Norman Farb, University of Toronto Mississauga (UTM), Canada

SENSORY INHIBITION AS A MARKER OF DISTRESS AND SENSE FORAGING AS A POTENTIAL SOLUTION

Interoception, the representation of the body's internal state, is central to theories of emotion, motivation, and wellbeing. Yet interoception is an understudied relative to the external senses. A potential reason for this disparity is the challenge in manipulating interoceptive stimuli, combined with difficulties in relying on participant self-report of interoceptive experience. Meeting this challenge requires innovation in experimental methods, with promising paradigms emerging for interoception of the cardiac, respiratory, and gastrointestinal systems. Then, informed by a rich history of mind-body practices and phenomenological techniques, objective measures of physiology and neural function can help to characterize individual differences in interoceptive processing. In reviewing theories of interoception and wellbeing, healthy experience can be characterized by allowing the complete representation of the viscerosomatic signals before appraisal and regulatory responses are employed. Cognitive neuroscience evidence supports this principal: in community dwelling participants, subjective appraisals of sadness following a sad-mood induction did not distinguish between levels of concurrent depressive symptom burden. Instead, the degree of sensory suppression (as measured by fMRI) following such inductions was a closer associate of symptoms. Furthermore, in participants with a history of recurrent depression, the degree of sadness-evoked sensory suppression was associated with depression history, residual symptoms, and future relapse risk over a two-year follow-up period. To mitigate sensory inhibition, "sense foraging" practices appear efficacious: neuroimaging and clinical evidence converge to suggest that attentional training can reduce the tendency to inhibit sensory activity, with the preservation of interoception in the face of stress a marker of emotional resilience and flourishing.

Laura Marzetti, University of Chieti-Pescara, Italy

BRAIN STATE DYNAMICS AND COMPLEXITY IN MINDFULNESS MEDITATION

Mindfulness meditation has garnered significant attention in scientific research for its potential impact on psychological well-being. Indeed, mindfulness interventions demonstrated efficacy in reducing symptoms of anxiety, depression, and stress, while also promoting positive affect and emotional resilience. These behavioral effects are paired to neuroplastic changes in brain regions associated with emotional processing, attention regulation, and self-awareness with both short- and long-term characteristics. Methods to extract brain states and to assess their modulations across meditation practices can be successfully employed to study neuroplastic changes. In addition, brain state transitions reveal complexity patterns that differ across meditation practices in a way that is related to meditative expertise. These findings have implications for the development of targeted interventions aimed at improving mental health outcomes and fostering overall life satisfaction through mindfulness-based practices.

Daniele Marinazzo, University of Ghent, Belgium

HIGHER ORDER INFORMATIONAL CONTENT: THE PERFECT TOOL FOR BRAIN-BODY AND BRAIN-ENVIRONMENT RESEARCH?

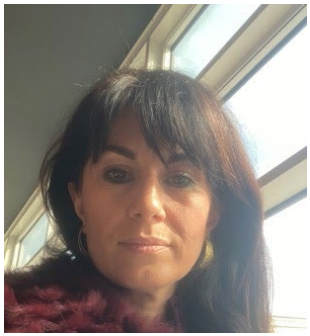
Systems composed of many units, whose behavior goes beyond the sum of the individual behaviors of the singles, are ubiquitous. Examples relevant to what we do are the brain, the body as a whole, and the social systems we live in, and multisensory research is the optimal framework for this mindset. When it comes to analyzing collective behavior we are often stuck with pairwise dependencies (often correlations). In this talk I will describe a framework rooted in information theory to mine multiplets of variables sharing common information about the dynamics of complex systems, and provide some examples in neuroscience, physiology, and behavioral scores. I propose that widespread concepts such as integration, emergence, manifolds, dimensionality reduction, can be seen through the lens of information-based synergy. This framework seeks for higher order behaviors, in a complementary way with respect to mechanisms.

Tjeerd Boonstra, Maastricht University, The Nederlands

BRAIN-MUSCLE NETWORKS OF POSTURE AND GAIT

The human body is a complex system consisting of many subsystems and regulatory pathways. The musculoskeletal system gives the body structure and creates the ability to move. It is made up of more than 200 skeletal bones and over 300 skeletal muscles. The central nervous system controls these movements through the spinal motor neurons, which serve as the final common pathway to the muscles. While the anatomical and physiological components of the musculoskeletal system are well characterized, the organizational principles of neural control remain incompletely understood. In this presentation I will discuss the use of functional connectivity and network analysis to investigate the functional organization of the distributed neural circuitry from which motor behaviours emerge. Examples will be given of intermuscular and corticomuscular coherence during different motor behaviours, including postural tasks and locomotion, and how coherence is modulated by age and sensory function. By estimating intermuscular coherence between numerous muscle pairs, the weights of so-called muscle networks can be estimated. Network analysis has been widely used to investigate functional integration in the central nervous system and this approach can be extended to investigate the network topology of functional interactions between muscles. When combining both approaches, we can map the brain-muscle networks involved in human motor control. This combined approach fits within the broader framework of network physiology and is well placed to provide new insights and interventions for movement disorders.

Viviana Betti, La Sapienza University of Rome, Italy



TITLE: TBA

Joachim Gross, University of Muenster, Germany

DECODING BODY AND BRAIN STATES WITH RHYTHMIC AND NON-RHYTHMIC FEATURES OF BRAIN SIGNALS

A Regional brain activity is shaped by a number of factors. First, different brain states are associated with specific signatures in brain activity. Second, brain activity is modulated by body state. Third, different brain areas have characteristically different brain activity that is shaped by the underlying anatomy and regional-specific connectivity. Fourth, brain activity changes with age. While these modulators of brain activity are well established we still know relatively little about the specific features in brain activity that are changed. Here, I report first results of a new project where we employ large-scale time-series phenotyping of MEG data. We use a large set of features to characterise source-localised MEG data and identify features that are informative for predicting age, changes in brain state or that follow cortical gradients. In all cases, these non-standard features outperformed traditional spectral measures.

Marcello Costantini, University of Chieti-Pescara, Italy

TITLE: TBA

James Kilner, University College of London, UK

PREDICTIVE CODING AND INTEROCEPTION

Interoception is the sensing and processing of signals that arise within our bodies. The most studied interoceptive signal is that from the heart. We know that the when the heart beats our ability to detect other sensory signals, touch, sight and hearing is reduced. However, why this occurs is not known. Recent theoretical accounts of interoception have focussed on the role of prediction in interoception, the predictive-coding models of interoception. However, there is little empirical data to support these accounts. An alternative view is that our awareness of our cardiac signals is not likely to be based on baroreceptor signals but rather on cardiac related signals that are present on all exteroceptive channels. This suggests that to interpret cardiac related signals we require a fuller understanding of the links between heart rate and signals arising from the heart beating.

Peggy Series, University of Edinburgh, UK

SCHIZOPHRENIA AND AUTISM AS DISORDERS OF PREDICTION

A growing idea in computational neuroscience is that perception and cognition can be successfully described in terms of predictive processing or Bayesian inference: the nervous system would maintain and update internal probabilistic models that serve to interpret the world and guide our actions. This approach is increasingly recognized to also be of interest to Psychiatry. Mental illness could correspond to the brain trying to interpret and act upon the world through distorted internal models, or incorrectly combining such internal models with sensory information.

I will discuss how this approach has led to important developments in the field now known as "Computational Psychiatry". In particular, I will review the theoretical frameworks that have been used to describe impairments in schizophrenia and autism and describe results from my lab that aim to test, refine, and contrast those theories. Based on our research looking at visual illusions and the representation of peri-personal space, I will also discuss how such approach can be combined with neural network modelling to investigate how they relate to differences in the neural substrate, such as differences in connectivity or in the balance between excitation and inhibition.

Katerina Fotopoulou, University College of London, UK

I CAN CONTROL MY HEART: ALTERING INTEROCEPTIVE SELF-EFFICACY IN THE LAB AND IN THE CLINIC.

Disruptions in interoception have emerged as a transdiagnostic pathogenic mechanism for several disorders at the mental-physical health interface, such as eating, functional or somatic symptom disorders. However, the interdisciplinary expertise required to identify and therapeutically target psychophysiological mechanisms has limited the efficacy of related therapeutic endeavours that tend to focus on only on limited levels and domains of interoception. Following co-design with users, we have developed and tested beliefs updating across many domains and levels of interoception in subclinical and clinical eating disorders and then we designed and tested the efficacy and mechanisms of action of a novel, interdisciplinary (psychophysiological) therapeutic module (InMe) in 100 individuals with low interoception awareness, stratified for subclinical disordered eating or somatisation symptoms. In a two-arm parallel group randomised controlled trial (RCT) we compare the InMe intervention to an active control intervention (imagery training without biofeedback). INME uses cardiac biofeedback during guided respiration exercises to train individuals to down-regulate their own heartrate under different conditions of stress, while also enhancing related metacognitive beliefs. Results showed significantly higher changes of the trials primary measure of interoception at follow-up for INME than for the control intervention ($p<0.05$). Advanced analyses methods also revealed important mediators and moderators of this effect and the subpopulations likely to benefit. We discuss the multidimensionality of interoceptive pathways, as well as the potential of further developing and testing this interoception-intervention as an augmented-therapy module for other pharmacological and behavioural interventions targeting disorders at the mental-physical health interface.

Suliann Ben Hamed, Paris (CNRS), France

DYNAMICS AND FLUCTUATIONS OF ATTENTIONAL CONTROL AND THEIR IMPACT ON PERCEPTION AT MULTIPLE TIME SCALES

Attention is a crucial cognitive function that guides gaze and the exploration of our environment through the selection of relevant information and the suppression of irrelevant information. Attentional control is implemented by the frontal eye fields. Recent evidence demonstrates that attentional control is highly flexible and dynamic and shapes our interaction with the world. Using a combination of machine learning and dimensionality reduction approaches, I will present electrophysiological evidence from the macaque frontal eye fields describing attentional control dynamics at multiple temporal scales from several cycles per second to a few cycles per hour. I will first describe attentional saccades that are organized at an alpha rhythm, and that subserve the top-down control of attentional exploration of space, the selection of relevant information, as well as both proactive and reactive suppression of irrelevant information. I will then describe, how states of impulsivity, optimal behavior and distractibility, impact attentional processes, at the scale of several minutes. These behavioral states of impulsivity and distractibility are described by two independent neural states. These neuronal states are independent from the neuronal state implementing attention but can interfere with it. Last, I will show that prefrontal attentional control consistently fluctuates at a rhythm of circa 5 cycles per hour, impacting both overall prefrontal information (i.e. how efficiently the world is perceived) as well as behavioral responsiveness (i.e. how fast subjects respond). At the neuronal level, these fluctuations impact the phase locking between local (MUA alpha) and distal (LFP theta) neural processes. These fluctuations in attentional control in the range of a few cycles per hour are impacted by noradrenergic neuromodulation. Overall, I will thus show that attentional control that guides gaze and the exploration of our environment should be viewed as a highly dynamic and flexible process encompassing multiple neuronal mechanisms, some of which are under voluntary control, others being associated with internal states the origin of which remain to be identified.

Zakaria Djebbara, Aalborg University, Denmark

UNRAVELING COGNITION AND BEHAVIOR IN MOTION THROUGH ENVIRONMENTAL RHYTHMS

Human behavior is shaped between brain, body and environment. While neuroimaging has seen rapid advances over the years, the body and environment have received much less attention in the cognitive sciences. Only recently has the body reclaimed its position in understanding behavior, leaving the environment as the only variable whose role is scarcely understood. There are several kinds of environments, however, we focus here on the built environment. To overcome the static reduction of the environment to e.g., “environment 1,” we present here a dynamic approach that aims to quantify the continuous relationship. Additionally, as oscillations and rhythmic patterns facilitate the communication between brain, body and environment, identifying rhythms in the continuous signals make an excellent approach to human behavior. We present Mobile Brain/Body Imaging research applied to build environments, illustrating the feasibility of mobile neuroimaging. We combine this technique with Virtual Reality, providing full control of the environment, in our recent work on neural entrainment, sensorimotor brain dynamics, and environmental features. Finally, we present an alternative approach to the quantification of environmental features, placing the environment back in the triad of human behavior.

Massimiliano Zampini, University of Trento, Italy

THERMAL PERCEPTION AND BEYOND: UNRAVELING THE INTRICACIES OF ENVIRONMENTAL TEMPERATURE'S IMPACT ON THE BODY AND THE BRAIN

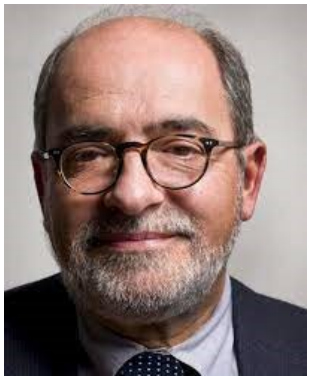
According to the grounded cognition perspective, our perception relies on current and past sensorimotor experiences, emphasizing the interaction between bodily states and the surroundings. While our environment provides various cues, temperature emerges as a critical factor for body survival and well-being. Initially, I will try to summarize the current state of knowledge on thermal sensitivity, delving into neural mechanisms responsible for temperature perception, with a focus on sensitivity variations across different body regions. Despite a wealth of research on the topic, there remains a gap in quantifying thermal perception when the entire body is involved. Therefore, I will introduce an innovative experimental paradigm we have developed to address this gap and discuss our preliminary findings, indicating both high participant accuracy and minimal variability. These results suggest an intrinsic mechanism in our body governing thermal sensitivity. Building on these findings, we have explored multisensory interactions between temperature and vision. Additionally, I will delve into the interplay between spatial perception and environmental temperature, examining how temperature cues influence individuals' perception of the surrounding space. Finally, my review will touch upon the potential of virtual reality (VR) devices in psychological research. The abstract concludes by briefly discussing the potential of virtual reality (VR) devices in psychological research. I highlight the unique opportunities afforded by VR technology to create immersive and controlled experimental environments while acknowledging its current limitations.

Patric Bach, Patric Bach, University of Aberdeen, UK

TOWARDS A NEW VIEW OF VISUAL PERSPECTIVE TAKING

Visual perspective-taking underpins human social interactions, allowing us to understand how the world appears to others, to empathize and to engage effectively with them, therefore promoting a sense of social connectedness. However, currently, there is no model of perspective taking that could explain the mechanisms that underpin perspective taking, which features of the other person, or the interaction promote it, and which personal characteristics separate good perspective takers from not so good ones. Here, I will review recent findings from our lab that indicate, first, that perspective taking is, at least in part, a perceptual ability to, which allows us to operate on another person's perspective as if it were our own view. Second, they show that these abilities are under partial control of the perceiver, who can decide which weight their judgments give to their own and the other person's representation of the environment, but who cannot fully disregard either perspective. Third, they show that spontaneous shifts into another's visual perspective are promoted by the human-likeness of the target person, in way that reflects the perceiver's individual attributions of human-like appearance and human-like to the person they are viewing. Finally, they show that perspective taking abilities are tied to the perceiver's personal characteristics. People who find it difficult to take another's perspective (and disengage from their own) are more likely to exhibit higher schizotypal traits and report lower abilities to predict and understand social interactions. Together, these data provide a new view of perspective taking, the role it plays in social interaction and our connectedness to others.

Vittorio Gallese, University of Parma, Italy



EMBODIMENT IN THE DIGITAL ERA. A NEUROSCIENTIFIC PERSPECTIVE.

Embodiment is the still poorly investigated key entry point to a deeper understanding of how digital technologies shape our identity, our social relationships and the world where we are living. The disintermediation of perception and meaning making operated by the new digital mediascape has literally revolutionized the world. Interconnected mobile digital devices are changing the style of our interaction with images and words, multiplying our 'province of meaning', projecting it into multiple dimensions beyond the reach of our naked eye. We must investigate the impact that the new digital technologies and related social practices have upon social life and culture. Capitalizing upon the results obtained by experimental aesthetics when applied to art and cinema, and by privileging embodiment and the performative quality of perception and cognition, Embodied simulation, a model of perception and cognition, is proposed as an ideal starting point to address these issues.

Noga Arikha, European University Institute - Florence, Italy

CULTURES OF EMOTION

There is always a cultural context within which research is conceived and communicated, and which allows for certain questions to arise, just as cultural context interacts with the construction of subjectivity, self-understanding and emotional experience. The nature of scientific research is such, however, that within the lab this cultural context can be easily forgotten. Yet it is worth remembering that it is only over the last three decades that the scientific exploration of the embodied, feeling subject has been scientifically validated, and that the culturally driven affective turn in neuroscience and psychology has enabled insights whose real-world applications are being developed now.

Two elements need further unpacking: 1) an analysis of the interplay of this research with variegated cultures of emotion - that is, the anthropological nut of how the "psychic unity of mankind" is declined culturally; and 2) the injection of its outputs into the social and political sciences, which has not yet recognised the ordinary political agent as the embodied, feeling self that these new scientific practices are finally showing us up to be.

By revisiting how scientific truth meets cultural construction, and taking on board the enactive, embedded nature of the embodied, extended, intersubjective self, I propose in this talk to bridge the gap between lab and world in both these directions - from the research on subjectivity to the world of cultural subjects, and back from world to lab.