake, behaving animals. The workshop, we believe, will be of general and broad interest. In particular for a large community of theoreticians as well as for experimentalists, who are keen on hypothesis-driven research questions using large-scale parallel recordings.

2.9 Coding, correlations, and the dimensionality of neural activity

Primrose A

Morning session

8.00–8.05a	*Gianluigi Mongillo, Fred Wolf,* Opening remarks
8.05–8.35a	*Elad Schneidman,* Learning a thesaurus for a population code
8.35–9.05a	*Julijana Gjorgjieva,* Optimal sensory coding by neuronal populations
9.05–9.35a	*David Hansel,* Random feedforward connections account for orientation selectivity of the thalamic input in rodent visual cortex
9.35–10.00a	Coffee Break
10.00–10.30a	*Jonathan Kadmon,* At the edge of chaos: Transition to chaos in random neuronal networks.
10.30–11.00a	*Michael Okun,* Understanding the 1st dimension of neuronal population dynamics in the cortex

Afternoon session

4.00–4.30p	*Surja Ganguli,* When do neural correlations from a small subset of neurons reveal the hidden structure of global neural circuit dynamics?
4.30–5.00p	*Rainer Engelken,* How spike initiation shapes pairwise correlations, attractor dimension and population coding bandwidth in balanced networks
5.00–5.30p	*Johnatan Aljadeff,* Low-dimensional dynamics of structured random networks
5.30–6.00p	Coffee Break
6.00–6.30p	*Tatyana Sharpee,* Correlated encoding between cell types
6.30–7.00p	*Máté Lengyel,* Cortical correlations: where top-down meets bottom-up