Joint Research Symposium
Wednesday, June 1, 2016
Donders Room (DCC)
8.45-16.30h

09:00-09:10 Opening by prof.dr. Gerard Meijer (president of Radboud University)

09:10-10:30 Development and language, chair Harold Bekkering
Rhodri Cusack: Neuroimaging of the Emergence of Cognition in Infants and its Clinical Applications.
Sabine Hunnius: Becoming a Social Partner: The Early Development of Action Understanding and Action Coordination.
Marc Joaiss: Exploring individual differences in second-language learning using multimodal neuroimaging.

10:30-11:00 Break

11:00-12:20 Imaging and neurophysiology, chair David Norris
Ravi Menon: Longitudinal brain changes observed with MRI in female athletes over one or more concussion-free seasons.
Ole Jensen: On the role of alpha and gamma activity for routing and prioritizing information processing.
Brian Corneil: Subtle indicators of oculomotor output.

12:20-13:20 Lunch

13:20-14:40 Sensory processing and decision making, chair Jody Culham
Jessica Grahn: Motor area involvement in perception of auditory rhythmic sequences.
Floris de Lange: Prediction in perception: How expectations change visual computations.
John van Opstal: The limits of spatial updating in eye-head gaze control.

14:40-15:10 Break

15:10-16:30 Memory and clinical cognition, chair Guillen Fernandez
Stefan Kohler: Category specificity of recognition-memory signals in the human medial temporal lobe.
Roshan Cools: Predicting dopamine's effects on human cognition. Towards personalized psychiatry.
Mel Goodale: Neural substrates of size constancy in perception and action.

16:30-17:00 Drinks
ABSTRACTS

Session 1: Development and language

Rhodri Cusack (BMI): Neuroimaging of the Emergence of Cognition in Infants and its Clinical Applications

Assessing emerging cognition is challenging, as infants can’t communicate what they know, and different behavioural protocols have yielded inconsistent findings. To study the emergence of brain function without the need for a behavioural response, we have used magnetic resonance imaging (MRI). We have found it provides a rich window onto emerging cognition, and that it holds great clinical potential as a biomarker for disrupted function in infants at risk of brain injury.

Sabine Hunnius (DI): Becoming a Social Partner: The Early Development of Action Understanding and Action Coordination

From early in life, infants and toddlers pay attention to the people around them and to the actions they perform. They enjoy interacting with others and cooperating with adults in a playful manner. How do infants acquire knowledge about their social environment? How do they develop the ability to understand actions they observe? In this talk, I will present a series experiments which examine the emergence of social understanding in early childhood and the neurocognitive mechanisms underlying these developmental changes.

Marc Joannise (BMI): Exploring individual differences in second-language learning using multimodal neuroimaging

Adults experience appreciably greater difficulty and variability in learning a second language (L2) compared to children. Recent research has used measures of brain activity to examine differences in how L1s and L2s are processed, and how age of acquisition (AoA) influences such findings. However, these studies have tended to confound AoA with L2 proficiency, making it difficult to understand the source of individual influences in L2 learning success. Here we present a series of studies in which we examine the independent effects of proficiency and AoA on brain activity during L2 processing of English, Mandarin or French. Studies use multiple neural measures including functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), and electroencephalography (EEG).

Session 2: Imaging and neurophysiology

Ravi Menon (BMI): Longitudinal brain changes observed with MRI in female athletes over one or more concussion-free seasons

We followed a team of female national level varsity athletes playing rugby over 3 seasons. Diffusion tensor imaging (DTI) was used to quantify the structural integrity of major white matter tracts. Resting state functional MRI (RS-fMRI) was used to examine functional connectivity between 136 anatomical regions. Hematology and flow cytometry were used to mechanistically interpret imaging changes,
along with Sport Concussion Assessment Tool (SCAT) and Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) clinical measures. After 2-3 months of post season recovery, there were significant increases relative to the pre-season time point in fractional anisotropy and decreases in mean and radial diffusivity in a number of long white matter tracts (p < 0.001) along with decreases in RS-fMRI functional connectivity between brain regions involving those same tracts (false discovery rate-corrected p < 0.05). There were also decreases in the total leukocyte population and increases in lymphocytes (p < 0.05) while some clinical measures like verbal, visual, and immediate memory composites improved following the 2-3 months of recovery. These observations are consistent with a remyelination process in the long white matter tracts after 2-3 months of post-season recovery.

**Ole Jensen (DI): On the role of alpha and gamma activity for routing and prioritizing information processing**

Networks in the brain must rely on powerful mechanism for routing and prioritizing information processing. In a set of attention and memory studies we have investigated the notion that alpha oscillations (9 – 12 Hz) are inhibitory and serve to route the information flow: ‘gating by inhibition’. The alpha band activity is under top-down control by areas in the dorsal attention network. As such the alpha band activity – previously believed to reflect a state of rest - serves an important role for shaping the functional architecture of the working brain. Gamma band activity (50 – 100 Hz) reflects feedforward processing and is modulated by the alpha oscillations. Importantly, the gamma activity is coupled to the phase of the alpha oscillations. We have found support for this framework using MEG, DTI/MEG, TMS/MEG, fMRI/EEG and non-human primate data. In future work we will investigate how alpha oscillations provide a mechanism for prioritizing sensory information processing by means of phase-encoded representations.

**Brian Corneil (BMI): Subtle indicators of oculomotor output**

The oculomotor system, which rapidly moves or stabilizes the line of sight, is one of the best understood motor systems in the human brain. While this system is often studied via discrete saccadic eye movements made with the head restrained, orienting of the line of sight can be brought about by coordinated movements of the eyes, head, and body, and may also incorporate subtle changes in pupil diameter. A key oculomotor area is the superior colliculus (SC), which coordinates an ancient orienting reflex via outputs that distribute widely within the brainstem and spinal cord to saccadic and other premotor and autonomic circuits. There are key differences in the response properties of such downstream circuits, with saccadic circuits in particular having the highest threshold for engagement. Because of such differences, non-saccadic circuits are, somewhat paradoxically, more responsive to subtle changes in upstream SC signaling. Recent work shows that causal manipulation of frontal inputs into this circuit, via either low-current stimulation or reversible cryogenic inactivation, can influence a variety of non-saccadic responses including pupil dilation, neck muscle recruitment, and the profile of fixational eye movements. These results support the emerging view that multiple components of orienting can be strategically deployed to optimally sample a visual scene.
Session 3: Sensory processing and decision making


fMRI and work with neuropsychological patient populations has heavily implicated the motor system in the perception of temporal sequences, particularly in sequences with a regular temporal structure. Here we use noninvasive stimulation techniques (TMS and tDCS) to probe how specific motor areas (supplementary motor area, premotor cortex, and cerebellum) contribute to accurate perception of regular and irregular temporal sequences, as well as how regular temporal structure alters the dynamics of motor system excitability over time.

Floris de Lange (DI): Prediction in perception – How expectations change visual computations

One of the fundamental functions of the human brain is to predict future events on the basis of the recent past. Prediction plays a prominent role in models of seemingly disparate cognitive functions such as perception, motor control, and language processing. Although there is ample behavioral evidence for the predictive nature of perception, the incorporation of prior knowledge in the neural computations underlying perception is still poorly understood. In my lecture, I will review recent work on how prior expectations about the sensory world change the neural computations that give rise to perception. I will provide empirical evidence for generative models in perception, and show how prediction signals are integrated with bottom-up input, drawing on electrophysiological (MEG) and hemodynamic (fMRI) methods.


John van Opstal (DI): The limits of spatial updating in eye-head gaze control

We study auditory- and visually evoked gaze shifts, revealing that the gaze control system stores targets into world-centered coordinates. Such a representation is invariant to intervening gaze shifts. We currently explore the limits of spatial updating for extremely brief stimuli, which preclude the system from obtaining evidence about sensory motion with respect to the world.

Session 4: Memory and clinical cognition

Stefan Kohler (BMI): Category specificity of recognition-memory signals in the human medial temporal lobe

The functional organization of the medial temporal lobes (MTLs) remains a topic of intense debate and investigation in cognitive neuroscience. Much pertinent research in human and nonhuman species focuses on the question of how different MTL structures contribute to memory functioning. Motivated by findings from research on the organization of the ventral visual pathway, we have recently turned to
the examination of category effects in the organization of signals that support recognition memory, i.e., the ability to discriminate between previously encountered and novel stimuli. Specifically we have used high-resolution fMRI in combination with multivoxel pattern analyses (MVPA) in order to compare patterns of activity in the MTL that carry information about the prior occurrence of visual objects from different stimulus categories. I will summarize initial findings from this program of research, arguing that they shed some light on the precise manner in which the prior occurrence of objects is coded within and across different MTL structures.

**Roshan Cools (DI): Predicting dopamine's effects on human cognition. Towards personalized psychiatry.**

Dopamine plays a key role in a wide variety of cognitive functions. Its cognitive enhancing potential is illustrated by the beneficial effects of dopaminergic drugs in many neuropsychiatric disorders, such as ADHD, depression, schizophrenia and Parkinson's disease. However, there is huge variability in the effects of dopaminergic drugs, both across and within individuals. I will review research that is beginning to elucidate the factors that account for this variability, thus contributing to personalizing pharmacotherapy in psychiatry.

**Mel Goodale (BMI): Neural substrates of size constancy in perception and action**

Although the retinal image size of an object changes with viewing distance, we tend to perceive the object as remaining unchanged in size. This phenomenon, which is often called size constancy, enables us to make sense of the visual world as we move around. Neuroimaging studies from our lab and others have demonstrated that activity in primary visual cortex reflects the real-world size of an object rather than its retinal image size. Recent work in our lab has been looking at the temporal properties of size coding in primary visual cortex – and the role of this coding in size constancy for perception vs. grip constancy during grasping.