University of Zurich[UZH]

**URPP Adaptive Brain Circuits in Development and Learning (AdaBD)**

## AdaBD Special Seminars

# Understanding the role of prediction in sensory encoding

**Wednesday, September 7, 2022, 10:30 h**
Department of Economics, Blümlisalpstr. 10,
8006 Zürich
Room BLU-003

## Jason B. Mattingley, Prof. Dr.

Queensland Brain Institute & School of Psychology, The University of Queensland, Brisbane, Australia

*Foundation Chair in Cognitive Neuroscience*

At any given moment the brain receives more sensory information than it can use to guide adaptive behaviour, creating the need for mechanisms that promote efficient processing of incoming sensory signals. One way in which the brain might reduce its sensory processing load is to encode successive presentations of the same stimulus in a more efficient form, a process known as neural adaptation. Conversely, when a stimulus violates an expected pattern, it should evoke an enhanced neural response. Such a scheme for sensory encoding has been formalised in predictive coding theories, which propose that recent experience establishes expectations in the brain that generate prediction errors when violated. In this talk I will present findings from experiments in humans and mice in which we asked whether the encoding of elementary visual features is modulated when otherwise identical stimuli are expected or unexpected based upon the history of stimulus presentation. In human participants we employed brain imaging to measure neural activity evoked by gratings of different orientations, and used multivariate forward modelling to determine how orientation selectivity is affected for expected versus unexpected stimuli. Using an analogous visual paradigm in awake head-fixed mice, we used two-photon calcium imaging to quantify orientation tuning of individual neurons in the primary visual cortex to expected and unexpected gratings. Results revealed enhanced orientation tuning to unexpected visual stimuli, both at the level of whole-brain responses and for individual visual cortex neurons. I will discuss the implications of these findings for predictive coding theories of sensory encoding.

Contact: Prof. Dr. Christian Ruff
christian.ruff@econ.uzh.ch

University of Zurich[UZH]

**URPP Adaptive Brain Circuits in Development and Learning (AdaBD)**

## AdaBD Special Seminars

# Cognitive and neural mechanisms of integrative perceptual decisions

**Tuesday, September 6, 2022, 14:15 h**
Department of Economics, Blümlisalpstr. 10,
8006 Zürich
Room BLU-003

*Research fellow at the Cognitive Neuroscience lab*


## Dragan Rangelov, PhD

Queensland Brain Institute, The University of Queensland, Brisbane, Australia



Adaptive behaviour depends on the ability to make fast and accurate decisions. Even the simplest decisions, such as stopping at a red traffic light, are subject to significant noise, such as adverse weather conditions. Past research has shown that decision making in both humans and non-human animal models relies on repeated sampling and accumulation of noisy sensory input over time. Specifically, the accumulation process is assumed to suppress noise and permit more accurate decisions. While most previous decision-making studies have focused on simple, perceptual decisions, most everyday tasks require integration of several distinct sources of evidence, separated in space and time. For example, deciding whether to cross a busy road requires one to consider traffic movements on both the left and right. My research focuses on characterising the cognitive and neural mechanisms that support such integrated decisions. In this talk, I will present three studies which used computational modelling of behaviour in combination with brain imaging using electroencephalography (EEG) to characterise integration of sensory inputs across time and space. Behaviourally, we find that integration processes are consistently and inherently biased, yielding suboptimal task performance. For example, participant responses are systemically biased in favour of sensory inputs which are perceived as more reliable, even though optimal performance in our task requires equal weighting of evidence sources. Using multivariate analyses of neural data, we found comparable biases in brain activity. Taken together, the research shows that integrative decision making recruits unique cognitive and neural mechanisms that go beyond those required for simple perceptual decisions.



Contact: Prof. Dr. Christian Ruff
christian.ruff@econ.uzh.ch