Fribourg Day of Cognition 2011

15 September 2011

Pérolles II – Salle A140

Fribourg Centre for Cognition

Program

9 :00	Welcome by V. Camos
	Presentation of the Research Groups
9 :15	V. Camos
9 :30	R. Caldara & S. Miellet
9 :45	J. Krummenacher
10 :00	P. Gygax & P. Wagner
10 :15	Pause
10 :45	E. Rouiller
11 :00	J.-M. Annoni
11 :15	G. Rainer
11 :30	P. Lavenex & P. Banta-Lavenex
11 :45	E. Hartmann
12 :00	Presentation of BENEFRI program
13 :45	Posters
15 :00	Meeting
	Future Plans and Actions for the Fribourg Centre for Cognition

Posters

G. Rainer, Anwesha Bhattacharrya, Felix Biessmann, Julia Veit, & Robert Kretz
Layer-dependent nicotinic and muscarinic cholinergic neuromodulation in the tree shrew primary visual cortex

G. Rainer & Abbas Khan
Novel object recognition (NOR) in tree shrew (Tupaia belangeri)

G. Rainer, Julia Veit, Anwesha Bhattacharyya, & Robert Kretz
Receptive field properties of tree shrew primary visual neurons and local field potentials

A.-D. Gindrat, Quairiaux Ch., Britz J., Lanz F., Michel Ch., & Rouiller E.
Feasibility of high-density scalp somatosensory evoked potential recordings in macaque monkeys: a pilot study

A. Hamadjida, Wyss A., Mir A., Schwab M.E., Belhaj-Saïf1 A., & Rouiller E.M.
Thalamocortical projections to the premotor cortical areas following unilateral lesion of primary motor cortex (M1) in macaque monkeys in presence or absence of anti-Nogo-A antibody treatment

M. Kaeser, Shahid Bashir, Alexander Wyss, Adjia Hamadjida, Yu Liu, Jocelyne Bloch, Jean-F. Brunet, Julie Savidan, Abderraouf Belhaj-Saif & Rouiller E.
Short-term effects of unilateral lesion of the primary motor cortex (M1) on ipsilesional hand dexterity in adult macaque monkeys

F. Lanz, Belhaj-Saif A., & Rouiller E. M.
Visual threshold evaluation in human and non-human primates

J. Savidan, T. Wannier, J. Bloch, M-L. Beaud, E.M. Rouiller, & A. Belhaj-Saif
Effect of anti-Nogo-A antibody treatment in hand dexterity recovery following unilateral hemisection: Electrophysiological study in non-human primates

E. Schmidlin, Hamadjida Adjia, Baechler Joël, Bashir Shahid, Belhaj-Saïf Abderraouf, Rouiller Eric, & Hoogewoud Henri-Marcel
Effect of anti Nogo-A antibody treatment on cortical lesion of the primary motor cortex (M1) of macaque monkeys assessed with Magnetic Resonance Imaging (MRI) correlated with manual dexterity recovery.

L. Chouiter, J.-M. Annoni, & L. Spierer
Distinct brain networks support inhibitory control of the two languages in late bilinguals

D. A. Magezi, Khateb, A., Mouthon, M., Spierer, L., & Annoni, J. M.
Distinct brain networks support inhibitory control of the two languages in late bilinguals

M. Mouthon, Asaid Khateb, Alan J. Pegna, Stéphane R. Simon, François Lazeyras, Caroline Lehr, Hannelore Lee-Jahnke, & Jean-Marie Annoni
Second language proficiency modulates the brain language control network in bilinguals: an event-related fMRI study

S. Dieguez, Karin Buetler, & Jean-Marie Annoni
Bilinguals as a research tool for cognitive neuroscience

A. Manuel, Narges Radman, Delphine Mesot, Leila Chouiter, Stephanie Clarke, Jean-Marie Annoni, & Lucas Spierer
Error analysis in ideomotor apraxia: by a large-scale lesion-symptom mapping study on subacute brain-damaged patients.

K. Buetler, Leila Chouiter, Jean-Marie Annoni, Lucas Spierer, & David Magezi
When stationary sounds are moving – the auditory motion aftereffect: an electrical neuroimaging study (Ongoing study)

N. Ruffieux, A. Wonkam, A.K. Njamnshi, E. Mayer, R. Sztajzel, R.F. Doh, S.C. Eta1, A.-M. Kengne, R.N. Ngamaleu, J. Chanal, & C.-A. Hauert
Déficits cognitifs chez l'enfant drépanocytaire: données camerounaises

F. Ribordy, Pamela Banta Lavenex & Pierre Lavenex
Discrete stages in the development of hippocampus-dependent spatial memory in children

L. J. Chareyron, Pamela Banta Lavenex, David G. Amaral, & Pierre Lavenex
Cellular changes underlying the normal postnatal development of the amygdala: a stereological study in monkeys

B. Perriard & V. Camos
Working memory capacity in French-German bilinguals

A.-L. Oftinger & V. Camos
Developmental interplay between attentional refreshing and articulatory rehearsal in working memory

C. Gillioz
Influence of emotion components on the specificity of emotion inference

S. Miellet, Klaus Kessler & Nienke Hoogenboom
Visual and embodied perception of others: The neural correlates of the "Body Gestalt" effect

M.-P. Haefliger, J. Lao, & R. Caldara
Does social evaluation of faces require the integrity of the neural face network? Insights from an acquired case of prosopagnosia

J. Krummenacher & Jonas Hoffmann
Investigating Event-Related Potentials of the EEG in Selective Attention Tasks

J. Krummenacher, Patrick Luethold & Géraldine Jean-Charles
Eye Movements in Visual Search and Selective Attention

Talks

V. Camos

Cognitive Control

The main characteristic of human cognitive functioning is its ability to adapt flexibly to changing situations, to plan actions or to solve problems by selecting and integrating new information. The aim of my work is to examine how we control our thoughts and actions to make them coherent with our internal goals and our environment. Cognitive control is at the interplay of the big memorial and attentional structures of the cognitive system. Studying cognitive control allows understanding how the cognitive dynamic is organized and how it could lead to failures.

My work aims thus to understand the cognitive structures that manage the cognitive control, by which processes this control is maintained, and what are the sources of individual differences, both intra and inter-individuals, as well as developmental and pathological differences. My research combines 3 approaches: experimental behavior study on children and adults, neuropsychological studies of some pathologies (hemineglect, mental deficiencies), and computational simulations.

Finally, my work has direct implications in the detection and rehabilitation of cognitive deficiencies, as well as in learning. Indeed, learning is the cognitive activity that requests the most our cognitive control, especially in mathematical cognition.

R. Caldara

Mapping Visual Cognition: from Micro Eye Movements into Macro Neural Coding

The human visual system is equipped with the most sophisticated machinery to effectively adapt to the visual world. Where, when and how human eyes are moved to gather information to adapt to the visual environment has been a question that has fascinated scientists for more than a century. With the recent advent of non-invasive functional neuroimaging technique, where, when and how the human brain achieves (visual) information processing has

become a topical field in science. A long-term challenge of my laboratory is to bridge the gap between these fields and investigate the dynamics of visual information processing, by tracking simultaneously eye movements and neural responses.
We are using this interdisciplinary approach to address important theoretical questions in visual neuroscience, as well as to develop new computational tools. Historically, it has long been presumed that across cultures all humans perceive the world essentially in a comparable manner, viewing objects and attending to salient information in similar ways. Recently, however, most of our work, and a growing body of literature, have disputed this notion by highlighting fundamental differences in perception between people from Eastern (China, Korea and Japan) and Western cultures. We have highlighted this striking cultural contrast by developing a Matlab toolbox to analyze eye movement data with robust data-driven techniques inspired from brain imaging analyses: iMap. The iMap method is available with open access. Our mainstream work aims at isolating culture-invariant and -specific mechanisms of the visual system.

J. Krummenacher
Perception, Selection, and Executive Control
The core research topics of the Experimental Cognitive Psychology unit at the Department of Psychology are selective functions of perception in (almost) all their guises. One of the main issues currently under investigation concerns the nature of sensation-based and perception-based mechanisms of selection, together with their interdependence and mutual modulations. Sensation-based mechanisms refer to pre-selective, pre-perceptual stages of processing and the research focus is on investigating effects of their functioning by changing stimulus characteristics. Perception-based mechanisms correspond to post-selective, perceptual processing stages and the research emphasis is on their modulation by cognitive control or semantic associative processes.
Methods involve psychophysical and psychophysiological approaches, complemented by eye movement parameters, all of

which are employed to analyze behavior in search tasks. In the visual domain, different types of visual search paradigms, such as feature, conjunction, and compound searches are used to generate reaction time and error rate data. Analyses of the effects of previous trials on behavior in the current trial are conducted to examine the dynamics of selective mechanisms. Recently, a novel procedure was developed allowing for statements on the processing times, in conjunction search tasks, of independent sensory signals before they are integrated into a unitary percept. Psychophysiological work focuses on the decomposition of reaction times using event-related potentials of the electroencephalogram such as the N2pc or the LRP.

Findings of basic research are applied to the investigation of the component functions affected in impairments such as hemi-spatial neglect or the alteration of selective processes in AD(H)D. A particular interest is on the relative contribution to selection by processing speed, vSTM capacity, cognitive control, and the spatial allocation of focal attention.

By the same token, component processes underlying above-average performance in search tasks in people with Asperger's syndrome are a specific research interest.

Another extension of the basic research involves the examination of the development of selection mechanisms, in particular the relative contribution of sensory-motor and cognitive mechanisms to the expedition of reaction times with increasing age.

A more recent research interest concerns the interplay of selection processes in multiple sensory systems, for instance, the integration of visual-auditory and visual-tactile stimulation with an emphasis on the nature of space-based mechanisms in real-world settings. A possible application is a test to assess whether elderly people are mentally fit to drive a car.

A recent research topic in the field of executive control involves the investigation of the processes governing the selection and integration of multiple sensory signals in conditions that require the resolution of conflicts at the level response generation and execution.

P. Gygax & P. Wagner
The Unit's strength lies within the dialogue between three domains, namely the psychology of language, cognitive psychology and social psychology. In line with this interaction, the cognitive processes underlying text comprehension and social representations are at the heart of the Unit's research focus. Most of the questions we are currently investigating involve the interaction between these three domains. For example, typical questions are: Can readers really process grammatical masculine form as referring to both men and women? What are the cognitive and social factors that influence the way (pre)teenagers process health messages on cigarette packs? …

E. Rouiller
The main research interest of the laboratory is the study of motor control of voluntary movements as well as mechanisms involved in multisensory and sensorimotor integration.
- Control of voluntary movements
How do non-human primates (monkeys) exert their sophisticated manual dexterity? Manual dexterity is assessed using a large palette of reach and grasping tasks, comprising manipulation of small objects with the fingers. What is the impact of a lesion of motor cortex on the manual dexterity? What are the extent and the mechanisms of spontaneous functional recovery after lesion of the motor cortex? Can such functional recovery be enhanced with various treatments, such as implantation of exogenous or endogenous progenitor cells, as well as neutralization of neurites growth inhibitors (such as Nogo-A)?
- Multisensory and sensorimotor integration
The facilitation of reaction time and performance provided by simultaneous presentation of auditory and visual stimuli, as compared to separate presentation for each modality, is studied in non-human primates. There is behavioral evidence in favor of very early multisensory integration. What are the brain regions where such early integration takes place? What are the pathways giving rapid access to the motor system for rapid sensorimotor response?

J.-M. Annoni
The main project of the lab will focus on bilingual brain and body image, specifically on whether the perception of one's own body is influenced by proficiency and age of acquisition of language and which language is currently being used. This question will be addressed in healthy subjects
and in brain lesion patients, with potential implication for recovery after brain lesion. Techniques used for such paradigms include behavioral observations, analyses of networks through fMRI techniques and Brain Mapping/Evoked Potentials.Other topics will address the modification of theory of mind after brain lesions and potential implication on behavior.

G. Rainer
Our general goal is to contribute to the advancement of understanding the neural mechanisms of visual perception, learning and cognition in the mammalian brain. We use sophisticated behavioral paradigms to quantitatively study visually-based behaviors. Using multi-channel electrophysiology, we elucidate how sensory information is represented and processed by neural populations and how it is used to make behavioral choices. In addition to studying these basic mechanisms, we investigate effects of cholinergic neuromodulation on visually based behaviors and the underlying neural activations. To this end, we employ state-of-the-art pharmacological drug application, deep-brain electrical stimulation and mass spectrometry based analytical neurochemistry to better understand functional consequences of cholinergic activity on visual cognition. The cholinergic system has been implicated in a number of central nervous system disorders, so that progress in understanding its' mechanistic actions on brain networks may contribute to the development of novel therapeutic or diagnostic methods.

P. Lavenex & P. Banta-Lavenex
In addition to investigating the structural development and functional organization of the hippocampal formation at the genetic, cellular and neuroanatomical levels, our laboratory also investigates the role and involvement of the hippocampus in human memory processes. We currently have two parallel lines of research, at the behavioral level, which aim to further our understanding of memory and hippocampal function across the lifespan: The development of spatial relational memory in children, and spatial memory processing following brain damage.

E. Hartmann, Killmer Helene & Winkes Julia
A portrait of Speech and Language Pathology at the University of Fribourg
Fribourg's Speech-Language Pathology (also called logopedics) is an interdisciplinary subdiscipline of special education specialized for communication disorders. This presentation provides an overview of current educational activities and research interests and projects in our field. In addition, medium-term goals for both domains of academic work will be outlined along with perspectives related to the interdisciplinary cooperation with other academics such as psychology, linguistics and medicine at the University of Fribourg.

M. Kaeser, Thierry Wannier, Jean-François Brunet, Alexander Wyss, Jocelyne Bloch, & Eric M. Rouiller

A lesion of the right dorsolateral prefrontal cortex affects the motor strategy but not the motor control itself in monkeys performing manual dexterity tasks

In the context of a more comprehensive lesional study, a unilateral biopsy of cortical tissue was performed surgically from the right dorsolateral prefrontal cortex (dlPFC) in two intact adult macaque monkeys (dlPFC lesioned group), and they were also implanted with a chronic recording chamber above the left motor cortex. Three other monkeys were subjected to the same surgery, but without dlPFC biopsy (control group). These monkeys were initially trained to perform sequential manual dexterity tasks, requiring precision grip. The motor performance and the prehension's strategy (temporal sequence to grasp pellets at different spatial locations) were analyzed for each hand. Following the surgery, transient deficits of manual dexterity per se occurred in both groups, indicating that they were not due to the dlPFC biopsy (most likely related to the recording chamber implantation and/or the general anaesthesia). On the contrary, changes were observed on the strategy (sequential order), more prominent in the monkey subjected to the largest dlPFC biopsy, supporting the notion of a specific effect of the dlPFC lesion on the prehension's strategy of the monkeys. These observations are generally in line with previous studies using conditional tasks with delay that have proposed a specialization of the dlPFC for visuospatial working memory, although here in a different context of "free-will", non conditional manual dexterity task and without a component of working memory.

G. Rainer, Anwesha Bhattacharrya, Felix Biessmann, Julia Veit, & Robert Kretz

Layer-dependent nicotinic and muscarinic cholinergic neuromodulation in the tree shrew primary visual cortex

Cholinergic neurotransmission is essential in various cognitive functions and Acetylcholine (ACh) ,an important neuromodulator binds to both nicotinic and muscarinic receptor subtypes to exert its actions. These receptors have differential laminar distribution pattern in the primary visual cortex, therefore activating specific layers can explain better the effects of ACh on cotical processing. Here we investigated the influence of an iontophoretic application of a nicotinic (Nicotine) and muscarinic (Oxotremorine) cholinergic agonist in different layers of primary visual cortex. We recorded single neuron activity from 139 neurons in 8 anesthetized tree shrews during visual stimulation using drifting sinusoidal grating stimuli of various contrasts. The recording sites were identified by electrolytic lesions made along the electode track verified by cytochrome oxidase histochemistry. Each neuron was studied during drug injection as well as pre and post drug injection phase. We found an enhancement in contrast sensitivity by Nicotine that was layer dependent and most pronounced in the granular layer ($\chi 2$-tests, $P<0.01$), the input layer of cortex whereas muscarinic activation did not produce any significant changes in contrast sensitivity across different layers ($\chi 2$-tests, $P>0.1$). However, orientation selectivity was robustly enhanced by muscarinic activation in the upper supragranular layers, where a greater fraction of neurons showing enhancement as compared to a reduction in orientation tuning index ($\chi 2$-tests: $P<0.01$). Our results suggest that laminar position has a significant role in facilitating cholinergic modulation brought by cholinergic receptors. Our findings extend previous work in monkeys, suggest close homology between cholinergic modulation effects on visual function in monkey and tree shrew visual cortex.

G. Rainer & Abbas Khan

Novel object recognition (NOR) in tree shrew (Tupaia belangeri)

Novel object recognition test has widely been used in rodents to examine recognition memory. Here, we examine novelty preference using the NOR task in tree shrew, a small animal species regarded as an intermediary between rodents and primates. Our paradigm consisted of three phases: familiarization, training sessions with two identical objects in the arena and after a 24-hour retention period, a test session with a familiar and a novel object in the arena. The training phase consisted of either a single session or three sessions on three successive days. Following three training sessions, tree shrews showed robust preference for novel objects on the test day and a significant habituation in familiar object exploration, occurring largely after the first day of the training phase. Conversely, single-session training in tree shrews did not result in a significant preference for the novel object after a 24-hour retention period. However, they spent significantly less time exploring the familiar object on the test day compared to the training day, indicating that they did maintain a memory trace for the familiar object. Our study showed different time courses for habituation and the emergence of novelty preference, suggesting that novelty preference is dependent on well-consolidated memory of the competing familiar object. Taken together, our results reveal robust novelty preference of tree shrews, in general similarity to previous findings in rodents and primates.

G. Rainer, Julia Veit, Anwesha Bhattacharyya, & Robert Kretz

Receptive field properties of tree shrew primary visual neurons and local field potentials

The local field potential (LFP) comprises the low frequency membrane potential fluctuations of an extracellular recording. It is thought to be closely related to frequently used, noninvasively recorded signals such as the EEG or the BOLD signal and has been proven to show some stimulus selectivity in various brain regions. Thus the relationship of the LFP to the spiking activity as well as a comparison of their level of selectivity is of great interest. We

simultaneously recorded spiking activity and LFPs from tree shrew primary visual cortex using pairs or triplets of tetrodes separated by between 200 and 1200µm. We map the receptive fields at eccentricities between 10 and 25° using binary sparse noise and estimate their spatial extent by fitting oriented two dimensional Gaussians to the resulting activation map. We have preliminary data from 49 pairs of simultaneously recorded neurons as well as 18 additional single sites from a total of 14 animals. The visual spread of the receptive field estimated from the trial averaged LFP (~2.99°2) was statistically similar to the one for the spiking activity (~3.06°2). Estimating the receptive field size using LFP gamma power (30-90Hz), we found significantly smaller values (~2.17°2) compared to the above two conditions (1-way ANOVA: $p<<0.001$). In addition, we found that receptive fields tended to be ellipsoidal: long to short axis ratio: 1.41 (LFP) and 1.36 (spikes) and oriented mostly horizontally: mean angle 5.79° (LFP) and 6.95° (spikes). This bias toward horizontal orientations was statistically significant (Rayleigh tests: $p << 0.001$) for both signal types. Relating the spatial separation between the tetrodes to the respective receptive field centers, we found that 1° of visual angle corresponded to a cortical distance of around 180µm for both spikes and LFP. Our results suggest that the spatial extent of activation estimated from LFPs can be similar or smaller than the values for spiking activity depending on which features of the LFP are analyzed. Thus, we obtained smaller receptive field sizes using gamma-band oscillations compared to trial-averaged stimulus evoked LFPs. Our findings represent the first detailed investigations of this relationship in tree shrew V1, and are in good general agreement with related work in macaque monkeys.

A.-D. Gindrat, Quairiaux Charles, Britz Juliane, Lanz Florian, Michel Christoph, & Rouiller Eric

Feasibility of high-density scalp somatosensory evoked potential recordings in macaque monkeys: a pilot study

The goal of the present pilot study was to establish a simple and minimally invasive method to record somatosensory evoked potentials (SSEPs) from the whole scalp surface in anaesthetized adult macaque

monkeys using a high-density electrode array.

Recordings were performed with a customised EEG cap containing 32 electrodes regularly distributed over the scalp while the monkey was anaesthetized (2.5% sevoflurane). Electrical stimulations were delivered separately either to the median nerve at the wrist or to the tibial nerve at the ankle (0.5Hz repetition rate (1 sweep every 2 seconds), intensity slightly above the visible motor threshold, total of 75 sweeps). The SSEP data were analysed both conventionally in terms of component amplitude and latency at selected scalp locations and topographically by cluster analysis of the voltage maps. This topographical analysis is a data-driven approach and reveals a series of scalp topographies reflecting the steps in information processing.

Although responses were somewhat variable in amplitude and latency across the different recording sessions, they were topographically very reproducible. The map topography of the responses obtained after either median or tibial nerve stimulations was in line with the somatotopic organisation of the sensorimotor cortex.

Our data show that SSEPs can be successfully and reproducibly recorded from a multichannel EEG cap in macaque monkeys. This minimally invasive method to record large-scale neuronal networks in real-time can be useful if repeated assessment of the cortical activity is desired, for example to study functional damage and recovery after a central nervous system lesion. In this case, topography of SSEPs will allow to assess the possible cortical reorganisation of neuronal networks and relate it to functional recovery. The tool we developed is very relevant in the context of promoting non-invasive approaches also in animal research.

Rouiller E. M.

Thalamocortical projections to the premotor cortical areas following unilateral lesion of primary motor cortex (M1) in macaque monkeys in presence or absence of anti-Nogo-A antibody treatment

The premotor cortical area (PM) contributes to the preparation and programming of skilled movements. While the thalamocortical projections to M1, the dorsal premotor cortex (PMd) and the ventral premotor cortex (PMv) have been extensively described in intact macaques, almost nothing is known about the patterns of thalamocortical projections to PM after unilateral lesion of M1, representing an important issue as PM was shown to contribute to the incomplete functional recovery. The goal of the present study was to investigate the thalamocortical projections to PM in macaque monkeys after unilateral lesion of M1 and to assess the influence of anti-Nogo-A antibody treatment.

The origin of the thalamic projections to PM was derived from injections of the retrograde neuroanatomical tracer BDA into PM in ten adult monkeys. Three monkeys were intact and seven monkeys were subjected to a unilateral cortical lesion produced by microinfusion of ibotenic acid in the hand area of M1. In the lesioned monkeys, three monkeys were treated with the anti-Nogo-A antibody and four monkeys were untreated. The anti-Nogo-A antibody treatment was delivered immediately after the lesion during 4 weeks. Following hand dexterity recovery, BDA was injected in PM on the lesioned hemisphere. The distributions of BDA-labelled neurons in the thalamus was plotted and then superimposed to photomicrographs obtained from the corresponding Nissl and/or SMI-32 stained sections. The number of retrogradely BDA-labeled thalamocortical neurons was normalized based on the volume of the BDA injection sites in PM. The normalized number of labeled thalamocortical neurons was significantly enhanced in the monkeys subjected to M1 lesion, as compared to the intact monkeys. However, there was no difference between the untreated and the anti-Nogo-A antibody treated monkeys. The distribution of labeled neurons across the thalamic nuclei of origin was comparable in the 3 subgroups of monkeys, with a predominance in the ventral thalamic nuclei, mainly VL. The present data suggest

that, as a result of lesion in M1, some thalamic inputs originally sent to M1 may be redirected to PM.

M. Kaeser, Shahid Bashir, Alexander Wyss, Adjia Hamadjida, Yu Liu, Jocelyne Bloch, Jean-François Brunet, Julie Savidan, Abderraouf Belhaj-Saif, & Eric M. Rouiller

Short-term effects of unilateral lesion of the primary motor cortex (M1) on ipsilesional hand dexterity in adult macaque monkeys

Although the arrangement of the corticospinal projection in primates is consistent with a more prominent role of the ipsilateral motor cortex on proximal muscles, rather than on distal muscles involved in manual dexterity, the role played by the primary motor cortex on the control of manual dexterity for the ipsilateral hand remains a matter a debate, either in the normal function or after a lesion. We therefore tested the impact of permanent unilateral motor cortex lesion on the manual dexterity of the ipsilateral hand in 11 macaque monkeys, within a time window of 60 days post-lesion. For comparison, unilateral reversible pharmacological inactivation of the motor cortex was produced in an additional monkey. Manual dexterity was assessed quantitatively based on three motor parameters derived from two reach and grasp manual tasks. In contrast to the expected dramatic, complete deficit of manual dexterity of the contralesional hand that persists for several weeks, the impact on the manual dexterity of the ipsilesional hand was generally moderate (but statistically significant) and, when present, lasted less than 20 days. Out of the 11 monkeys, only 3 showed a deficit of the ipsilesional hand for 2 of the 3 motor parameters, and 4 animals had a deficit for only one motor parameter. Four monkeys did not show any deficit. The reversible inactivation experiment yielded results consistent with the permanent lesion data. In conclusion, the primary motor cortex exerts a modest role on ipsilateral manual dexterity, most likely in the form of indirect postural control.

F. Lanz, Belhaj-Saif A., & Rouiller E. M.

Visual threshold evaluation in human and non-human primates

The cross-modal integration can be defined as the capability to integrate information from different modalities at the same time, with the aim at enhancing perception and also better adapting to our environment. Several studies in human and non-human primates showed that, in a sensory-motor task close to the sensory thresholds, cross-modal integration leads to a significant increase of the percentage of correct responses and a decrease of the reaction time. These advantages are assimilated to facilitatory effects. One of the essential parameter to assess this effect of multisensory integration lies in the search of the sensory thresholds. Indeed, the reliability of the estimated thresholds depends not only on the used stimulus (here visual and auditory cue), but also on the used methodology. For the auditory stimuli (noise or tones), the thresholds were determined by an automated procedure based on intensity steps of 1 dB. The choice of the visual cue (static, moving, shape) was however less evident. In the perspective to find the most relevant visual thresholds, we tested a series of protocols performed in human and non-human primates to determine the most appropriate visual cue. In this study, we have developed a method to evaluate the visual thresholds based on automated behavioural procedure with positive reinforcement, using a green flash generated by a light emitting diode (LED). Indeed, the LED allows a precise modulation of its luminous intensity by the modification of its frequency (Hz). In this case, the precision of thresholds evaluation was obtained by steps of 1 Hz. The preliminary results obtained on 6 human subjects' show that the lowest mean visual threshold obtained in one subject was at 24.3 Hz (range 24.3-28 Hz). In conclusion, the LED is a reliable method for the evaluation of visual thresholds. The average threshold determined on several subjects will serve as a reference to set the visual intensity in dB, for subsequent precise control of visual and auditory intensities in the cross-modal task.

J. Savidan, T. Wannier, J. Bloch, M-L. Beaud, E. M. Rouiller, & A.

Belhaj-Saif

Effect of anti-Nogo-A antibody treatment in hand dexterity recovery following unilateral hemisection: Electrophysiological study in non-human primates

Anti-Nogo-A antibody treatment has shown in both rat and non-human primate to improve recovery of hand dexterity following spinal hemisection. Such behavioral improvement was correlated to new sprouting of corticospinal (CS) axons caudal and rostral to the lesion. Nevertheless, the functional role of such new CS sprouting in the recovery process needed to be assessed. Separately the BDNF has shown to improve axons growth and to be implicating in inhibition of the neurite outgrowth inhibition, so potentially to improve the recovery after a spinal cord injury. In recent work we assessed the effect of combined treatment of anti-Nogo-A antibody and BDNF after a spinal cord lesion in adult macaque monkeys using transcranial electrical stimulation (TES). The obtained results were correlated to behavioral recovery of the hand dexterity. The behavioral and TES data was analyzed in 4 adult monkeys that were submitted to unilateral cervical spinal lesion (C7/C8). Two monkeys were treated intrathecally with anti-Nogo-A antibody and BDNF, whereas a control antibody was infused in the other monkeys.

The TES results showed that there were no significant differences between treated and untreated monkeys. These results were correlated with the recovery of the hand dexterity that didn’t show any beneficial effects of this combined treatment compared to the control group.

Therefore, following these results our ongoing study will investigate the functional role of these new projections only in anti-Nogo-A antibody treated monkeys, using sophisticated methods: stimulus triggered averaging of EMG activity from chronically recorded forelimb muscles in monkeys before and after lesion. In this project, we will focus principally on the primary motor cortex (M1).

E. Schmidlin, Hamadjida Adjia, Baechler Joël, Bashir Shahid, Belhaj-

Saïf Abderraouf, Rouiller Eric, & Hoogewoud Henri-Marcel

Effect of anti Nogo-A antibody treatment on cortical lesion of the primary motor cortex (M1) of macaque monkeys assessed with Magnetic Resonance Imaging (MRI) correlated with manual dexterity recovery

Central nervous system (CNS) lesions in adults results generally in intractable deficits. In particular, cortical lesions affecting in extenso the primary motor cortex hand area strongly decreases the manual dexterity in human patients. Recent studies in rodents have shown that a treatment enhancing the axonal growth increased the plastic reorganization of the brain and the functional recovery following cortical injuries. The aim of this study was to assess MRI signal changes in the cortical parenchyma resulting from a permanent cortical lesion and their evolution in three adult macaque monkeys; two animals served as control and one animal was treated with the anti Nogo-A antibody, to neutralize the axon growth blocking effect of Nogo-A.

The cortical lesion was made unilaterally by microinfusion of ibotenic acid in the functionally defined hand area of M1. MRI sessions were performed at repeated time points: several days before the lesion, 24 hours immediately after the lesion, four times with a week interval and a last one several months later. Under deep anesthesia, the head of the animal was placed in a non ferro-magnetic fixation frame. The location and orientation of the head were constant along the different sessions. Image analysis was performed using the OsiriX© software. The impact of the lesion has been assessed in two animals (one treated and one control) by testing their manual dexterity using a precision grip task

One day after the cortical lesion, a hypersignal was observed in the MRI data, which location and size corresponded to the injection sites. The temporal comparison of this hypersignal between the animals showed a faster disappearance in the treated animal, as compared to the control animals. The cortical lesion resulted in a dramatic decrease of performance in the manual dexterity task in both groups, meanwhile a particular analysis of the precision grip showed an increased recovery in the treated animal.

These preliminary results suggest a faster decrease of the hypersignal in the animal treated with the Anti-Nogo A antibody treated monkey, as compared to the control monkeys. The structural changes observed between the two groups of animals can be the result of vascular and/or pathological changes in the parenchyma. Further investigations with focused acquisitions protocols have to be performed.

L. Chouiter, J.-M. Annoni, & L. Spierer

Distinct brain networks support inhibitory control of the two languages in late bilinguals

Bilinguals show remarkable ability to switch between languages depending on contextual demands. Cognitive control of language selection varies with language proficiency, but little is known on intra-language inhibitory mechanisms. We investigated the spatio-temporal brain mechanisms supporting inhibition of reading in first and second language. We addressed this question by contrasting electrical neuroimaging analyses of visual evoked potentials (VEPs) recorded in twelve late bilinguals during the completion of a bilingual color-stroop paradigm with Language (First/L1; Second/L2) and Congruency (Congruent; Incongruent) as within subject factors. Behaviorally, we observed a main effect of Congruency and a interaction Language * Congruency, respectively driven by longer response time to incongruent than congruent trials (i.e. the stroop effect) and by larger stoop effect for L1 than L2. At the electrophysiological level, we replicated the classical stroop effect and the effects related to reading L1 vs. L2. We observed a significant interaction between factors Language and Congruency 390 to 460 ms post-stimulus onset at both the topographic and global field power levels, indicating that the inhibition of automatic reading in L1 vs L2 is supported by distinct brain networks. Electrical sources were then analyzed with the same Language * Congruency design over the time period showing the significant VEP interaction. The results revealed a significant interaction at the level of the anterior cingulate, the left temporo-parietal junction and right inferior frontal gyrus. We interpret our results in terms of qualitatively distinct executive mechanisms for the control language depending on proficiency and age of acquisition

D. A. Magezi, Khateb, A, Mouthon, M, Spierer, L., & Annoni, J.M

Language control in bilinguals: an electrical neuroimaging study

It remains unclear whether the neural mechanisms for controlling language switching in bilinguals are different from general cognitive control mechanisms. The current study measured brain event-related potentials (ERPs) of bilingual volunteers as they made verbal responses to visual stimuli under four conditions: two linguistic and two general cognitive conditions, both with and without switching. A two-by-two analysis of variance (ANOVA) of the waveforms and the sources (using a distributed linear inverse solution), revealed a significant interaction, giving strong evidence for language-specific control mechanisms. Furthermore, during the linguistic-switching condition, activity at the source-level varied with language proficiency.

M. Mouthon, Asaid Khateb, Alan J. Pegna, Stéphane R. Simon, François Lazeyras, Caroline Lehr, Hannelore Lee-Jahnke, & Jean-Marie Annoni

Second language proficiency modulates the brain language control network in bilinguals: an event-related fMRI study

Humans have the extraordinary ability to manage the use of several languages in a very precise way in their everyday life. The brain's network involved in this control process was the subject of several functional studies which pointed to the participation of various brain regions including the caudate nucleus (CN), anterior cingulate cortex (ACC) and the prefrontal cortex (PFC). The present functional magnetic resonance imaging (fMRI) research aimed at better characterizing the so called "language control" network and assessing the influence of bilinguals' second language proficiency on it. For this purpose, brain activation was compared through conditions manipulating both task and language selection processes as well as simple non-selection contexts. Our analyses confirmed the implication of the CN, ACC and PFC in language selection processes with an even

more extensive engagement during the selection of the weaker language. We showed that some structures are recruited during the selection of L2 and L1 words (e.g. ACC) while others were recruited only during the weaker L2 (CN). We observed that the second language proficiency modulates activity in several brain areas, even when the task concerned the selection of the first language. These analyses indicate that language selection uses specific brain modules, which are recruited gradually depending on the difficulty of the task at hand and the complexity of the language aspect to process.

S. Dieguez, Karin Buetler, & Jean-Marie Annoni

Bilinguals as a research tool for cognitive neuroscience

To date, research interest on bilingualism has mostly focused on questions related to language processing and frontal executive functions. While such pursuits have been valuable and are still ongoing, another approach to bilingualism has been largely neglected. We suggest that bilinguals can be used as a powerful research tool to investigate embodied cognition and spatial processing.

Because the bilingual's brain harbor distinct language systems each tapping into shared perceptual, semantic and motor systems, they afford a unique chance to study the links between linguistic and extra-linguistic processes within the same individuals.

Our projects involve revisiting classic paradigms in cognitive and social psychology by comparing performance in different languages. Participants are carefully screened for level of proficiency, age of acquisition, length of education and degree of immersion, as related to their use of their second language (L2). Compared to performance in their first language (L1), this provides an opportunity to dissociate phonemic, lexical and semantic mechanisms from other parameters (being equal across languages as they pertain to the same individuals) in any given task.

We are currently investigating bilingual versions of spatial coding of affective evaluation, implicit association test, self-other distinction, number space representation and visual object and scene perception. In return, such investigations might help address a central question of

bilingual research: do bilinguals remain the same "person" when they use one language or another.

A. Manuel, Narges Radman, Delphine Mesot, Leila Chouiter, Stephanie Clarke, Jean-Marie Annoni, & Lucas Spierer

Error analysis in ideomotor apraxia: by a large-scale lesion-symptom mapping study on subacute brain-damaged patients

Accurate pantomimes of object or tool use to command require precise representations and execution of movements as well as a selection of the most task-relevant gestures. Prominent models of apraxia and functional neuroimaging evidence consistently predicts a critical role for left parietal cortices in pantomime and advance that this area store representations of tool use required for planning and executing the pantomimes. By contrast, lesion data from the chronic state indicate that pantomime depends on the integrity of left inferior frontal but not parietal areas, in turn suggesting that defective feature selection is the critical cause of pantomime errors. In the present study, we investigate i) the anatomical correlates of apraxia in the subacute and early chronic stages, i.e. before major re-organization could have taken place; and ii) the distinct pantomime errors types following lesion to different brain regions. To address these questions, we conducted a large-scale retrospective voxel-based lesion-symptom mapping statistical analysis on a group of 156 unselected right and left brain-damaged patients. We analyzed separately continuous scores of configural/spatial and body parts as object pantomime error types collected during the subacute stage. Our results reveal the involvement of left parietal regions in pantomime and a left intra-hemispheric dissociation for different types of error. Spatial/configural pantomime errors were associated with left parietal and inferior frontal lesions, while body part as object errors were associated with left middle and inferior frontal lesions. Collectively, these results suggest that the specificity of parietal areas for pantomime are revealed during the subacute state and a left intra-hemispheric dissociation for various aspects of pantomime, but with an unspecific role for inferior frontal regions in pantomime.

K. Buetler, Leila Chouiter, Jean-Marie Annoni, Lucas Spierer, & David Magezi

When stationary sounds are moving – the auditory motion aftereffect: an electrical neuroimaging study (Ongoing study)

The visual motion aftereffect (vMAE) is a well-known and compelling phenomenon. After prolonged gazing at a visual pattern moving in a single direction (referred to as "adaptor" stimulus), a stationary pattern ("probe") is perceived as moving in the opposite direction. This phenomenon is also observed for sounds, where it is referred to as the auditory motion aftereffect (aMAE). However, in contrast to vision, the physiological mechanisms underlying auditory motion perception, both real and illusory, are poorly understood. While direction-specific motion-sensitive neurons have been well-studied in vision, their existence in the auditory system is still a matter of debate. On the one hand, some researchers propose that such neurons are present in the ascending auditory system and that, analogous to the vMAE, the aMAE results from adaptation of low-level unimodal, motion detectors. Other researchers propose that auditory motion perception is based on a "snap shot" mechanism that is not direction-specific. In this case, the aMAE may be due to high-level, multi-modal processing. In order to address these issues, the current study measured scalp potentials of human participants during an auditory motion discrimination task, using broadband sounds presented over headphones. Following exposure to an adapting sound, moving horizontally in a single direction, participants were asked to indicate the direction of motion of a probe sound. Unbeknown to the participant, the majority of the probe sounds were stationary. As predicted by the aMAE, participants reported most of the stationary probes as moving in the direction opposite to that of the adaptor. This aMAE was not observed during the control conditions, where the adaptor was either stationary or moving horizontally in both directions (left and right). This would be consistent with the hypothesis that the aMAE is due to direction-specific motion detectors. Furthermore, the aMAE was not observed when the adapting sound was replaced by a horizontally moving visual pattern, suggesting that the effect may not

be multimodal. Scalp potentials are currently being analysed. Our hypothesis is that the aMAE is due to adaptation of direction-specific neural populations and we propose an opponent-channel system for motion-detection, with right-hemisphere dominance. We expect that the auditory evoked potentials (AEPs) for probes that were reported as moving in the direction opposite to the adaptor (i.e. consistent with the aMAE) will be different from the AEPs to probes where this was not the case. By performing source-analysis algorithms on this difference, this study would be the first, to the authors' knowledge, to reveal the neuro-anatomical basis of the aMAE. A similar source-analysis of the control conditions would allow us to directly test whether the aMAE is due to direction-specific opponent-channels.

N. Ruffieux, A. Wonkam, A.K. Njamnshi, E. Mayer, R. Sztajzel, R.F. Doh, S.C. Eta1, A.-M. Kengne, R.N. Ngamaleu, J. Chanal, & C.-A. Hauert

Déficits cognitifs chez l'enfant drépanocytaire: données camerounaises

La drépanocytose compte parmi les maladies génétiques les plus répandues dans le monde. Comme les accidents vasculaires cérébraux (AVC) constituent l'une des complications les plus handicapantes de cette maladie, les drépanocytaires sont particulièrement à risque de présenter des déficits cognitifs.

L'objectif de ce travail était de mettre en place un examen neuropsychologique systématique pour les enfants et adolescents souffrant de drépanocytose au Cameroun, où la drépanocytose constitue un problème majeur de santé publique. Une batterie de 10 tests psychométriques évaluant 4 domaines cognitifs (fonctions exécutives, attention, mémoire et dextérité manuelle) a été adaptée au contexte socio-culturel camerounais et des données normatives ont été récoltées à Yaoundé auprès de 125 sujets en bonne santé. La batterie a ensuite été administrée à 96 enfants et adolescents souffrant de drépanocytose.

Les principaux résultats indiquent que 1) la prévalence des déficits cognitifs chez les drépanocytaires au Cameroun est élevée, même chez

les patients n'ayant pas souffert d'AVC; 2) la maladie a un impact négatif sur le fonctionnement exécutif et attentionnel, alors que la mémoire et la dextérité manuelle sont relativement préservées; 3) les déficits exécutifs augmentent avec l'âge; 4) l'anémie a un effet négatif sur les fonctions exécutives, alors que l'hémoglobine foetale exerce un effet "protecteur" sur les fonctions exécutives et attentionnelles.

L'ensemble de ce travail suggère que l'examen neuropsychologique peut contribuer à l'amélioration de la prise en charge des drépanocytaires et qu'il constitue un instrument particulièrement bien adapté pour les pays en voie de développement. Ce projet a permis d'établir les premières bases de l'utilisation de l'examen neuropsychologique au Cameroun. Dans la continuité de ce travail, nous projetons de développer dans ce pays un programme de réhabilitation cognitive pour les enfants drépanocytaires.

F. Ribordy, Pamela Banta Lavenex, & Pierre Lavenex

Discrete stages in the development of hippocampus-dependent spatial memory in children

Episodic memories for events that happen in unique spatiotemporal contexts are central to defining who we are. Yet, there is a significant period during early childhood when episodic memories are incapable of being formed or recalled. Here, we studied the development of allocentric spatial memory, a fundamental component of episodic memory, which is dependent on the integrity of the hippocampus in adult subjects. Children were tested in a real-world spatial memory task. Rewards were hidden beneath cups distributed in an arena, in presence or absence of local cues marking the rewarded locations. One group of children was tested with one rewarded location amongst four potential locations, whereas another group of children was tested with three rewarded locations amongst 18 potential locations. In the group of children aged 17-39 months (n=38) tested with four potential locations, 58% of 17-23-month-olds found the rewarded location reliably in the presence of the local cue, whereas 100% of the 25-439-month-olds did. In the allocentric spatial condition (no local cue), only 21% of the 17-23-month-olds tested found the rewarded location

reliably, whereas 84% of the 24-47-month-olds did. In the group of children aged 25-61 months (n=44) tested with 18 potential locations, all children found the three rewarded locations reliably in the presence of the local cues. In contrast, in the allocentric spatial condition (no local cues), only 18% of the 25-42-month-olds found the rewarded locations reliably, whereas 96% of the 44-61-month-old children did. These findings indicate that the ability to form a basic allocentric representation of the environment is already present in 25-month-old children. However, more precise, potentially richer, allocentric spatial memories develop between 25 and 43 months of age. These discrete developmental stages might be dependent on the maturation of specific hippocampal circuits, which in turn may underlie the eventual emergence of episodic memory.

L. J. Chareyron, Pamela Banta Lavenex, David G. Amaral, & Pierre Lavenex

Cellular changes underlying the normal postnatal development of the amygdala: a stereological study in monkeys

Abnormal development of the amygdala has been linked to several neurodevelopmental disorders, including schizophrenia and autism. However, the postnatal development of the amygdala is not easily explored at the cellular level in humans. We therefore performed a stereological analysis of the monkey amygdala in order to characterize the cellular changes underlying its normal structural development in primates. We counted the number of neurons, astrocytes and oligodendrocytes, measured the size of neuronal somas and the volume of the main amygdala nuclei at different postnatal ages. The lateral, basal and accessory basal nuclei exhibited the same developmental pattern, with a large increase in volume between birth and three months of age, followed by a slower growth until at least 5-9 years. In contrast, the central nucleus was already highly developed at birth and increased significantly in volume only between one year and 5-9 years of age; the medial nucleus was highly developed at birth and exhibited only a marginal increase in volume to reach adult levels. Quantitative analyses of different cell types revealed that neither neuronal soma size nor the numbers of neurons or astrocytes changed

during postnatal development. In contrast, there was a large increase in oligodendrocyte number and myelination, which was associated to an increase in amygdala volume after one year of age. Interestingly, at birth, the paralaminar nucleus contained a large pool of immature neurons that developed gradually into mature neurons, leading to a late increase in volume of this nucleus. Our findings revealed that different amygdala nuclei have distinct developmental profiles and that the amygdala is not fully mature until young adulthood. We discuss how pathogenic factors at different postnatal ages might lead to the abnormal development of distinct amygdala circuits, thus contributing to different neurodevelopmental disorders affecting amygdala structure and functions in humans.

B. Perriard & V. Camos

Working memory capacity in French-German bilinguals

It was suggested that bilinguals have advantage on complex non-verbal tasks, because of the superiority of their executive functions (Bialystok et al., 2010). More especially, Bialystok et al. (2004) have shown that bilinguals gave faster answers on trials in a Simon task and concluded that bilinguals had better inhibitory capacity. However, in a replication with children when language and socio-economic status (SES) are controlled, difference between bilinguals and monolinguals disappears (Morton & Harper, 2007).

The aim of the present study is to reassess the difference between bilinguals and monolinguals adults while controlling other variables as Morton and Harper did. We then contrasted in a Simon task two groups of young adults with equivalent mean age, French proficiency, SES, and working memory capacity. Contrary to previous findings, our two groups showed no difference in the Simon task. Thus, it could be suggested that previous observed difference relied on impact of other variables like SES. It remains possible that the better inhibitory capacity between monolinguals and bilinguals depends also on the distance between the two languages mastered by the bilinguals. Indeed we contrasted two European languages whereas Bialystok compared Asian population speaking English.

A.-L. Oftinger & V. Camos

Developmental interplay between attentional refreshing and articulatory rehearsal in working memory

Past research in adults shows two mechanisms of maintenance of verbal information in working memory, articulatory rehearsal and attentional refreshing. Rehearsal in Baddeley's model is already in use at 7 years of age (Tam, Jarrold, Baddeley, & Sabatos-DeVito, 2010). At that age, children also use attentional refreshing mechanism described in time-based resource-sharing (TBRS) model (Barrouillet, & Camos, 2010). The present study evaluated the interplay between these two mechanisms and its changes from 7 to 9.

In a complex span task, children have to maintain letters, while they performed a concurrent task. The opportunity for attentional refreshing was manipulated by varying the attentional demand of the concurrent task. This task was performed either silently or aloud, the latter involving an additional articulatory suppression.

As expected, recall performance increased with age. The articulatory suppression had a detrimental effect on recall, but it did not varied across the age groups. Finally, increasing the attention demand of the concurrent task reduced recall, but this effect did not interact with age, or with articulatory suppression. To conclude, the efficiency of the articulatory rehearsal or the attentional refreshing did not improve from 7 to 9, contrary to previous results.

C. Gillioz

Influence of emotion components on the specificity of emotion inference

Research on emotion inference has led to different conclusions regarding the specificity of the emotion included in the readers' mental representation of the text. Whereas Gernsbacher et al. (1992) argued that readers do infer specific emotions during reading, Gygax et al. (2003, 2004) showed that readers do not differentiate between similar emotions during reading. One possible explanation for the non

specificity of emotion inferences found in these studies may be that readers did not have sufficient information to infer a specific emotion, not in terms of quantity (investigated by Gygax et al., 2004) but in terms of quality. In this study, we focused on the content of the narratives, in terms of emotion components. We manipulated the degree of typicality of emotional narratives by varying the degree of typicality of the emotion components in the stories. 24 emotional narratives were constructed based on the emotional features contained in the GRID instrument (Scherer, 2005), that assesses which feature of each emotion component is the most likely to be inferred when an emotion term is used in one's own cultural group. There were three versions of each narrative. In the typical version, the narrative included all components qualified by their most typical feature. In the similar version, the features of two components (motor expression and psychophysiology) were congruent but not typical of the target emotion. In the filler version, these two components were omitted. Results showed that target emotion sentences were read slower in the typical condition. We suggest that when confronted to typical components and as the text itself provides sufficient information to restrict their representation, readers may engage in a process of including specific inferences, restricting their mental model of the described emotion to a specific one, which may not exactly match the emotion presented in the target sentence (created by the experimenter).

S. Miellet, Klaus Kessler & Nienke Hoogenboom

Visual and embodied perception of others: The neural correlates of the "Body Gestalt" effect

When we perceive others in everyday life, their bodies are often partially occluded. High-level visual areas are known to automatically complete partially occluded objects, as revealed by classic "gestalt" phenomena. In contrast, using novel stimuli with a face and two hands that could either form a "Body Gestalt" (BG) or not, we showed, across 5 behavioral experiments requiring imitation of finger movements, that BG completion is an "embodied" process and not purely visual. Moreover, it seems that the BG completion relies more on posture resonance than motor resonance. Finally, an MEG study

revealed a clear early (during static stimulus, before finger movement) BG effect in the time domain and a BG effect in the 8-12Hz range during finger movement (more α suppression in the BG compared to the noBG conditions). Analyses of the cortical sources of the ERF- and the TFR- modulations are carried out in order to test if the robust Body Gestalt effect we observed depends on the mirror neuron system and/or the proprioceptive body schema.

M.-P. Haefliger, J. Lao, & R. Caldara

Does social evaluation of faces require the integrity of the neural face network? Insights from an acquired case of prosopagnosia

he recognition of faces and their evaluation on social dimensions are critical processes routinely performed by humans to sustain efficient social interactions. Neuroimaging studies have clearly demonstrated that the evaluation of faces on social dimensions recruits recruits a neuronal network similar to face recognition, but with greater subcortical responses in the amygdala. Interestingly, developmental prosopagnosics are impaired to recognize faces with no apparent brain lesions, but show normal performance for evaluating trustworthiness. Nevertheless, the extent to which this observation is related to an intact functional connectivity between the high-order face-sensitive regions with the amygdala remains to be clarified and verified for other important social judgements.

To address both issues, we tested the perceptual space of a well-studied single-case of acquired pure prosopagnosia (PS), suffering from bilateral lesions in the occipito-temporal cortex with a spared amygdala. As expected, PS was impaired in performing visual and social similarity judgments on faces presented in pairs. More importantly, PS performance for the diverse social judgments from faces was normal.

Our data clearly show that the evaluation of social dimension for faces does not rely on the brain areas devoted to face recognition. These findings posit the amygdala as a critical filter for face evaluation.

J. Krummenacher & J. Hoffmann

Investigating Event-Related Potentials of the EEG in Selective Attention Tasks

Electro-encephalography (EEG), due to its high temporal resolution, resolution has recently become the method of choice in research attempting to decompose overall reaction times into separate definite components. Using the event-related potential (ERP) technique, we focus on studying the functional architecture of the cognitive system underlying visual selective attention. The ERP technique relates EEG activity recorded from the participant's scalp to external sensory events, for example the presentation of visual or auditory target stimuli. Characteristic patterns in the ERP waveform, the ERP components, reflect brain activity associated with specific cognitive processes. Examples of ERP components we frequently use are the N2pc (a negativity of the ERP wave about 200 post-stimulus at scalp locations posterior-contralateral to a visual target object) reflecting attentional selection of a target stimulus and the LRP (lateralized readiness potential) reflecting activation at the stage of motor response preparation. The perception-based N2pc and the response-based LRP allow for the distinction of early vs. late effects of selection. Currently, we are investigating the effects of task demands on the behavior in conditions in which participants are presented with physically identical visual stimuli. Results show that, in tasks requiring participants to search for targets differing from distractors by features such as color or orientation, the N2pc, component is modulated dependent on the target's specific characteristics while the LRP component remains unaffected. Task differences – mere detection vs. identification of a target item in a search array – affect the LRP component while the N2pc remains unaltered. We currently aim at integrating the observed pattern of affected and unaffected components into a cognitive model of the functional dynamics of the processes involved in different types of visual search tasks.

J. Krummenacher, P. Luethold & G. Jean-Charles

Eye Movements in Visual Search and Selective Attention

Eye movement parameters such as oculomotor latency and fixation accuracy have been used with much success as pointers to cognitive processes right from the emergence of the cognitive-behavioral approach. In one SNFS-funded project, we use recordings of saccadic eye movements to investigate the relationship between the cognitive mechanisms controlling the allocation of visual selective attention and those governing eye movements. Visual search tasks, in which participants are instructed to decide on the presence or absence of a target presented in an array of non-target objects, constitute our main research tool. Analyzing manual reaction times and oculomotor latencies, together with fixation accuracies, we aim to establish the link between overt and covert attention. Results show that participants use and, responding flexibly to task requirements, adapt strategies that allow them to direct saccades to target locations as quickly as possible. In another SNFS project, we investigate the development of saccade latencies and fixation accuracy in children and young adults between the ages of six and 20 years in different types of visual search tasks. The developmental pattern of healthy children will then be compared to the eye movement parameters of children with attention disorders in order to identify potential sources of attention problems in the cognitive mechanisms underlying the allocation of focal attention.