Alpha scales - December 6th, 2018

Abstracts

The rhythms of attention

Laura Dugué, Laboratoire Psychologie de la Perception, France

Despite the impression that our visual perception is seamless and continuous across time, evidence suggests that our visual experience relies on a series of discrete moments, similar to the snapshots of a video clip. My research focuses on these perceptual and attentional rhythms. Information would be processed in discrete samples; our ability to discriminate and attend to visual stimuli fluctuating between favorable and less favorable moments. I will present a series of experiments, using multimodal functional neuroimaging combined with psychophysical measurements in healthy humans that assess how these rhythmic mental representations are implemented at the neural level.

State dependent fluctuations of thalamic activity on various timescales

Magor Lorincz, University of Szeged, Hungary

Spontaneous activity in many brain regions is state dependent. This is most apparent when comparing neuronal activity recorded during wake and sleep periods. However fluctuations during the awake state have also been shown to profoundly influence neuronal and behavioural responses. During my talk I will focus on the state dependent activity of thalamic neurons first during the alpha rhythm in felines and discuss its mechanisms and functions and then on a slower activity fluctuation in awake rodents and show its cell-type specific features, its origin and speculate on its role.

The role of alpha oscillations in the temporal rhythms of visual perception

David Melcher, University of Trento, Italy

There is growing evidence that cognitive and perceptual systems have an inherent temporal structure that is present even prior to stimulus presentation. Here, I will present recent work from my lab investigating the mechanisms underlying temporal integration windows. Our results suggest that a hierarchy of temporal cycles, including the alpha cycle, play a role in creating capacity limits and in influencing our subjective interpretation of events. These studies, using behavioral measures, M/EEG, sensory entrainment and eyetracking, suggest a role for temporal rhythms in parsing continuous sensory input into meaningful objects and events. Overall, this work points to a critical role of the brain's time frames in organizing and aligning perception, attention, cognition and action.

Alpha as a gating mechanism: evidence and open questions

Saskia Haegens, University of Columbia, USA

I will discuss the proposal that alpha provides a mechanism of active inhibition, functioning as a "gate" that selectively controls processing. I will present evidence from MEG work in healthy human subjects, as well as intracranial recordings in patients and in non-human primates. These data show the link between alpha activity and task performance on the one hand, and between alpha and neuronal activity (in terms of single unit spikes and broadband activity) on the other hand, substantiating the inhibition framework. I will then discuss critique & open questions regarding this framework.

The spatial and temporal dynamics of attention: insights from direct access to the attentional spotlight

Suliann Ben Hamed, Institut des Sciences Cognitives, CNRS, France

Recent behavioral studies suggest that attention samples space rhythmically (Landau and Fries, 2012, Kastner et al., 2013; VanRullen et al., 2013, Dugué et al., 2016). However, the precise mechanism through which this rhythmic exploration of space is subserved remains unknown. Recent work by Heinrich et al. (2018) and Fiebelkorn et al. (2018), proposes that specific inter-areal synchronization mechanisms in the theta range play an important role in this respect. Here, I will apply machine learning methods to ongoing monkey prefrontal multi-unit population activity, to decode, in real-time, the (x,y) location of the attentional spotlight (Astrand et al., 2016, 2018). I will first describe behavioral and neuronal evidence for multiple spatial filtering mechanisms independently of task objective configuration. Specifically, I will show that this real-time decoding of the attentional spotlight serves to filter in task relevant information while at the same time filtering out task irrelevant information. In a second part of the talk, I will demonstrate that the overall decoded spatial attention information that can be extracted from population multi-unit activity oscillates at a 7-12Hz rates. These oscillations in attentional information account for stimulus encoding, as well as for behavioral trial outcome, and this whether considering target processing or irrelevant distractor processing. Importantly, these oscillations characterize displacements of the decoded attentional spotlight. While these oscillations are task-independent, we demonstrate that how space is explored by the decoded attentional spotlight is task specific. In other words, while 7-12Hz oscillations mediate attentional displacement, top-down control flexibly adjusts these displacements to the ongoing behavioral demands. I will conclude by bridging the gap between this alpha rhythmic exploration by the attentional spotlight and previous reports on a contribution of long-range theta oscillations in attentional exploration.

Alpha oscillations, travelling waves and predictive coding

Rufin vanRullen, CerCo, France

Alpha oscillations are not strictly spontaneous, like an idling rhythm, but can also respond to visual stimulation, giving rise to perceptual "echoes" of the stimulation sequence. These echoes propagate across the visual and cortical space with specific and robust phase relations. In other words, the alpha perceptual cycles are actually travelling waves. The direction of these waves depends on the state of the system: feed-forward during visual processing, top-down in the absence of inputs. I will tentatively relate these alpha-band echoes and waves to back-and-forth communication signals within a predictive coding system.