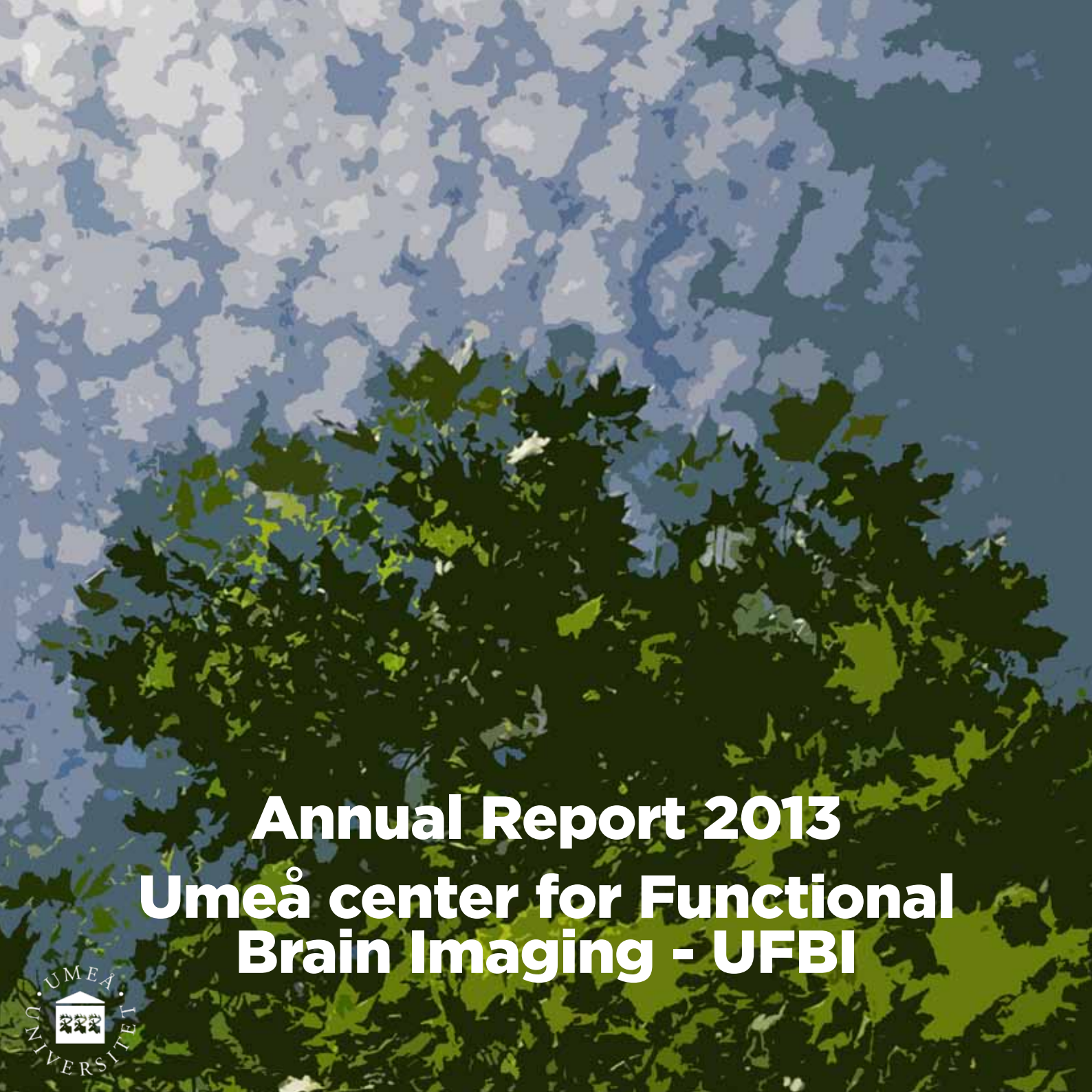


Annual Report 2013
Umeå center for Functional Brain Imaging - UFBI

UMEÅ UNIVERSITET

Content

/ Annual / Report / 2013

Lars Nyberg's Editorial

Welcome to the 2013 Annual Report from Umeå center for Functional Brain Imaging (UFBI). This report is about communication and exchange of ideas. In this context it can be mentioned that UFBI celebrated the 200th lab meeting in 2013, we hosted a workshop on resting-state fMRI in May, and we arranged a mini-symposium on "test-enhanced learning" in June (read more about UFBI meetings and seminars on page 18).

2013 offered many opportunities for us to present our work, including a "lab trip" to San Fransisco and the Cognitive Neuroscience Society meeting (p. 4). Also, in January I was invited by Umeå University to present UFBI – past and present – at Västerbottensdagarna held at the Grand Hotel in Stockholm. This required reflection on past efforts, successes and failures, and also on where to go in the years to come. In part, future activities will likely involve large-scale collaborative work with groups elsewhere in Sweden and abroad. One example of this is our participation in the "ENIGMA consortium" as illustrated by a recent paper with 180+ (!) authors (see Publications). Another example is our involvement in the recently launched Human Brain Project (see p. 8).

Our imaging infrastructure is continuing to operate seamlessly, with a record-high number of scan hours in 2013. This is of course largely due to the dedicated work by our staff at the MRI-lab, and our very competent hardware and software experts. In August, we opened up for a site visit by colleagues from Stockholm University. They are in the process of trying to build an imaging center, and we gladly shared our experiences. The work on infrastructure is constantly ongoing, which is exemplified in this year's Annual Report by texts describing installations of "Synthetic MR" and "motion tracking".

I have said it before; the hard work by students is an essential component of UFBI. In this year's report we present our course on brain imaging, and introduce several new Ph.D.'s affiliated with UFBI. Relatedly, we present some of the many research projects that are currently ongoing. Some of these are led by scientists from outside Umeå, as the pain project summarized by India Morrisson and collaborators from Gothenburg. We also continue to interact closely with colleagues at the Karolinska Institutet (KI) in Stockholm. This includes the support by our UFBI board director (Martin Ingvar), KI-collaborators in the Betula and Cobra projects, and the strategic neuroscience program (StratNeuro). The newly installed MEG scanner at the KI (p. 8), a nation-wide resource where I represent Umeå University, offers additional opportunities for collaborations.

In summary, as in previous reports, our ambition is to give you readers a glimpse of the activities that were ongoing in 2013, and in that way share some of the excitement we experience in our daily work on the mysteries of the human brain.

February 2014
Lars Nyberg, UFBI Director (2001 - Present)

In Short

In 2013 the

39

members of UFBI together produced:

15 conference presentations

13 published articles

4 DISSERTATIONS

in December we had our

200th labmeeting

775 hours of scanning

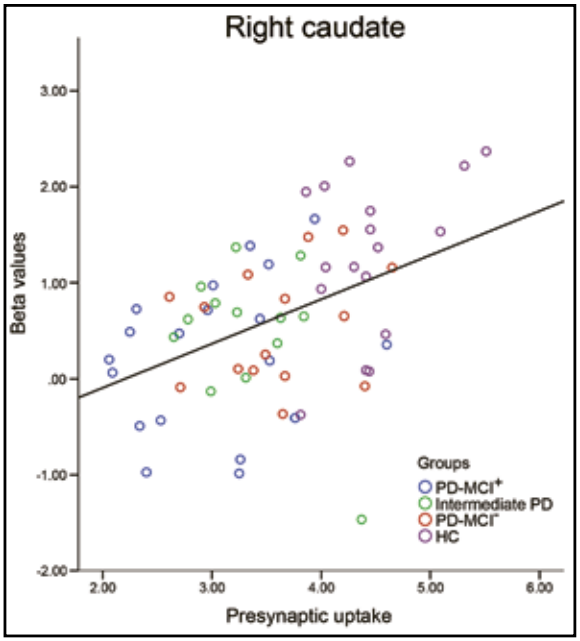
6 clinical fMRI sessions

610 clinical MR sessions

Research

NYPUM

The new parkinson patient in Umeå (NYPUM) project is an ongoing (started in 2004) longitudinal population-based cohort study of incident patients with idiopathic parkinsonism, including Parkinson's disease (PD). The projects ambition is to identify all new cases with idiopathic parkinsonism within the Umeå catchment area (approximately 140 000 inhabitants), and follow them in their disease progression for at least five years. The included patients repeatedly undergo extensive investigations that engage many scientists in several disciplines from both preclinical- and clinical research. An important part of the versatile project is to investigate the evolvement of cognitive functioning in PD related to brain responses.



A significant correlation (r = 0.44, p < 0.001) between functional MRI blood-oxygen-level-dependent signal and SPECT presynaptic dopamine uptake in the right caudate for Parkinson's disease patients with MCI (PDMCI+; blue), Parkinson's disease patients with intermediate MCI (green), Parkinson's disease patients without MCI (PDMCI-; red), and healthy control individuals (purple).

Cognitive impairment is common in PD and many patients have mild cognitive impairment (MCI). The risk of developing PD-dementia is highly increased for patients with MCI compared to patients without MCI. Repeated examinations with functional MRI and single photon emission tomography (SPECT) are used to increase understanding of the functional basis of PD-pathology and cognitive impairment.

Urban Ekman

Key imaging findings within NYPUM include:

• De novo drug-naïve patients with PD demonstrated transient under-recruitment in striatum (caudate and putamen) compared to healthy controls. The reported finding demonstrated that patients with PD had impaired phasic components of executive working-memory control subserved by the striatum (Marklund et al., 2009).

• In a cross-sectional study, early-phase PD-patients demonstrated extensive cortical working-memory related under-recruitments compared to healthy controls. Within the PD-group, PD-patients with MCI demonstrated additional under-recruitments in right caudate nucleus and bilateral anterior cingulate cortex (ACC) compared to PD-patients without MCI. Furthermore, the dopaminergic presynaptic uptake (SPECT) were lower in right caudate for patients with MCI compared to patients without MCI, and the presynaptic uptake correlated with the fMRI-signal (Ekman et al., 2012).

References:
Marklund P, Larsson A, Elgh E, et al., Temporal dynamics of basal ganglia under-recruitment in Parkinsons's disease: transient caudate abnormalities during updating of working memory. Brain 2009; 132: 336-46.

Ekman U, Eriksson J, Forsgren L, Jakobson Mo S, Riklund K, Nyberg L. (2012) Functional brain activity and presynaptic dopamine uptake in patients with Parkinson's disease and mild cognitive impairment: a cross-sectional study. The Lancet Neurology; 11: 679-87.

Pain and touch signaling

In May of 2013, the final data was collected on a project in collaboration with India Morrison and Irene Perini, researchers at the University of Gothenburg. The project began in autumn 2011 and focused on a group of rare mutation carriers, most of whom live in Norrland. Carriers of the mutation show reduced density in thinly-myelinated and unmyelinated sensory nerve fibers in the skin, which play crucial roles in signaling pain and touch information (Minde et al, Muscle Nerve, 2004). The Gothenburg team's project investigated the effects of the mutation on the structural and functional neuroanatomy of the brain.

The thin-diameter sensory afferents affected by the mutation are associated primarily with pain, yet the carrier group's thermal pain thresholds did not differ from those of controls (Perini et al, in prep). This implies that their low density of fibers is sufficient for simple thermal detection. Any differences in cutaneous pain processing might lie elsewhere. The Gothenburg team's research asked whether this "elsewhere" might involve pain behavior - not in how one detects pain, but how one reacts to it. Part of the project therefore explored pain behavior using a task that requires using pain information in a behavioral context (Perini et al, J Neurosci, 2013).

Another main part of the project investigated touch. Evidence is emerging that a particular type of thin-diameter sensory afferent, the tactile C or CT afferent, plays a role in affective touch. Affective touch is the loving, affectionate kind of touch you use with your family and close friends. Mutation carriers show an altered subjective evaluation of affective touch stimulation in the form of caressing (Morrison et al, Brain, 2011). A major aim of the project was therefore to chart the neuroanatomy of affective touch pathways in the carrier group. This research also explores the possibility that the carriers have a unique organization of sensory neural pathways in the brain - an organization that might also affect the way social, affective touch modulates stress responses.

India Morrison

Statistics and brain imaging

In 2013, UFBI and the Department of Statistics started a joint project with the title "Longitudinal studies of cognitive aging: Multivariate and fMRI outcomes with non-ignorable dropout". The project is funded by the Swedish Science Council (VR) for four years, 2013-16. Non-ignorable (i.e. non-random) dropout is frequently encountered in longitudinal studies, for instance dropout due to disease or death. At UFBI, such dropout has been seen in e.g. the BETULA and NYPUM studies, and it is expected to appear in the recently initiated COBRA study as well. Thus, the methods developed will find immediate applications. During 2013, two papers have been finished, both included in Maria Josefsson's PhD thesis.

Anders Lundquist

Image processing

For storing and processing fMRI-data we have several servers running on Windows and one with Linux. The researchers connect to those from their office through remote desktop connection. In Matlab they can run analyses in SPM, or using the batch function for several subjects in the in-house program DataZ. Not all data processing can be done on our own computers. E.g. brain segmentations with FreeSurfer is very time-consuming, it typically takes about 24 hours for one brain image. For this type of processing we have access to a 15 000-CPU super computer, named Abisko, located at HPC2N (*http://www.hpc2n.umu.se/*) in the MIT-building at Umeå University. This allows several hundred segmentations to be run at the same time. This service is invaluable for big samples of data, like the ones in Betula, NYPUM and COBRA-projects.

Micael Andersson

Human Brain Project

The Human Brain Project (HBP) is a European-Union funded "mega project" (135 institutions in 26 countries) that aims to work as a platform for integrating and distributing knowledge of the human brain. The long-term goal is to build a computer simulation of the human brain, and was originally conceptualized as a computer model that integrates as much existing data as possible on how the cortical circuits are constructed from the "bottom up", putting together detailed knowledge to find over-arching principles. This original ambition has been complemented with a "top-down" approach that will guide the bottom-up approach, as well as with several other parts.

Currently, the HBP consists of many different components to make the platform feasible and are organized into 13 different sub-projects: strategic mouse brain data, strategic human brain data, cognitive architectures, mathematical and theoretical foundations of brain research, neuroinformatics, brain simulation, high-performance computing, medical informatics, neuromorphic computing, neurorobotics, applications, ethics and society, and management.

UFBI is involved in the HBP from the "top-down" perspective, taking part in the task of describing the cognitive architectures (sub-project 3) that are to be implemented in, and to constrain, the computer models. SP3 consists of further sub-components and Lars Nyberg is heading the component of "working memory".

The HBP has been in planning for many years and has several precursor projects, e.g., the "Blue Brain Project". At last the inauguration of the HBP was held in Lausanne, Switzerland, in October 2013, where Anna-Lena Tallander, Johan Eriksson, and Lars Nyberg participated. The project has thus just started. During 2014 Lars and Johan will work out a working-memory protocol that may be used, together with other protocols crafted by other partners, in a coordinated data-collection effort (in Paris and/or Jülich). The project has a horizon of 10 years, so if successfully evaluated after the initial steps, the UFBI work within HBP will likely expand and be a topic for future Annual Reports.

Lars Nyberg &
Johan Eriksson

Photo: Johan Eriksson

Lars Nyberg and Anna-Lena Tallander (IMB) outside the Rolex forum, Lausanne, Switzerland.

Cerebral blood flow

In collaboration with PIs Jan Malm and Anders Eklund at the Departments of Clinical Neuroscience and Biomedical Engineering, respectively, we are investigating how cerebral blood flow changes with aging and how this may affect brain structure and function, as well as vulnerability to stroke. We are also investigating stroke related functional deficits and potential benefits from innovative rehabilitation strategies by mapping brain function in task and rest conditions.

Stroke is one of the leading causes of death and chronic disability in the world. Moreover, vascular risk factors are frequently associated with cerebral aging and dementia. We aim to improve the stroke diagnosis by adding valuable information concerning the capacity of the secondary, emergency blood vessels that the brain possesses in order to withstand deviations in blood flow of the large cerebral arteries. Ultimately, this information will be used to predict disease development. Another direction of our research in cerebral hemodynamics tries to relate deviations in blood flow, such as decreased perfusion and increased pulsatility, to structural damage and cognitive decline among elderly subjects.

To assess the cerebral vessel hemodynamics we apply high-resolution phase contrast flow measurements with whole brain coverage (4D flow). Additionally we apply 3D arterial spin labeling to quantify brain tissue perfusion. The complementary nature of these techniques allows a comprehensive analysis of deviations in blood flow. The 4D flow measurements have been developed at the University of Wisconsin and within a productive collaboration we are applying this technique to extract vital and previously unknown properties of the cerebral circulation. A technical development is paralleling our clinical studies. Here, we strive to improve 4D post-processing strategies and to develop rational tools that ultimately can be used by clinicians.

In order to understand the neuronal mechanisms underlying stroke related symptoms and effects from symptom rehabilitation we are applying conventional fMRI as well as functional connectivity analyses. Such connectivity analyses maps correlated patterns of intrinsic and/or evoked activity across surface of the brain and adds a further dimension to the MR-based characterization of the neural integrity. This rich information will generate new insights regarding the brain's functional organization and potential functional reorganization following a stroke.

Anders Wåhlin

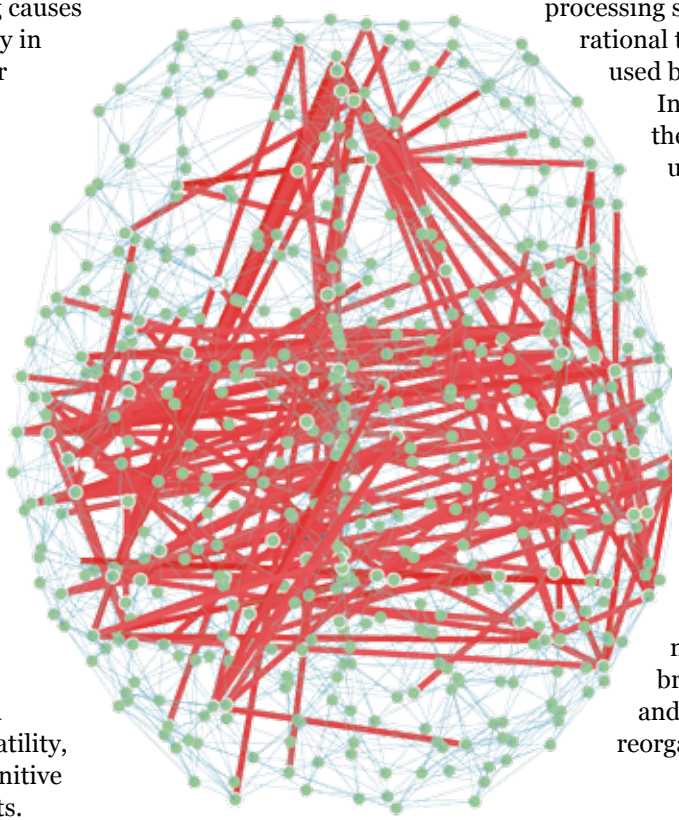


Illustration: Anders Wåhlin

The figure shows a functional connectivity analysis showing widespread alterations in patients with a right-sided stroke.

Intervention

Interventions are intense and require hard work, but believe me it is definitely worth it. When examining data from interventions it feels like you are given a chance to directly study the plasticity of the brain, making interventions tremendously rewarding and exciting. At UFBI, we have several ongoing interventions with healthy individuals as well as various clinical groups, and 2013 turned out to be a good year.

For one of our randomized clinical interventions, RECO (REhabilitation for improved COgnition), we completed a large and busy data collection. This project is performed at the Stress Rehabilitation Clinic at the University hospital of Umeå and together with Lisbeth Slunga Järvholm, Therese Stenlund and Anna Stigsdotter Neely we aim at understanding how rehabilitation of patients with exhaustion disorder affects brain structure and function. It was a three-armed intervention with one group adding a computer-based cognitive training program of executive functions to a current multimodal rehabilitation program and a second group adding physical fitness (cardiovascular) training, the third group underwent the ordinary rehabilitation program and served as controls. In this project we also welcome a new PhD-student, Hanna Malmberg-Gavelin.

For another of our clinical interventions, SOFIE-8, 2013 was the year for our first publication (Månsson et al, 2013, Psychiatry Research, Neuroimaging). This is a joint collaboration with the Universities at Linköping (Gerhard Andersson and Kristoffer Månsson), Uppsala (Thomas Furmark) and Stockholm (Per Carlbring) and we are investigating the underlying neural mechanisms following internet based cognitive therapy of individuals diagnosed with social phobia. To have the first paper published is always rewarding for your work.

Finally, in 2013 we launched a new intervention, PHIBRA (PHysical Influences on BRain in Aging). In this project we will use PET/CT imaging targeting the dopamine system and investigate how physical training affect dopamine receptor availability and cognitive functions of elderly healthy individuals. For this project we have engaged a new PhD-student, Lars Jonasson, and after a fall of planning we will be ready to start the data collection during 2014.

As you have seen 2013 was a busy year for the interventions at UFBI, but I must say that I am already looking forward to see what next year has to offer and my prediction is that it will be both busy and rewarding!

CJ Olsson

Dissertations

In 2013 we had 6 members and collaborators of UFBI that completed their doctoral dissertations (Daniel Sjölie, Susanna Jakobsson Mo, Karolina Kauppi, Sara Pudas, Maria Josefsson and Magdalena Domellöf). Below, three of the new doctors share some thoughts and feelings about their time as PhD students and on page 15 we will read about Karolina Kauppis adventures in Norway.

Towards the end of my PHD studies I increasingly focused on how cognitive neuroscience and brain imaging may inform the development of computer applications designed to work optimally with the human brain. In particular, my thesis focused on how a developed understanding of the neural correlates of the sense of presence may provide a foundation for deliberate design of improved computer-generated virtual reality applications. After the thesis defense I have spent some time teaching. I enjoy teaching, and I plan to continue spending some time teaching, but I will also start to work on research focusing on computer visualization. Given the technological options available for visualizations today it is becoming increasingly important to consider how they may be optimized for the human brain. I hope to contribute to the integration of cognitive neuroscience into human-computer interaction, informing the design of realistic virtual realities and visualizations optimized to synchronize with the human brain.

Daniel Sjölie

The 4th of October 2013 is a day that I will not soon forget. This is when I defended my thesis ”Brain characteristics of memory decline and stability in aging” at the department of Psychology, Stockholm University. More than four years of hard work had led up to this day, with many ups and downs on the way. Overall, the defense went beyond expectation, much thanks to my fantastic opponent, Professor Emrah Düzel from the University Hospital in Magdeburg, Germany. He had very interesting and thoughtful questions for me, and the manner in which he posed them made me feel comfortable answering even the trickiest ones.

As of February 2014 I hold a post doc position at the Department of Integrative Medical Biology at Umeå University. My work will involve integration of cognitive and neuroimaging data from the Brainchild and Betula studies, which will result in a lifespan sample of individuals aged 6-85 years. I look forward to this and to continuing my collaboration with the team at UFBI!

Sara Pudas

After completing a M.Sc. in Statistics from Umeå University, I decided to pursue a PhD in Statistics. I wanted to study a field that was highly quantitative but had many applications to real-world problems.

During my studies I got the opportunity to work in a multidisciplinary team, with both statisticians and cognitive neuroscientists, on problems related to cognitive aging. Despite my sparse knowledge, the weekly seminars organized at UFBI were stimulating and gave me a good introduction to the world of neuroscience. I wrote my dissertation on attrition in studies of cognitive aging, a combination of a fascinating neurological process with interesting statistical properties. It was immensely valuable for me working with professors outside my home department and I learnt a lot from working with Lars and his other students.

Currently, I am teaching at the Department of Statistics and will continue doing research at UFBI.

Maria Josefsson

Zooming in

Kalpouzos, G. & Eriksson, J. (2013). Memory self-efficacy beliefs modulate brain activity when encoding real-world future intentions. PLoS ONE, 8(9), e73850

Text by Gregoria Kalpouzos

"-Could you pick up Lars at school this afternoon, I will work late today.

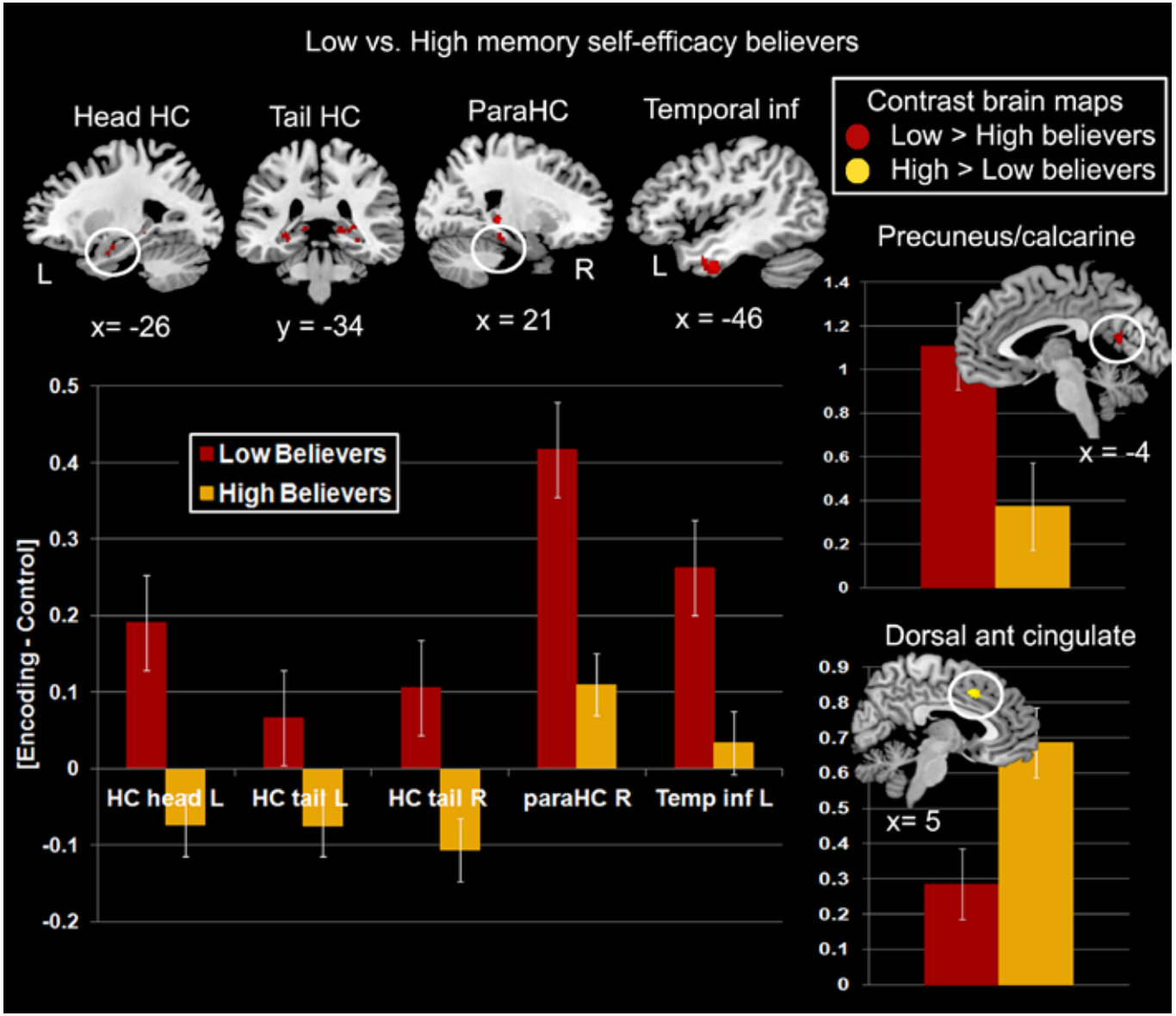
-You'd better remind me again in the afternoon, I have a very bad memory."

It is not uncommon to hear people stating their memory capabilities, especially when they have to remember things to do in the future, a behavior called "prospective memory". Individuals come to know their own cognitive capabilities, partly by inferring them from observations of their own overt behavior. We hypothesized that this knowledge or beliefs of their own memory self-efficacy is likely to drive the implementation of strategies in order to compensate for their shortcomings and thereby optimize performance.

Young adults were asked to complete a general questionnaire about their memory in everyday life, resulting in a score of memory self-efficacy beliefs. The sample was split in two groups: the high-memory self-efficacy beliefs group (who judged their memory to be relatively good), and the low-memory self-efficacy beliefs group (who judged their memory to be relatively bad). The day after, the participants underwent a functional MRI protocol. They had to imagine and memorize errands that were to be performed later in a virtual environment (e.g., throw a candy wrapper in a trash bin). A week later, the participants came back and performed a series of unrelated cognitive tasks.

The results showed that when encoding tasks for later retrieval, the low believers activated more brain regions known to be implicated in episodic memory and visuospatial processes (hippocampus, parahippocampal cortex, precuneus/calcarine), whereas the high believers activated more the dorsal anterior cingulate cortex, involved in cognitive control. Moreover, at the offline tasks, the low believers performed less well at feature binding in working memory, which is an essential cognitive function for episodic memory.

Overall, memory self-efficacy beliefs modulate the neurocognitive processes engaged when having to memorize intentions. The low believers, objectively weaker in feature binding in working memory, rely more on visuospatial mechanisms to enhance memory, while the high believers use more executive-like processes. Because of the experimentally induced high performance at retrieval, it remains unknown whether memory self-efficacy beliefs and the difference in the strategies used had an impact on performance. A next step would be to study the efficacy of the self-engaged strategies at encoding on retrieval success.



Differences in brain activity during encoding between the low and high memory self-efficacy believers (from Kalpouzos & Eriksson, 2013, PLOS ONE).

Illustration: Gregoria Kalpouzos

UFBI in the world

A trip to Cognitive Neuroscience

We were five eager UFBI members who embarked on the long journey to San Francisco. The 2013 annual meeting of the Cognitive Neuroscience Society was a 20-year celebration and we expected a particularly interesting and rewarding conference. We were all equipped with posters to present at any of 8 poster sessions with a total of 1108 presentations. The conference covered a wide range of topics, for example emotion, language, memory, attention, and decision making. Especially intriguing were results from pattern analysis of fMRI-data, studies using electrocorticography (ECoG), and results calling into question accepted explanatory models, just to mention some.

Peter presented results from a study on the effects of testing on brain activity during subsequent restudy. Karolina's poster covered combined gene effects on hippocampal mnemonic processing. Linnea presented results from an fMRI study investigating what brain regions are modulated during repeated testing. Carola's presentation involved results regarding how successful retrieval practice during initial learning of new foreign vocabulary modulates subsequent memory one week after practice. Johan presented fMRI results demonstrating prefrontal cortex involvement in what can be thought of as non-conscious working memory. We all received a lot of positive feedback during the poster session. Many new and interesting questions relating to the different studies were brought up.

We had some free time that we spent walking up and down the famous San Francisco hills and getting acquainted with the sea lions in the harbor (unfortunately we were not able to spend time at Alcatraz). A considerable portion of the walking was the result of trying to find restaurants that would satisfy all members' diverse food preferences. We usually ended up in some alley having hamburgers (there were vegetarian options). As a whole, the conference was very interesting and rewarding and we were even more motivated to pursue new challenges in cognitive neuroscience.

Johan Eriksson
Linnea Karlsson
Karolina Kauppi
Peter Vestergren
Carola Wiklund-Hörnkvist

Photo: Linnea Karlsson

Photo: Private

December 10th

I am watching the first snow as it finally falls in Oslo, and my thought naturally wanders to the north of Sweden – the place where my heart still belongs.

I first came to UFBI as a Master's student in Biomedicine six years ago, since long highly fascinated by the human brain and eager to finally get my research training started. In my PhD work, I had great use for my genetic and medical background by entering the relatively new research field of "imaging genetics". Here, I used brain imaging to study the role of memory-related genes on underlying brain functions. Throughout my time at UFBI, the lab group has provided a highly stimulating research environment with friendly and motivated people with broad expertise. I defended my thesis on June 14th, and was a bit surprised to find myself – despite years of pre-defense anxiety – truly enjoying the event and the opportunity to discuss my work with others.

After the defense, I moved on with a postdoc at the University of Oslo. Here, I apply what I have learnt from imaging genetics of memory to the psychiatry field. I am investigating the role of genetics on brain functions that are relevant to psychiatric disorders. Oslo is a great place to be, both for working and for living, and I see many possibilities for collaboration projects with UFBI. I feel grateful for the opportunity to come here.

Karolina Kauppi

Miscellaneous

NatMEG

In October 2013 the Swedish national facility for magnetoencephalography (NatMEG) opend at the Karolinska Institute (KI) in Stockholm. From UFBI, Lars Nyberg was one of the co-applicants for the grant to acquire the MEG-scanner and he is also sitting in the national steering board for NatMEG.

An inaguration conference was held on October 17-18 at KI and gave an overview of some of the key areas in current MEG-research. Among the speakers were David Cohen (the father of MEG) and Riitta Hari from Aalto University in Finland.

Besides beeing the first facility in Sweden with a MEG-scanner (a Electa Neuromag TRIUX), the facility is unique due to the focus on precision timing of the stimuli presentation. There are several different kinds of stimuli and response equipment allowing researchers to study anything from tactile processing to executive control (*http://www.natmeg.se*).

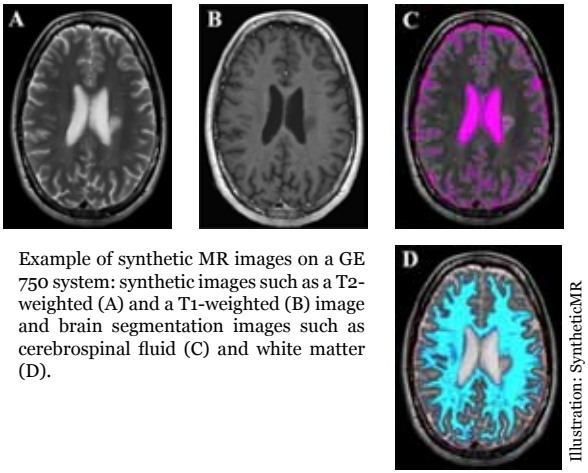
The core staff includes Martin Ingvar (P.I.), Daniel Lundqvist (project manager), Stephen Whitmarsh (post-doc) and Mimmi Wernman (administrative support).

Photo: Stephen Whitmarsh

Synthetic MR

In November 2013 a new pulse-sequence was installed on the scanner. Qmap is a quantitative technique that generates images to serve as input for the software SyMRI™ (*www.syntheticmr.com*). Data obtained in a 6 minutes scan can be used to quantify T1 and T2 relaxation and proton density of the whole brain. A range of normal MR images, such as T1-weighted, T2-weighted or FLAIR, can then be recreated without rescanning the patient. Furthermore, an automatic brain segmentation is performed, giving quantitative measures of white matter, grey matter and cerebrospinal fluid. The method is presently under validation for use both in clinical and research applications.

Greger Orädd



Example of synthetic MR images on a GE 750 system: synthetic images such as a T2-weighted (A) and a T1-weighted (B) image and brain segmentation images such as cerebrospinal fluid (C) and white matter (D).

Illustration: SyntheticMR

Brain imaging course

As part of the masters program in cognitive science, UFBI runs an advanced-level course in functional brain imaging (formally under the regime of the Department of Integrative Medical Biology). While also addressing other neuroimaging techniques such as PET, the focus of the course is on fMRI from a theoretical and practical perspective. As the course covers fMRI from research question to data analysis and interpretation, it is of great value that we have people that can address the different steps with appropriate knowledge, with Lars Nyberg and myself on research design, Greger Orädd on MR physics, and Alireza Salami on data analyses.

Often-appreciated parts of the course are the practical exercises. The students are visiting our MR research facilities at Norrland's University Hospital for demonstration of experimental setup and data collection, and are also working through examples of fMRI data analyses. Throughout the five-week course the students are also working on their own (imaginary) fMRI design that is presented at the end of the course and commented on by their peers. Many interesting ideas and designs have been presented over the years.

The interest for the course continues to grow and it has also spun off into a PhD-student version. The course is not only a way for us at UFBI to disseminate our knowledge, but also works as a path for new students to approach the research field. We have during the last years received more requests for project and thesis work than we can accommodate, and many of these requests are from students that have taken the brain-imaging course. Thus, the course works both ways: by creating an opportunity for students to learn functional brain imaging, and by creating opportunities for us at UFBI to solicit knowledgeable and creative new people.

As PET becomes more and more an integrated modality within UFBI, for the future it may become of interest to expand the part on PET or introduce a separate PET course.

Johan Eriksson

Motion tracking

In the fall of 2013, three high-speed motion tracking cameras were installed in the MR facility at Umeå University Hospital. The cameras installed are to be used in the MOST study (MOvement control in Stroke - clinical and laboratory assessments in relation to brain imaging with fMRI). The main goal with the project is to deepen the knowledge concerning motor function and control of the limbs, focusing on hand/finger movements and restrictions in stroke patients. The new cameras will provide a detailed kinematic movement analysis, and when paired with simultaneously collecting collected fMRI data, this will give a combination that is only possible found in a few labs in the world. Initiators for this project is professor Charlotte Häger, docent Carl-Johan Olsson, professor Louise Rönnqvist and PhD & engineer Helena Grip.

Meetings and seminars

A multidisciplinary research environment, a multi-faceted research agenda, and a growing research group makes structured interaction platforms indispensable. To this end we have weekly lab meetings where project plans, experimental designs, analysis strategies, and results are discussed in an informal setting to take benefit from the whole brain trust of UFBI. Besides these weekly inhouse meetings, members of UFBI usually attend several meetings and conferences held in and outside Sweden, and 2013 was no exception. In this section we present some "memories" from 2013. A complete list of conferences attended by UFBI members can be found on page 25-26.

In the beginning of June, we arranged an international mini-symposium on "Cognitive and brain-imaging studies of test-enhanced learning" at Rex here in Umeå. The aim with the symposium was to present and discuss recent advances in research on test-enhanced learning. In line with research at UFBI, focus was on studies that had used the functional magnetic resonance imaging technique (fMRI).

Invited international speakers were from various parts of the world. We were all excited to have the possibility to meet up, exchange ideas and share the latest research results from our research groups. The longest trip was probably done by Mary Pyc, who has a post-doctoral position at the Department of psychology at Washington University in St. Louis. With no signs of jetlag, Marys' talk focused on when and why testing is so beneficial for memory. A shorter trip had Attila Keresztes and Mihály Racsmány from Budapest in Hungary. Together, they presented their results from an fMRI study where they compared study and test-enhanced learning both in the short- and the long run. Finally, from the Behavioural Science Institute of the Radboud University Nijmegen in the Netherlands, Atsuko Takashima (also Donders Institute for Brain, Cognition and Behaviour) and Gesa van den Broek presented data from three different studies, two behavioural and one fMRI study. Those studies focused on the time frame and neural correlates to the testing-effect in adult learners.

We also had a poster session. The poster-session included research from a spectrum of the psychological- and neurosciences and was not limited to the specific topic of the symposium. The poster session was an opportunity for researchers other than the invited speakers to contribute with their specific research and hopefully get a useful feedback. It turned out to be a very nice event, and a lot of fruitful discussions were held. The first day ended up with a very delicious dinner and possible future collaborations were further discussed during the dinner. Full of energy at the second day, we continued with local

presentations held by Peter Vestergren, Linnea Karlsson and Carola Wiklund-Hörnqvist based on their imaging studies on test-enhanced learning. The mini-symposium ended with a general discussion that encouraged everyone to raise questions and then ended up with some concluding remarks summarized by Lars Nyberg.

In sum, we all had the pleasure to listen to several interesting talks from our international guests, and to discuss various different posters. The symposium contributed with an improved understanding of both the cognitive and neural mechanisms underlying efficient and durable learning which is of significant relevance for education. The mini-symposium also resulted in several new collaboration projects related to test-enhanced learning and the future has just begun for educational neuroscience as a potential research area. We want to thank Inga-Lill Bäckström, Mikael Stiernstedt and Johan Eriksson, UFBI, for assistance during the organization of this symposium.

Thank you all for your participation,
The Organizing Committee

Carola Wiklund-Hörnqvist, PhD-student,
Department of Psychology & UFBI

Linnea Karlsson, PhD.
Senior Postdoctoral Research Fellow, UFBI

Peter Vestergren, PhD.
Postdoctoral Research Fellow, UFBI

Lars Nyberg, PhD. Professor. Director,
Umeå Center for Functional Brain Imaging (UFBI)

New Members

Name: Linus Andersson
Discipline: Psychology/Cognitive Science
Research and work: I am currently working as a post-doc in a project on decision making. It seems like we humans only occasionally follow statistical or logical rules when making judgments. Under what conditions, if any, do we actually behave like the rational beings we think we are? I am peering into the brain using fMRI to find out.

Name: Frida Bergman
Discipline: Medicine
Research and work: I am a physiotherapist and PhD-student who is currently working within a project where we will investigate the effects on cognition, functional brain response and brain structure when decreasing sedentary time and increasing NEAT - that is, everyday exercise – at offices.

Name: Lars Jonasson
Discipline: Cognitive neuroscience
Research and work: I am a PhD student part of the PHIBRA project (Physical Influences on Brain in Aging). We use PET to investigate potential plasticity-induced changes to the brain's dopamine system and cognition following physical activity. This is particularly exciting as the system is associated with multiple aspects of cognition.

Name: Nina Nevalainen
Discipline: Neuroscience
Research and work: I am a postdoc at the Department of Radiation Sciences. The focus of my research is the study of brain structure and function that could be responsible for cognitive decline in the healthy elderly population. My project revolves around investigating changes in the dopamine system by measuring dopamine receptor availability using PET.

Photo: Private

Name: Lars-Göran Nilsson
Discipline: Psychology
Research and work: I am a professor in psychology at Aging Research Center, Karolinska Institutet and here at UFBI. Since 1988 I am the PI of the Betula Project and I have devoted my research time since then to Betula in collaboration with colleagues at Umeå University, in particular with UFBI.

Name: Sara Stillesjö
Discipline: Cognitive neuroscience
Research and work: I am a PhD student studying the neural correlates of judgment and decision making. My main focus is to investigate how people make inferences, and the neural processes related to it. The main methods are fMRI and cognitive modeling. I am also interested in research on learning and memory.

Members*

Name: Micael Andersson
Position: Research engineer
Research and work: I am a diploma engineer and have been working with fMRI since 2004. I make the in-house program DataZ, which is a Matlab-based add-on for the analysis software SPM and is used for batching the analysis and visualizing results. I am also performing the fMRI-analysis for several of the research projects.

Name: Fredrik Bergström
Discipline: Cognitive Neuroscience
Research and work: I am a PhD student that uses fMRI to study the neural correlates of consciousness. I am particularly interested in the role of attention and memory for consciousness, and is currently investigating the possibility of working memory without conscious experience and its potential limitations

Name: Magdalena Domellöf-Eriksson
Discipline: Clinical neuroscience
Research and work: I am a PhD investigating cognitive functions in patients with Parkinson's disease (PD). I will be using fMRI to explore differences in brain activation during working memory between PD and controls.

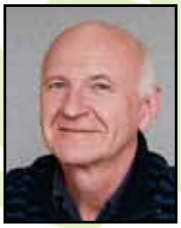
Name: Urban Ekman
Discipline: Cognitive Neuroscience
Research and work: I am a PhD student that focuses on questions that relates working-memory processing to functional brain responses in a population-based cohort diagnosed Parkinson's disease with or without mild cognitive impairment (MCI). Additionally, potentials of brain plasticity will be examined in participants with MCI.

Name: Kerstin Englund
Position: X-ray technician/nurse
Assignments: I have been working with MR since 2000. When the new MR-scanner was installed in November 2009, I got the opportunity to start working part time with fMRI. My other workplace is the Interventional Neuroradiology lab at Norrlands University Hospital.

Name: Johan Eriksson
Discipline: Cognitive Neuroscience
Research and work: I am an Assistant Professor and uses fMRI to study the neural correlates of consciousness, several forms of memory, brain plasticity and learning, and to perform preoperative mapping of brain functions.

Name: Peter Hägglund
Position: Master of Science in Engineering
Assignments: I am involved in the service and technical support of the MRI scanners at Umeå University and Norrlands University Hospital.

Name: Susanna Jakobson Mo
Discipline: Radiology and Nuclear medicine
Research and work: I am a consultant specialist in Radiology and Nuclear medicine. I am also a PhD working with imaging of dopamine function with SPECT in parkinsonian disorders within the NYPUM-project.



Name: Roland Johansson
Discipline: Sensorimotor control in humans
Research and work: I am a professor of physiology working with analysis of neural mechanisms supporting planning and control of dexterous object manipulation with emphasis on sensory, mnemonic and predictive mechanisms. I am also a member of the Swedish Royal Academy of Sciences.

Name: Maria Josefsson
Discipline: Statistics
Research and work: I am a PhD in statistics, studying models for longitudinal memory performance using data from the Betula project. My main focus is models for repeated measures data with informative attrition and causal inference.

Name: Hans-Olov Karlsson
Position: X-ray technician/nurse
Assignments: I worked with MR between 1993-98, and since 2003 onwards. I then started working part time with fMRI in the autumn of 2009 when the new MR scanner was installed at Umeå University Hospital. When I am not at MR, I work at the Interventional Neuroradiology lab.

Name: Linnea Karlsson
Discipline: Psychology/Cognitive Science
Research and work: I am working on educational neuroscience investigating test-enhanced learning and mathematical learning with fMRI. I am also the principal investigator in a project studying the neural correlates to judgment and decision making.

Name: Karolina Kauppi
Discipline: Brain imaging and genetics
Research and work: I completed my PhD on the genetics of brain functions related to memory in June 2013. I am now a postdoctoral fellow at the NORMENT center, Oslo University, working on brain imaging and genetics in relation to psychiatric disorders .

Name: Ann-Kathrine Larsson
Position: X-ray technician/nurse
Assignments: I have been working with MR since 1990, and started working with fMRI in 1999. I am currently a research nurse, running logistics for the different studies including method development, creating protocols and making sure that the contacts between the different parts involved in the project are working.

Name: Helen Ledin
Position: X-ray technician/nurse
Assignments: I have been working with MR for about 11 years. I started working part time at the new research MR-scanner in January 2010. When I am not at MR, I work at the Interventional Neuroradiology lab at Norrlands University Hospital.

Name: Lenita Lindgren
Discipline: Nursing
Research and work: I am a PhD whose main interest is to understand emotional and physiological responses observed during rewarding stimuli such as human touch. In her research, she used fMRI to identify brain regions activated by pleasant human touch.

Name: Anders Lundquist
Discipline: Statistics
Research and work: I am a Senior Lecturer at the Statistics departments, working half-time at UFBI. My methodological research mainly deals with longitudinal fMRI studies with nonrandom dropout, which applies to e.g. the BETULA, NYPUM and COBRA studies at UFBI. I also do applied research together with UFBI researchers.

Name: Malahat Mousavi
Discipline: Molecular biologist and Biochemist
Research and work: I am a PhD in molecular neuropharmacology. In March 2011 I joined the UFBI as a group leader and works with metabolomics for finding distinct metabolites in serum and saliva which will be used as biomarkers for preclinical diagnosis of dementia.

Name: Per Nordmark
Discipline: Physiology
Research and work: I am a PhD student as well as doing my internship at Norrlands University Hospital. In my research I use MRI to study functional and structural changes of the central nervous system in persons who have suffered from traumatic peripheral nerve injury.

Name: Lars Nyberg
Discipline: Cognitive neuroscience
Research and work: I am a professor of Neuroscience and the Director of UFBI. PI for work on cognitive training and imaging within the longitudinal Betula project. I am a member of the Swedish Royal Academy of Sciences. In 2007 I received the Göran Gustafsson award in medicine, and in 2009 I became a Wallenberg scholar.

Name: Carl-Johan Olsson
Discipline: Neuroscience
Research and work: I work as an Associate Professor (Docent) of Neuroscience at the Ageing and Living Conditions Programme (ALC). In my work I am examining how life style factors such as diet and physical exercise may help to preserve brain structure and function across the lifespan.

Name: Greger Orädd
Discipline: Physics
Assignments: I am an Associate Professor (Docent) in Biophysical Chemistry and have been working as an MR physicist since 2009, taking care of quality control of the MR scanner and making sure that new equipment is installed without adverse effects. I am also involved in improving the protocols and procedures for MRI data collection.

Name: Andrew Pruszynski
Discipline: Neurophysiology
Research and work: I completed my PhD in 2011 at Queen's University in Canada where I studied the fast feedback mechanisms that underlie successful motor behavior. My current research, funded by the Swedish Research Council and the Human Frontier Science Program, investigates information processing in human tactile afferent neurons.

Name: Jonas Persson
Discipline: Cognitive Neuroscience
Research and work: I am an Associate Professor at the Aging Research Center at KI and Stockholm University. I use MRI to study the structural and functional correlates of episodic memory and executive functions in young and older adults. I am also involved in brain imaging within the longitudinal Betula project.

Name: Sara Pudas
Discipline: Psychology
Research and work: I recently became a post doc at the Department of Integrative Medical Biology at Umeå University. I will be working on integrating cognitive and neuroimaging aspects of two population-based datasets: the Brainchild study on children and the Betula study on adulthood and aging.

Name: Alireza Salami
Discipline: Computational neuroscience
Research and work: I completed my PhD in computational neuroscience in 2012 at Umeå University where I implemented various multivariate and multimodal techniques for analysis of different imaging modalities. I am now a joint postdoctoral researcher at (UFBI) and at Aging Research Center (ARC).

Name: Matthias Schenkel
Position: Master of Science in Engineering
Assignments: I am involved in the service and technical support of the MRI scanners at Umeå University and Norrlands University Hospital.

Name: Mikael Stiernstedt
Position: Research engineer
Assignments: I am the lab coordinator for UFBI and are involved with data collection several different studies, and handling general matters concerning the Betula-project. I am in charge of the production of the annual reports, the UFBI webpage and other general matters in the lab.

Name: Peter Vestergren
Discipline: Educational neuroscience
Research and work: I began my current post doc position in Educational neuroscience in 2011. I use fMRI to investigate fundamental learning processes. I have investigated the effects of previous testing on encoding activity during restudy in one project, and similarities and differences in brain activity during repeated study and repeated testing in another project.

Name: Daniel Sjölie
Discipline: Human-Computer Interaction
Research and work: My PhD research focused on investigating how brain measurements and an increased understanding of the human brain and can inform the design of realistic computer applications, such as virtual reality. Improved presence and brain-computer synchronization facilitates, for example, optimized training and rehabilitation.

Name: Carola Wiklund-Hörnqvist
Discipline: Psychology
Research and work: I am a PhD student investigating how different learning methods are related to successful learning. My main focus is to identify the cognitive processes, particularly memory processes, related to pedagogical methods including elements of testing. The effects will be examined using brain imaging and behavioral data.

Name: Anders Wåhlin
Discipline: MR-Physicist
Research and work: I completed my PhD in 2012 at Department of Radiation Sciences, Umeå University, where I specialized in MR based measurements of cerebral blood flow and cerebrospinal fluid dynamics. My post-doc research, funded by the Swedish Brain Foundation, investigates cerebral blood flow in stroke and aging.

Photo: Josefin Åhlström Riklund

Name: Katrine Åhlström Riklund
Discipline: Radiology and nuclear medicine
Research and work: I am a professor/consultant doctor who works with movement disorders (parkinsonian diseases), imaging of dopamine function, dementia, imaging of brain function, and PET/CT - oncologic applications.

* = The list of UFBI members is not exhaustive. Several past members, currently working outside Umeå, are still involved in UFBI-activities. In addition, many group leaders and their teams at UmU (e.g., Bert Jonsson, Johan Lithner, Xavier de Luna, Anna Neely, Steven Nordin) and at NUS (e.g., Tommy Bergenheim, Lars Forsgren, Niklas Lenfeldt, Jan Malm, Anders Eklund, Tommy Olsson) are involved in various fMRI projects.

Publications

The list below is focused on journal articles, book chapters, doctoral theses and conference proceedings that were based on structural and functional MRI data collected within UFBI.

Bäckman, L., & Nyberg, L. (2013). Dopamine and training-related working-memory improvement. *Neuroscience & Biobehavioral Reviews, 37*(9), 2209–2219.

Kalpouzos, G., & Eriksson, J. (2013). Memory self-efficacy beliefs modulate brain activity when encoding real-world future intentions. *PloS one, 8*(9), e73850.

Kauppi, K., Nilsson, L.-G., Adolfsson, R., Lundquist, A., Eriksson, E., & Nyberg, L. (2013). Decreased medial temporal lobe activation in BDNF (66)Met allele carriers during memory encoding. *Neuropsychologia, 51*(12), 2462–8.

Kauppi, K., Nilsson, L.-G., Persson, J., & Nyberg, L. (2013). Additive genetic effect of APOE and BDNF on hippocampus activity. *NeuroImage. [Published online Dec 7, 2013]*

Lenfeldt, N., Larsson, A., Nyberg, L., Birgander, R., & Forsgren, L. (2013). Diffusion measures in early stage parkinsonism: Controversial findings including hemispheric lateralisation. *Parkinsonism & Related Disorders, 19*(4), 469–471.

Månsson, K. N. T., Carlbring, P., Frick, A., Engman, J., Olsson, C.-J., Bodlund, O., … Andersson, G. (2013). Altered neural correlates of affective processing after internet-delivered cognitive behavior therapy for social anxiety disorder. *Psychiatry research: Neuroimaging,* (214), 229–237.

Nilsson, L.-G. & Nyberg, L. (2013). Åldern tar inte alltid ut sin rätt. Tidskriften *Äldre i Centrum, 3*, 41-43. *[In Swedish]*

Nyberg, L., Andersson, M., Kauppi, K., Lundquist, A., Persson, J., Pudas, S., & Nilsson, L.-G. (in press). Age-related and Genetic Modulation of Frontal Cortex Efficiency. *Journal of cognitive neuroscience.*

Nyberg, L., & Salami, A. (in press). The APOE e4 allele in relation to brain white-matter microstructure in adulthood and aging. Scandinavian Journal of Psychology.

Olsson, C.-J. (in press). Physical experience shapes neural correlates of internal imagery. Journal of Mental Imagery, 36(1-2), 76–79.

Olsson, C.-J., & Lundström, P. (2013). Using action observation to study superior motor performance: a pilot fMRI study. Frontiers in human neuroscience, 7(November), 819.

Pudas, S., Persson, J., Josefsson, M., de Luna, X., Nilsson, L.-G., & Nyberg, L. (2013). Brain characteristics of individuals resisting age-related cognitive decline over two decades. The Journal of neuroscience. 33(20), 8668–77.

Thompson, P. M., … Nyberg, L. … & the SYS group. (in press). The ENIGMA consortium: large-scale collaborative analyses of neuroimaging and genetic data. Brain Imaging and Behavior.

Vestergren, P., & Nyberg, L. (in press). Testing alters brain activity during subsequent restudy: Evidence for test-potentiated encoding. Trends in Neuroscience and Education.

Dissertations

Josefsson, M. (2013). Attrition in Studies of Cognitive Aging. Doctoral dissertation, Umeå University.

Kauppi, K. (2013). Genes to remember. Imaging genetics of hippocampus-based memory functions. Doctoral dissertation, Umeå University.

Pudas, S. (2013). Brain characteristics of memory decline and stability in aging. Doctoral dissertation, Stockholm University.

Sjölie, D. (2013). Human brains and virtual realities. Computer-generated presence in theory and practice. Doctoral dissertation, Umeå University. *[contains data from UFBI]*

Conference procedings

Eriksson, J. & Bergström, F. (2013, April). Unconscious working memory engages the prefrontal cortex. Poster presented at the Cognitive Neuroscience Society annual meeting, San Francisco, USA.

Karlsson, L., Wiklund-Hörnqvist, C., Eriksson, J., Jonsson, B., & Nyberg, L. (2013, April). Retrieval practice is characterized by activity reductions: an fMRI study on the "testing effect". Poster presented at Cognitive Neuroscience Society Annual Meeting (CNS). San Francisco, USA.

Kauppi, K. (2013, April). Combined gene effects on hippocampal mnemonic processing: a large-scale imaging-genetics study of APOE, BDNF, KIBRA, and CLSTN2. Poster presented at Cognitive Neuroscience Society Annual Meeting (CNS). San Francisco, USA.

Nordmark, P.F., Ljungberg, C., Wiberg, M. & Johansson, R.S. (April, 2013). Structural changes in the human brain following median nerve injury. Poster presented at European Neuroscience Conference by Doctoral Students, Bordeaux, France.

Nordmark, P.F., Pruszynski, J.A. & Johansson, RS. (June, 2013). BOLD responses to tactile stimuli in visual and auditory cortex depend on the frequency content of stimulation. Talk presented at the 14th International Multisensory Research Forum, Jerusalem, Israel.

Nordmark, P.F. & Johansson, R.S. (September, 2013). Brain activation in median nerve injured people during tactile detection tasks. Talk given at the annual meeting of the Swedish Society for Surgery of the Hand 2013, Sigtuna, Sweden.

Nyberg, L. (2013, December). Hjärnans åldrande i relation till genetik och livsstil. Talk presented at Demensdagene, Oslo, Norway.

Nyberg, L. (2013, November). Kognition och kognitiv neuroanatomi. Talk presented at the Interdisciplinary conference for cognitive medicine. Stockholm, Sweden.

Nyberg, L (2013, October). Working memory. Oral presentation at the Inaugural Summit of the Human Brain Project, Lausanne, Switzerland.

Nyberg, L (2013, September). Longitudinal studies of successful aging. Invited presentation at the 3rd INAPIC fall workshop on "Developmental models of brain-behavior change relationships". Zürich, Switzerland.

Nyberg, L. (2013, July). Cognitive psychology and brain imaging: 20 years of cross-fertilization. State-of-the-art lecture at the 13th European Congress of Psychology, Stockholm, Sweden.

Nyberg, L. (2013, May). Cross-sectional and longitudinal studies of age-related changes in memory across the adult life span. Talk presented at the MRC cognition and brain sciences unit, Chaucer Club. Cambridge, United Kingdom.

Nyberg, L. (2013, January). The adaptive capability of the brain after an injury, seen from a biological perspective. Talk presented at Hjärnskadeforum 2013. Stockholm, Sweden.

Vestergren, P., Nyberg L. (2013, April). Test-potentiated encoding of paired associates as revealed by functional magnetic resonance imaging. Poster presented at Cognitive Neuroscience Society 20th Anniversary Meeting. San Francisco, USA.

Wiklund-Hörnqvist, C., Karlsson, L., Eriksson, J., Andersson, M., Jonsson, B. & Nyberg, L. (2013, April). Activity in left temporal-parietal regions characterizes long-term retention after repeated testing. Poster presented at the Cognitive Neuroscience Society (CNS) annual meeting. San Francisco, USA.

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