Umeå center for Functional Brain Imaging - UFBI

Annual Report 2014
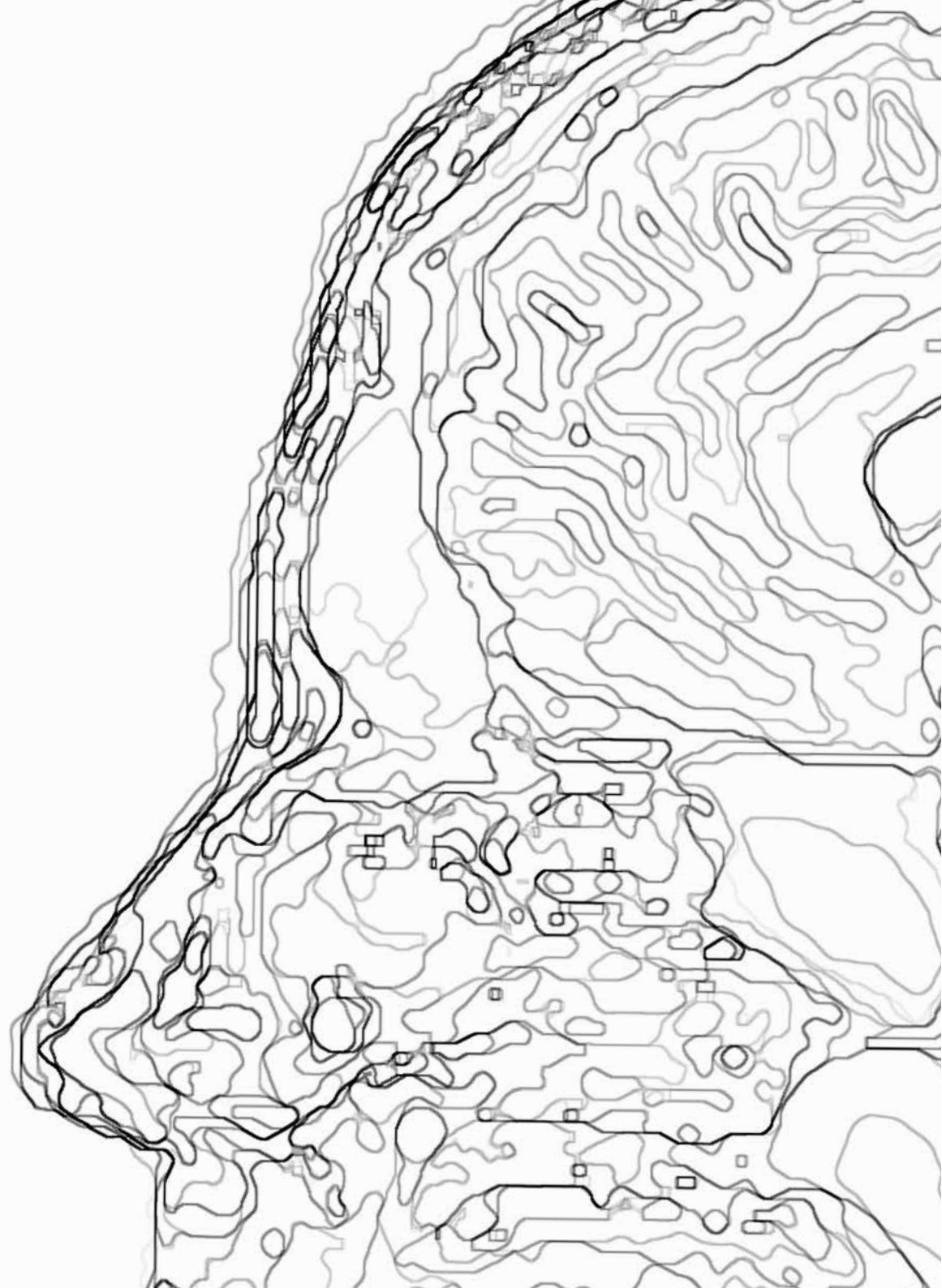
Content

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/ **Report**
/ **2014**

Lars Nyberg's Editorial

Welcome to UFBI's Annual Report for 2014!

This year we have a strong focus on presenting some of the many research projects that run at UFBI. We have completed a 5-year USE-funded project on "memory and learning", in which we have worked on bridging education, learning, and neuroscience. In this inter-disciplinary project, a number of scientists have been involved, and some of these contribute summaries of their work (pp. 6-8). Also, on page 17, Carola Wiklund-Hörnqvist gives an account for her time as a PhD student in the project. Her dissertation on "brain-based teaching" was a clear highlight of the project. Together with Bert Jonsson and other colleagues, we have secured a new grant in "educational neuroscience" from the Swedish Research Council, so this line of work will continue within the UFBI.

Some projects continue and some begin to come to an end. In the record-long Betula project, the 6th wave of data collection was completed in 2014. This will likely be the last major test wave of the project, but as I think will be clear from the text on pages 10-12, we will continue to work on Betula data for many years to come.

Additional projects concern human decision-making (p. 9), memory-maintenance of unconscious information (pp. 18-19), a clinical project on spinal cord injury (p. 16), and Urban Ekman's dissertation work on cognitive status in Parkinson's disease (p. 17). Mostly, these projects are based on MRI, but an emerging theme is the use of PET imaging as well. Katrine Åhlström Riklund presents the PET/CT facility on page 13. This facility offers unique opportunities to, for example, study dopaminergic neurotransmission in the brain. The first such study, on reward-related striatal dopamine release, is summarized on page 14, and the large-scale Cobra project in which dopamine PET is

the main ingredient is described on page 15. Many other interesting research projects run at the UFBI, and we look forward to highlighting some of these in future reports.

Looking back, as the UFBI director it is very rewarding to see that last year was a record-busy year in terms of number of research examinations as well as clinical examinations. We also continue to be active when it comes to meetings, student activities (including dissertations), and publications. The entire UFBI organization works very well, and as described on page 22, we have made some organizational changes to highlight the different research groups, with their leaders and group members. In addition, for a technology intense center as ours, the dedication and expertise of the many UFBI specialists constitute the backbone of all activities. You meet them in the members section of the report.

Looking forward, it has been approved that UFBI will continue to function as a center during the next three years to come (2015-17) – and hopefully longer!

February 2015
Lars Nyberg, UFBI Director (2001 - Present)

In short

In 2014 the members of UFBI
together produced:

16
published
articles

787
clinical MR sessions

5
clinical fMRI
sessions

1034
hours of scanning

14
conference
presentations

2
dissertations

Memory and learning

In 2010 Lars Nyberg was awarded an internal grant from Umeå university and Umeå school of education denoted as "Memory and learning". From that point and onwards, several research projects emphasizing aspects of memory and learning have been conducted in collaboration with psychology and educational science. Those projects did in turn generate a large VR grant which is described in more detail on page 8. On the next couple of pages several of the involved researchers will give an overview of the different projects that are included in "Memory and learning".

Learning mathematics without a suggested solution method: Durable effects on performance and brain activity

How is mathematical understanding best achieved in education? This is the core question in the research program "Learning mathematics through imitative and creative reasoning", initiated by Johan Lithner at Umeå Mathematics Education Research Centre (UMERC).

Lithner and colleagues have identified that a dominant mathematics teaching method is to present a solution method and let pupils repeatedly practice it. The effectiveness of this method in terms of promoting both mathematical understanding as well as high levels of performance has been called into question. One alternative method could be to to let pupils create a solution method themselves. This could have the benefits that once the pupil has actively learned the solution method by their own, they should have an easier time to remember or to recreate this knowledge at a later point in time.

In an interdisciplinary study here at UFBI, performed together with Linnea Karlsson and Lars Nyberg (UFBI), Johan Lithner and Mathias Norqvist (UMERC), Bert Jonsson (Department of Psychology) and Yvonne Liljekvist (Karlstad University) we approached this question by combining a mathematical learning experiment with brain imaging. We compared model versions of the two teaching methods in terms of lasting effects on performance and brain activity.

Seventy-three participants practiced applied mathematical reasoning tasks according to one of the two approaches mentioned above. In one approach they were given tasks such as figuring out how many matchsticks that would be needed in order to create 40 consecutive squares of matchsticks in a row and they were also provided with a suggested solution method (in this case, the solution can be found by the formula $y = 3x + 1$, where y is the number of matchsticks needed and x is the number of squares). In the other approach, participants were given the exact same tasks but they were not provided with a suggested solution method, and instead explicitly asked to figure it out by themselves.

One week later, participants underwent fMRI while being tested on the practice tasks. Participants that had created the solution method themselves performed better at the test questions. In both conditions, participants engaged a fronto-parietal network more

when solving test questions compared to a baseline. Importantly, participants that had created the solution method themselves showed relatively lower brain activity in left angular gyrus, possibly reflecting reduced demands on verbal long-term memory.

Moreover, individual working memory capacity was found to correlate with brain activity in a right superior parietal region, a region that was also identified in relation to mathematical performance. Overall, the results indicate that there might be advantages to creating the solution method oneself and has potential implications for design of mathematical teaching methods. Also, the results demonstrate that the right superior parietal cortex is pivotal for mathematical performance in general, possibly reflecting attentional and/or working memory contributions to complex mathematics. The study is accepted for publication in Trends in Neuroscience and Education.

Linnea Karlsson
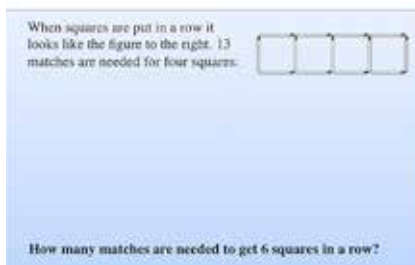
Figures shows tasks designed for construction of solution (left image: more active approach) and for algorithmic reasoning (right image: more passive approach).
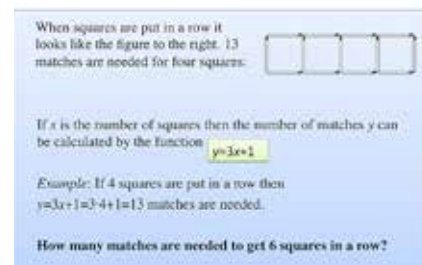
Illustrations: Johan Lithner

◆

Neurocognitive substrates of understanding mathematics and effects of testing

During 2014, planning and extensive piloting was conducted for the new fMRI project "Analytical (relational) and non-analytical (associative) thought processes during mathematics learning". The project is a sub study of "Learning mathematics through imitative and creative reasoning" located at the Department of Science and Mathematics Education/Umeå Mathematics Education Research Centre (UMERC), and funded by Kempestiftelserna. Peter Vestergren, Johan Lithner, Bert Jonsson, and Linnea Karlsson are involved in the project.

The project addresses what is possibly the most common problem in mathematics education – that students learn, but do not understand the mathematics. Various terms have been used in the literature for the distinction between learning with and without understanding, but all essentially contrast deep, meaningful and flexible knowledge with shallow, meaningless and inflexible knowledge. The concern is that the dominating teaching methods appear to favor the

acquisition of the latter type at the expense of the former. However, little is known of the types of cognitive processes and anatomical regions involved in this phenomenon.

The aim of the study is to investigate neurocognitive substrates of learning with, and without, understanding. The basic hypothesis is that learning of mathematics with understanding involves relational processing, whereas learning of mathematics without understanding is dominated by associative processing. A model situation has been constructed where participants either learn the meaning of mathematical relation symbols, or only learn the association between types of geometrical figures. Both types of processing is expected to engage the hippocampus. Relational processing is expected to involve the rostrolateral prefrontal cortex, whereas associative processing may involve the basal ganglia to a greater extent. Data collection for the project started in January 2015.

2014 was also spent analyzing data and writing on the manuscript for the project "Memory effects of repeated testing and studying – a functional brain imaging study". Data collection for this project ended in the latter part of 2013, and submission of the manuscript is expected in the beginning of 2015. In brief, the results suggest important roles for the parietal and temporal lobes and fusiform gyrus in superior retention after repeated testing.

Peter Vestergren

◆

Learning to engage the brain

In the end of 2014 Bert Jonsson, department of psychology, was awarded a grant from the Swedish research council's call for learning-brain-practice, of almost 13 million Swedish kronor for the project "learning to engage the brain". The project will include researchers from psychology (Bert Jonsson, Tova Stenlund), UMERC (Johan Lithner, Carina Granberg), UFBI (Lars Nyberg) two post docs focusing on the neuroscience perspectives of test-enhanced learning, creative mathematical reasoning and individual variation in cognitive proficiency.

The purpose of the project is to address fundamental questions arising in educational science and pertaining to the cognitive neuroscience of children's learning. This focus is on par with international school reforms advocating a transition from seeing students as relatively passive learners, to instead stressing active participation.

The more specific aims is to investigate the relations between active and passive types of learning in relation to cognitive proficiency, an index defined by measures of working memory (WM) and the executive functions (EF; updating, inhibition and shifting) that is closely related to school achievements. The existing knowledge on this topic is inconclusive, with some evidence suggesting that active learning methods will be especially beneficial to those with lower cognitive proficiency. Conversely, there is much prior evidence that cognitive support and training will provide more benefit to those who already have high cognitive proficiency and that active learning benefits performance generally, regardless of cognitive proficiency.

The significance of the project can be divided into two parts. The first part is related to the research council's call for learning-brain-practice, for which the statement "combining knowledge about children's learning with knowledge about the brain" is essential. The second part is related to the unique information fMRI can provide about if, why, and under what circumstances active learning may be favorable for the learning process that cannot be inferred from simply analyzing the behavioral end results. The results of the proposed research have consequences in terms of understanding individual variation in passive and active learning and their relation to cognitive proficiency, for which the relation to academic achievement is substantial.

Bert Jonsson

◆ Imaging the rational and irrational human brain ◆

It is well documented that human probability judgments often deviate from the norms of probability theory. One explanation for that is that humans at times resort to employing simple rules of thumb and that these rules can give rise to judgment fallacies. The conjunction fallacy is the label for the erroneous judgment that the conjunction A&B is more probable than the constituent A. It is often exemplified by the so called Linda problem. Linda is described as a woman with a background and interests that suggest she is a feminist. When asked, participants tend to judge it as more probable that Linda is a bank teller and feminist (A&B) than a bank teller (A). The conjunction (A&B) is however not the correct answer, as all bank tellers who are feminists (A&B) by definition must be bank tellers (A), whereas the opposite is not true.

A hypothetical explanation for this error is that people fail to apply logical rules in these situations, and make judgments based on similarity to an internal representation instead. This is referred to as "attribute substitution", and constitutes a cornerstone in Tversky and Kahneman's Nobel Prize winning heuristics and biases research paradigm. In the Linda case, the argument is that the conjunction is chosen because Linda is more similar to an imaginary bank teller who is also a feminist, than to an imaginary bank teller.

Some previous research has indeed shown that asking participants to make similarity judgments of Linda-like tasks instead of probability judgments produce almost identical behavioral results. Although this seems to corroborate the attribute substitution hypothesis, this issue is very difficult to investigate using purely behavioral measures. For example, participants might very well apply two different judgment strategies that give rise to the same behavioral response.

During autumn 2014 we collected data for an fMRI study at UFBI with the aim to investigate whether the conjunction fallacy can be explained by attribute substitution, and whether decision makers who make logically correct judgments recruit different brain regions than those that do not. To investigate this, we constructed 30 Linda-like tasks, suitable to be performed within the scanner environment. Participants were randomly assigned to one of three groups based on judgment condition – similarity judgments, probability judgments, as well as a group who made probability judgments but received additional information containing hints about the logical structure of the task. The reason for providing this information was to prompt participants to make logically correct judgments. Each group consisted of 11 men and 11 women.

Preliminary analyses suggest that judgments of the similarity and probability groups were practically identical – most participants chose the conjunction A&B as the most similar and probable alternative, respectively. Thus, participants in the probability group committed the conjunction fallacy on the majority of trials despite being given 30 trials to recover from their mistakes. The informed probability group, however, chose the logically correct constituent (A) to a large degree. Analyses of BOLD-responses are currently ongoing, but first preliminary results suggest that largely overlapping brain regions are recruited for probability judgments (that is, where the conjunction fallacy was committed) as for similarity judgments. This provides initial support for the hypothesis of attribute substitution. On the other hand, the informed probability group seems to recruit some additional areas of the brain that are not evident for the other groups. This provides initial support for the idea that additional cognitive resources might be demanded for making logically correct judgments. If these results hold, this study may provide essential information regarding the psychological mechanisms and neurocognitive systems of human decision making.

Linus Andersson
Linnea Karlsson

◆ Betula ◆

During 2014, a major accomplishment was to finalize the 6th major Betula test wave. Quite likely, this wave will be the last one in this unique large-scale project that began as early as in 1988.

We had the privilege of having Betula PI, professor Lars-Göran Nilsson, as a UFBI team member during the final test wave. Towards the end of the data collection, we also thanked nurse Maud Widing, who retired. Maud has been a "rock" who's importance for the successful data collections cannot be overstated. With the completion of the 6th test wave, more than 4500 unique participants have been included, and they have in total taken part in about 10 400 examinations, including around 6000 longitudinal observations. The resulting database is unique and will keep scientists at Umeå University as well as at other places busy in the next several years to come.

At Betula test wave 5, a new brain imaging study was launched, involving as many as 376 participants between 25-80 years of age. Already, as reported in previous annual reports, this data collection has laid the foundation for several fine UFBI publications and dissertations. The large scope of the sample, in conjunction with the fact that we have genetic and other data on the participants, have led to a marked interest from various partners to conduct joint projects. One recent example is a collaboration within the ENIGMA (Enhancing NeuroImaging Genetics through Meta-Analysis) network, that resulted in a publication in Nature (Medland et al., 2015). In this study, some 300 scientists from close to 200 sites joined forces to study genes that contribute to individual differences in the volumes of various subcortical brain regions and the hippocampus as determined by structural MRI. The results, based on data from more than 30 000 individuals (!), provided evidence for some novel gene-brain structure associations. Additional joint projects are under way.

At the 6th Betula test wave, thanks to the hard work by many involved, about two-thirds of the 376 participants who took part in the brain-imaging sub-study in 2009-2010 were re-tested. This will be a very rich longitudinal dataset to explore in the years to come. Moreover, in a few years, we may even conduct a 3rd longitudinal imaging test wave on these participants, as there is a great demand for longitudinal data on brain-cognition changes in adulthood and aging - and we have a unique position to contribute in this regard at UFBI!

Lars Nyberg

◆

Default mode network

Most of our knowledge about brain function comes from studies in which a cognitive task is administrated in the MRI scanner and resulting changes in neural activity are measured. Recently, however, a paradigm shift in functional brain imaging has been brought about by surprising discoveries in brain metabolism imaging research. That is, in comparison to the remarkably small energy consumption (< 5%) associated with evoked changes in brain activity, the resting brain consumes a large portion (~20%) of the body's energy. Based on this critical finding, the brain is not idle at rest. Rather, intrinsic neuronal signaling, which manifests as spontaneous fluctuations in the blood oxygen level-dependent (BOLD) fMRI signal, is ubiquitous in the

human brain and is often synchronized over distant parts of the brain. Coherent spontaneous activity has been revealed in several networks that span large-scale functional circuits of the brain. One of the resting state networks (RSNs) critically implicated for episodic memory (EM) processing is the default mode network (DMN), which contains a set of cortical regions that interact with a hippocampus (HC) subsystem. The functional architectures of the DMN and HC is affected by different conditions, such as Alzheimer's disease, yet the exact form of DMN-HC alterations and concomitant memory deficits in aging is largely unknown.
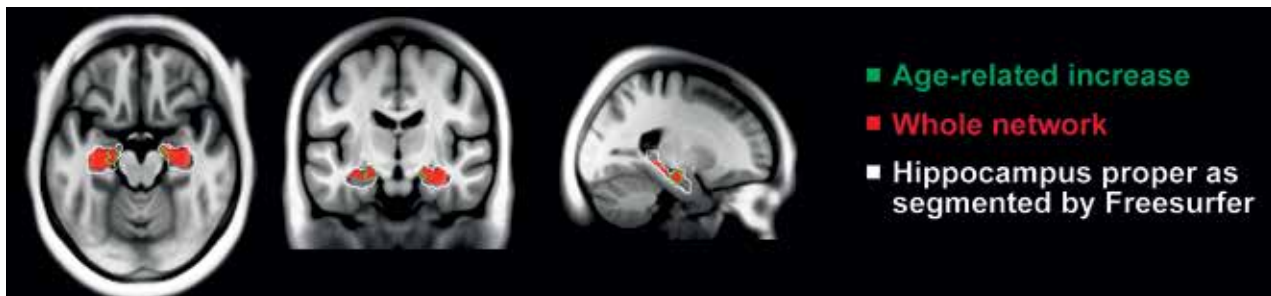
We used both memory task and resting state data from 339 BETULA participants (25-80 years old). During the memory task, the participants performed an episodic face-name paired-associate encoding, retrieval, and active baseline tasks. During the rest, participants were instructed to keep their eyes open and look at a presented fixation cross.

We found 24 RSNs including the anterior and posterior DMN as well as the HC subsystem. Both the anterior and posterior cortical DMN showed age-related decline in functional connectivity (FC). In contrast, for the HC, a significant positive correlation between age and FC was observed. Furthermore, the degree of internetwork FC between cortical DMN and HC subsystem decreased with age, suggesting that the cortical DMN and the HC tended to operate more independent of each other. We also found that elevated HC FC was negatively correlated with an EM composite score. Furthermore, individuals who showed typical age-related EM decline over 20 years exhibited greater HC FC as compared to individuals maintaining EM relatively intact. The latter findings suggest that elevated HC FC is detrimental for the integrity of the EM system. Finally, we found that older adults with stronger elevation of HC during rest displayed a highly restrictive FC pattern during episodic memory encoding, whereas older adults with weaker elevation of HC reflected a more extensive FC pattern. The latter finding suggests that elevated HC FC was associated with reduced integration of HC with other regions that are critically important for EM encoding.

Our result provides a novel empirical evidence of how the relation between cortical DMN and HC subsystem breaks down in aging and how such alterations underlie deficient mnemonic processing. More specifically, age-related disruption in cortical DMN-HC FC leads to a functionally isolated HC at rest, which makes the HC less flexibly interactive with other brain regions during active tasks, and thus results in deficient memory processing.

Alireza Salami

■ Age-related increase
■ Whole network
■ Hippocampus proper as segmented by Freesurfer

Illustration: Alireza Salami

Age-related increases of the HC RSN for the voxel-wise and global connectivity.

Brainchild meets Betula

Currently, work is underway with merging two longitudinal imaging datasets to explore lifespan development and decline in episodic memory and hippocampal volume. On one side of the lifespan we have the Brainchild dataset on children and adolescents aged 6-25 years, and on the other side the Betula study with participants aged 25-85. The project is a collaboration with our colleagues at the Karolinska Institute; Charlotte Nymberg and Torkel Klingberg, who is the principal investigator of Brainchild. From the outset, the Brainchild study was planned so as to include some of the same cognitive variables that were used in the Betula study, permitting lifespan analyses. Both studies also include longitudinal brain imaging, with 97 Brainchild participants being scanned 1-3 times with two-year intervals, and in total 231 Betula participants with longitudinal imaging data.

The combined dataset holds great potential but also poses some methodological challenges, which brought about an excursion to Stockholm in June 2014. During this trip three UFBI-collaborators had their brains scanned at the 1.5 Tesla MR scanner in Huddinge, the scanner used in the Brainchild study. The intention was to assess whether the scanner produced estimates of brain volume comparable to those from the 3 Tesla scanner in Umeå. Although some scanner differences were noted, luckily the hippocampal formation appeared to be reliably reproduced across scanners.

Thus far, some interesting preliminary observations have been made in the combined data set. For instance, as can be seen in the figures below, it appears as though 8 and 90-year olds perform equally well on episodic memory tests. Also, population-level memory and hippocampal volume development and decline appears to follow roughly the same lifespan trajectories. The trajectories of lifespan change were estimated with so-called generalized additive mixed models, created with the help of Anders Lundquist's statistical expertise. Clearly, this unique data set enables many interesting future analyses, and our colleagues in Stockholm are currently investigating genetic effects on prefrontal volumes and processing speed performance.

Sara Pudas
George Samrani

Illustration: Sara Pudas
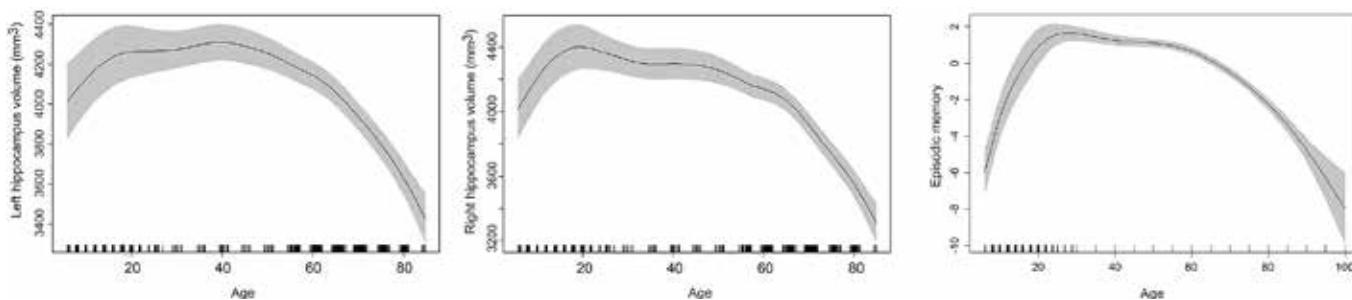
Left panel shows left hippocampal volume change trajectories across the human lifespan, middle panel shows the change in right hippocampal volume, whereas right panel displays episodic memory change across approximately the same age-range.

◆ The PET/CT facility at UFBI ◆

A complete facility for PET/CT imaging is available at UFBI. The PET/CT at Umeå University hospital is a General Electric (GE) 690 scanner with a 64-slice CT. One third of office hours are dedicated to clinical research, and the annual turnover on the scanner is now 1700 examinations. Most of the examinations are static but the amount of dynamic studies is increasing. The radiochemistry department is well equipped with both manual and automatic production of a variety of radiotracers. The Cyclotron, a PETtrace (GE), is capable to accelerate protons to 16,5 MeV and is used to produce the radionuclides, 18F, 11C, and 15O for tracer labelling. All production is made at GMP quality.

Today, four radiochemists are employed at the department (Margareta Ögren, Mattias Ögren, Jonna Jacobsson and Micaela Smeds). Mattias and Margareta are responsible for the production and quality control, as well as the development of new tracers. A gallium generator was delivered in late autumn 2104 and the production of Ga-DotaTOC is under development. More tracers are in the pipeline but since the number of radiochemists is limited we do have a waiting list for setting up production of new tracers.

All image data is stored in the PACS system and there is also a possibility to send it to other systems for post-processing and evaluation after anonymization. The physicist Jan Axelsson is working with development of protocols, post-processing and quantification of PET studies. One focus is to improve the quantification of tracer uptake. For this purpose both human and phantom data is used. The most complex phantom is made in collaboration with Umeå Institute of Design and is simply put, a 3D-print from a MRI brain examination. The phantom consists of the skull, and striatum delivered in three different sizes, and is used in the on-going dopamine studies. The possibility to create phantoms is increasing and today we can export a 3D script from a CT-scanner if needed. The optimization of CT protocols is done together with the physicist Jonas Andersson and there is a close collaboration with the CT department at the Radiology department.

Helena Nylander is head nurse of PET/CT imaging and with her crew the patients and study participants are in good hands. The personnel are skilled and have a long experience in imaging. A lot of research studies are done with 11C-tracers that has a half time of 20 minutes and the requirement on logistics and timing is high with such short turn on time. The routines at the department are set up to take care of this issue.

As head of nuclear medicine I have the overall responsibility of the work and development and together with the physicians working with PET/CT; Carolina Flygare, Jussi Remes, Sara Strandberg, Susanna Jakobson Mo, Torbjörn Sundström, we do all reading of the PET/CT studies and evaluate and develop imaging methods.

In summary, there are a lot of needed collaborators and the key to make PET/CT running smoothly is a well-developed collaboration between all these, which we have. If interested in starting a PET/CT study please contact me for an initial discussion.

Katrine Åhlström Riklund

Photo : Private

The radiochemists (from the left): Margareta Ögren, Mattias Ögren, Jonna Jacobsson and Micaela Smeds.

Reward related striatal dopamine release

In the first brain study from the Umeå PET-centre we used PET (Positron emission tomography) and [11C]-raclopride (see box) to measure the change in dopamine release in striatum when monetary rewards were introduced in a cognitive task context.

When something is rewarding we tend to put more effort into the task at hand. This increase in effort, or motivation, also tends to improve task performance.

Why dopamine and why striatum? The striatum is involved in motor, executive, and emotional processing. Dopamine release has previously been shown in the limbic striatum following reward. In this study we zoomed in on the nucleus accumbens (NAcc) with the high-resolution imaging enabled by the GE PET/CT scanner at the Umeå PET-centre. NAcc is believed to be the most crucial region within the limbic striatum in processing reward information but the small size of the region has made it a difficult target for PET imaging in human subjects.

Participants performed a task switching task known to involve striatal processes. For the first 55 minutes participants simply performed the task not knowing that they would start earning money on a subset of subsequent trials based on their performance after the 55 minute mark. Performance improved considerably, especially on the rewarded trials, and we also detected a decrease in the binding of [11C]-raclopride once the reward was introduced. The effect was seen specifically in the NAcc region of interest, with no effect seen in the putamen and caudate regions.

In addition, contrary to previous investigations we could also see a relationship between higher release of dopamine and task performance. This indicates that dopamine release in NAcc increases effort and is not only related to the acquisition of the reward itself.

These findings complement existing computational models of reward by showing the same effects in human subjects. Dopamine release in NAcc does appear to explain, at least in part, the positive effects on behavior that can be seen when we find something rewarding.

Lars Jonasson

[11C]-Raclopride
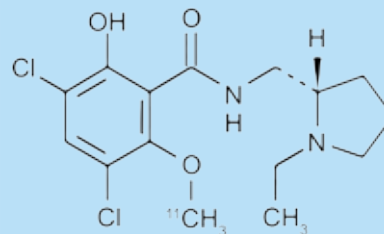
[11C]-raclopride is a PET (positron emission tomography) radioligand used in human brain imaging to measure the density of the dopamine D2 family of receptors. These receptors are highly concentrated in the striatum, but can also be detected in other areas, albeit to a lesser degree. Due to the displacement properties of raclopride, i.e. its binding to and unbinding from receptors, it can be used to index dopamine release. When endogenous dopamine is released, it competes with [11C]-raclopride for binding to receptors. Hence, the detected signal will decrease when dopamine is released in the brain.

Jonasson, L. S., Axelsson, J., Riklund, K., Braver, T. S., Ögren, M., Bäckman, L., & Nyberg, L. (2014). Dopamine release in nucleus accumbens during rewarded task switching measured by [11C] raclopride. NeuroImage, 99, 357-365.

The Cobra study – Cognition, Brain and Aging

The normal aging process is accompanied by decline of cognitive functions. Vulnerability to such deterioration is varying, and while some individuals maintain their cognitive abilities throughout life, others suffer significant decline. The mechanisms underlying these inter-individual variations are currently not fully understood. However, previous studies have indicated functional and structural brain parameters and lifestyle factors as potential candidates. As the current understandings are largely based on results from cross-sectional studies, which are known to be at risk of confounding bias, longitudinal assessments are needed. On this basis, a study investigating cognition, brain, and aging (COBRA) commenced in 2012. In the COBRA study, healthy older individuals undergo cognitive testing and brain imaging at three equally spaced occasions during a 10-year period.

Illustration: Micael Andersson

Visualization of striatal dopamine D2-receptor binding with PET and the ligand 11C-raclopride.

The first test session was completed in June 2014, resulting in collection of baseline data for 181 individuals of ages 64-68. Shortly after, a paper describing the study design, cohort, and selected results was published (Nevalainen et al, in press). Briefly (for more information please see the mentioned paper), all individuals underwent extensive cognitive testing of age-sensitive functions, structural and functional magnetic resonance imaging (MRI) of the brain, and a positron emission tomography (PET) session with the dopamine D2 receptor ligand [11C]-raclopride. Assessment of dopaminergic markers is motivated in a study of cognition and aging, as the dopamine system is central for cognitive functions and undergo degeneration during the normal aging process. Importantly, the lack of longitudinal data for this neural substrate have hindered establishment of reliable correlations between aging, dopamine, and cognition.

Furthermore, lifestyle data was collected for all individuals in order to assess implications of physical, intellectual, and social activity levels on cognitive aging. Also, genetic material was stored for future evaluation. We demonstrated that the recruited cohort consist of cognitive high- and low-performing individuals, in which striatal dopamine D2 receptor availability was markedly low for a subpopulation of the sample. Whether the latter is predictive for poor cognitive aging remains to be found upon the second and third data collection. Gender effects were found and it was shown that whereas women performed better in episodic memory tasks and had higher dopamine D2 receptor availability, men had higher working memory task scores.

Nina Nevalainen
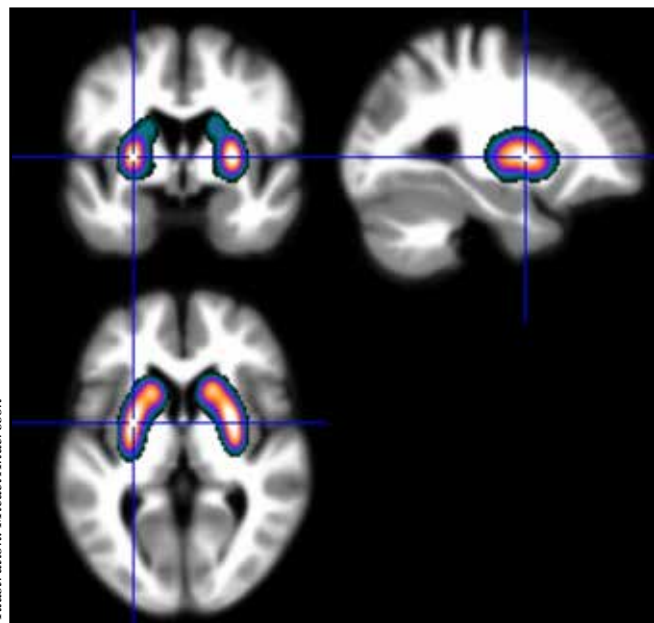
Nevalainen, N. Riklund, K., Andersson, M., Axelsson, J., Ögren, M., Lövdén, M., Lindenberger, U., Bäckman, L. & Nyberg, L. (in press). COBRA: A prospective multimodal imaging study of dopamine, brain structure and function, and cognition. Brain Research

◆ Spinal cord injury ◆

Spinal cord injury (SCI) is typically a devastating, life-changing event, as it impairs conduction of sensory and motor signals across the lesion site, leaving the person severely disabled with paralysis and loss of sensation. To date, SCI severity classification has been purely based on clinical assessment according to an international classification system (American Spinal Injury Association, ASIA), which classifies SCIs into 'complete' and 'incomplete' injuries. According to ASIA, the term complete injury is used when there is no preservation of any sensory or motor function below the level of the spinal lesion. However, only observable voluntary motor activity and conscious somatosensory perception is evaluated. Thus, any preserved subclinical sensorimotor functions are not taken in to account by the current classification.

Neuropathological studies have shown that a total transection of the spinal cord is rare following common blunt traumatic injuries. This was shown experimentally during the 80s, by using neurophysiological recordings to demonstrate that many persons with clinically complete SCI showed neurophysiological evidence of residual brain influences on spinal motor function below the lesion. The term discomplete SCI was coined to describe this subgroup of patients. Thus, the current classification, which only differentiates between complete and incomplete injuries, must be considered as relatively crude from a neurobiological perspective.

To date, few investigations of somatosensory preservation following SCI have been presented, possibly due to a perceived lack of clinical applications. We used fMRI to examine the somatosensory system in a healthy participant and in a participant with a clinically complete SCI, by applying tactile stimulation above and below the SCI level, with and without visual feedback. We found that in the SCI participant, somatosensory stimulation below the SCI gave rise to fMRI signal changes in the corresponding areas of the somatosensory cortex. Visual feedback of the stimulation strongly modulated the somatosensory fMRI signal, implicating that cortico-cortical rather than spino-cortical connections can drive
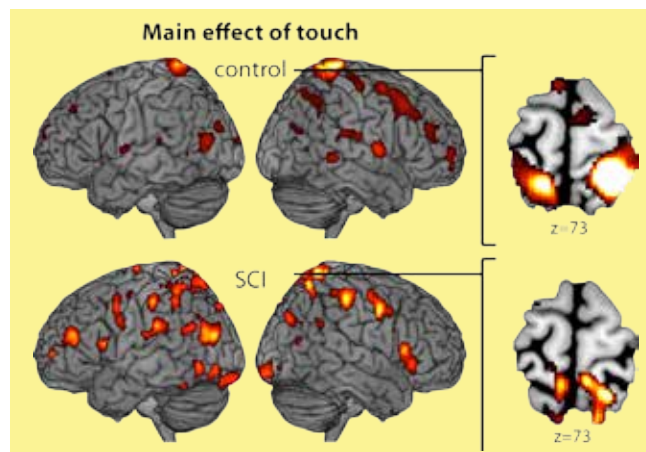
Brain activation due to left leg stimulation in a healthy control (top) and the participant with SCI (bottom).

Illustration: Johan Eriksson

activity in somatosensory cortex. Critically, fMRI signal change was evident also when removing visual feedback of the stimulation, demonstrating "sensory discomplete" SCI.

These findings indicate preserved nerve impulse communication between body parts innervated by segments located below the lesion and the brain. Albeit insufficient to give rise to a conscious sensory experience, this preserved somatosensory conduction is presumably reaching the brain and might contribute to explain behavioral variability and the risks of developing complications such as decubitus ulcers and neuropathic pain, within the category of patients who are currently classified to have complete injuries. Further studies with a larger sample are needed to corroborate such associations.

Amar Awad
Johan Eriksson

Awad, A., Levi, R., Lindgren, L., Hultling, C., Westling, G., Nyberg, L., & Eriksson, J. (accepted). Preserved somatosensory conduction in a patient with complete cervical spinal cord injury. Journal of Rehabilitation Medicine.

Dissertations

Wiklund-Hörnqvist, C. (2014). Brain-based teaching. Behavioural and neuro-cognitive evidence for the power of test-enhanced learning. Doctoral dissertation, Umeå University.

Ekman, U. (2014). Functional brain imaging of cognitive status in Parkinson's disease. Doctoral dissertation, Umeå University.

December 15, 2014 was the day that I defended my thesis "Brain-based teaching: Behavioral and neuro-cognitive evidence for the power of test-enhanced learning".

Finally, after all these years, including all ups and downs, the "big day" was here. It was a strange feeling that morning. I felt both excited and nervous about the upcoming event. My supervisors, Bert, Linnea and Lars, had told me a dozen of times that I should enjoy the situation. I responded by saying; nope, don't think so! But I did. It was actually fun, much thanks to my brilliant opponent, Jeffrey D. Karpicke from Purdue University in West Lafayette, USA. He posed several tricky questions, but the way in which he addressed them opened up for interesting discussions.

The week after defending my thesis, we all had a Christmas break. During this break I started to realize that I had passed the examination but I also reflected upon how privileged I am by being a member of UFBI. All the competence and lovely people that constitutes UFBI makes all bad days to good days! Keep that spirit alive!

Currently, I am still at my position as a PhD student at the Department of Psychology having a few months left. While much of the future is unpredictable and full of possibilities, I look forward to challenge some of my ideas and hopefully continue doing research.

Carola Wiklund-Hörnqvist

During my graduate studies, I got the opportunity to work within the New Parkinsonism in UMeå (NYPUM) project which is a longitudinal population based study on idiopathic parkinsonism, including Parkinson's disease (PD). In co-operation with UFBI, an important part of the versatile project was to investigate the evolvement of cognitive functioning in PD related to brain responses. A PhD student position was announced to assess those important research questions, and luckily I got it.

Approximately four years later, to my great joy, I have been awarded a degree of Doctor of Philosophy. The former years has been extremely valuable and increased my knowledge in how high quality clinical research can be conducted. In agreement with my thesis, my future research plans is related to how neuropathological features relates to clinical cognitive impairments. With a position at the Karolinska Institute, I aim to study new cases with cognitive impairments at the Stockholm memory clinics to increase knowledge about prognostic information, cognitive and physiological mechanism, and diagnostic accuracy.

Urban Ekman

Zooming in

Bergström, F., & Eriksson, J. (2014). Maintenance of non-consciously presented information engages the prefrontal cortex. Frontiers in Human Neuroscience, 8, 938.

As we go about our days we consciously experience our external environment, inner thoughts, emotions et cetera. Our intuition is that we consciously experience all the information that is processed in our brain. However, in reality most of the information processing passes by non-consciously while we only consciously experience a small fraction of it all. During the last century scientists have tried to determine to what depth/level non-consciously perceived information can be processed in the human brain. Traditionally, it has been assumed that conscious experience is necessary for flexible higher-level processing (e.g., executive functions), while automatic lower-level processes (e.g., motor reflexes, sensory analysis) can occur without conscious experience. Another common assumption is that retention of non-consciously perceived information quickly fades within 500 ms.

However, recent findings have challenged these notions by showing that non-consciously perceived information can produce higher-level functions, together with BOLD signal change in the prefrontal cortex, a region associated with executive functions such as inhibition, cognitive control, and working memory. It has also been shown that non-consciously perceived information can last up to 5 s even with distractors, a feat that could be explained by working memory operations.

Here we wanted to (i) further challenge the assumption that non-consciously perceived information fades quickly, and (ii) determine if the neural substrates of this non-conscious durability is compatible with working memory as an explanation. In two experiments we manipulated attention to render a letter non-conscious on a portion of the trials. The participants were instructed to remember the letter, and when probed at the end of each trial, report the letter (or guess if they had not experienced a letter). They also estimated the perceptual experience of the letter at the end of each trial on a three-point scale. Trials with no reported experience were labeled non-conscious, and the rest of the trials as conscious.

In experiment 1 we used a variable delay up to 15 s with distractors between presentation and response probe to estimate the longevity of the non-consciously perceived information. The results showed that participants performed better than chance when guessing the letter, and this performance did not decline over time. In experiment 2 we used the relatively long delay to isolate the BOLD signal related specifically to the delay period, and found that the non-conscious memory retention was associated with sustained BOLD signal change in prefrontal and cerebellar regions.

Observed memory effects of non-consciously perceived information could be explained by several memory mechanisms, such as priming and working memory. Priming, an implicit long-term memory, could explain our behavioral results, but are likely dependent on residual activity and/or latent neural changes, and would not produce a sustained BOLD signal change lasting up to 15 s.
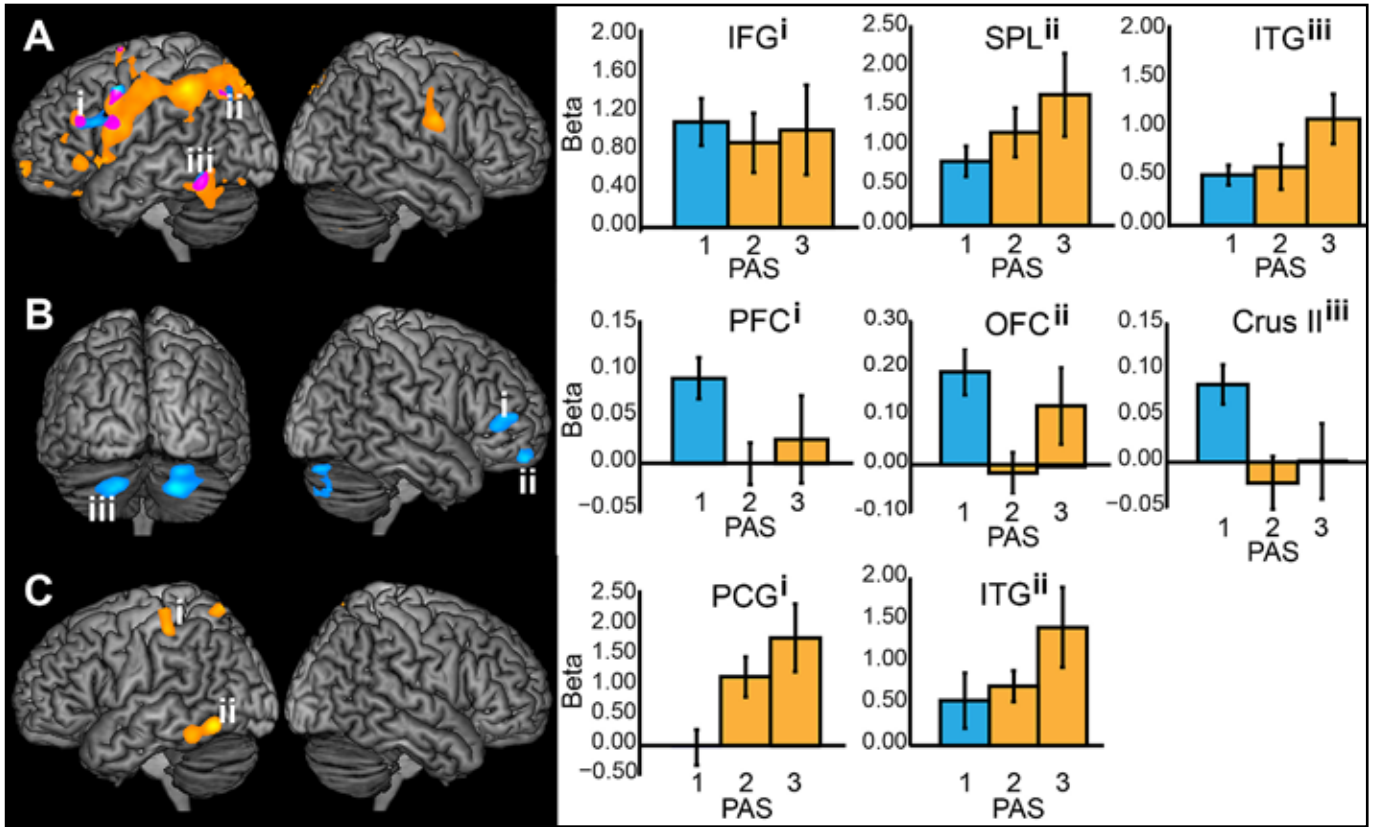
Illustration: Fredrik Bergström

All working memory epochs – (A) stimulus presentation, (B) delay-period, and (C) response – with conscious > baseline in orange, non-conscious > baseline in blue, and the overlap in purple. The X-axis consists of beta values, and the Y-axis consists of self-reported perceptual experience (PAS; 1. no experience, 2. vague experience, 3. clear experience).

That leaves working memory, the temporary activation of sensory or motor information for prospective use, which is heavily associated with sustained neural activity/ BOLD signal change in the prefrontal cortex and posterior regions depending on memorandum, and in some cases the cerebellum. We therefore conclude that our initial findings are consistent with the hypothesis that working memory mechanism can operate on non-consciously perceived information.

Fredrik Bergström
Johan Eriksson

Meetings and seminars

A multidisciplinary research environment, a multi-faceted research agenda, and a growing research group make structured interaction platforms indispensable. To this end we have monthly lab meetings where project plans, experimental designs, analysis strategies, and results are discussed in an informal setting to benefit from the whole brain trust of UFBI.

Besides these in-house meetings, members of UFBI usually attend several meetings and conferences held in and outside Sweden. Among others, three members of UFBI went to Long Beach, California. They describe their journey on the next page. A complete list of conferences attended by UFBI members can be found on page 28-29. In addition to visiting conferences, members of UFBI are often invited to give talks and presentations to the public. To the right is a list of the presentations that were given during 2014.

Popular science presentations
Eriksson, J. (2014, November 4). Exploring the nature of non-conscious short-term memory. Seminar given at Linneaus Centre for Cognition, Communication and Learning, Lund University, Sweden.

Nyberg, L. (2014, October 31). Brain Maintenance – a Key to Preserved Memory and Cognition in Older Age. Lecture presented at USF Health Byrd Alzheimer's Institute, Tampa, Florida, USA.

Karlsson, L. (2014, October 29). Kan studier av hjärnan säga oss något om varför vissa lärandemetoder är bättre än andra? Talk given at Fortbildningsdagar i teknik och naturvetenskap, Umeå, Sweden.

Nyberg, L. (2014, September 30). Forskning i fokus: Hjärnan, minnet och åldrandet. Talk presented at Nobelmuseet, Stockholm, Sweden.

Nyberg, L. & Karlsson, L. (2014, September 16). Think Fast, Take it Slow, The Brain Makes it Flow. Talk presented at Sliperiet Opening Week, Umeå, Sweden.

Wiklund-Hörnqvist, C. (2014, May 14). Two brain imaging studies related to test-enhanced learning. Invited presentation at the Department of Psychology, Washington University, St Louis, USA.

The annual UFBI-day was held on June 18 and was attended by over 40 UFBI-members and collaborators.

Decision makers in the USA

At the break of dawn November 19th, three UFBI-members (Sara Stillesjö, Linus Andersson and Linnea Karlsson) travelled from a dark, cold and wet Umeå to warm and sunny Long Beach, California, to attend the annual meeting of the Society for Judgment and Decision making (SJDM) and the Psychonomic Society's annual meeting. Along with our posters, we travelled for over 18 hours until finally arriving in Long Beach.

The agenda of SJDM covered a variety of different fields within judgment and decision making, including aspects of judgment and decision making in relation to for example cognitive psychology, economics, business management and medicine. We had the opportunity to listen to many great talks, some held by well-known researchers, and some by new and uprising stars. During the evening poster session, Sara and Linnea presented results from an fMRI study exploring the neurocognitive mechanisms of different judgment strategies. Linus presented results from a study on heuristics and biases, specifically on the so called "conjunction fallacy". The poster presentations provided us with the opportunity to discuss our projects with researchers from all over the world. Many interesting questions were brought up and we received positive feedback.

The sister conference Psychonomics were held parallel to SJDM just a few hundred meters down the street. That conference covers experimental psychology and we attended several interesting talks on judgment and decision making and memory.

Both conferences turned out to be as interesting and rewarding as we had hoped. One common topic was about "nudges" – how indirect suggestions might be used to improve people's decision making. Moreover, we witnessed an explosion of studies presenting new ways to investigate cognitive models of judgment and decision making.

Between talks, social events and poster sessions, we explored Long Beach small range of stores, walking along the shore and drinking coffee. Long Beach offered a variety of different restaurants with food from all over the world. Some relaxing time were also spent at the hotel pool area where we enjoyed the nice weather, and in a hot tub under the stars at night. We also had the chance to meet up with many old but also new colleagues. Many new ideas were consolidated during the long journey home and we returned feeling positively enriched and excited about future projects and collaborations, although a bit tired.

Sara Stillesjö
Linus Andersson
Linnea Karlsson

Photo: Linnea Karlsson

The new UFBI website

During the fall of 2014, the new UFBI website was launched. We moved from an external site to the InfoGlue-based system here at Umeå University.

The move, and the remake of the site, was partly done so that we would be able to follow the standard structure for faculties, institutions and research centers based at Umeå University. The main idea is that this general structure should make it easier for visitors to navigate the different Umu-sites when similar information are located at the same place at different sites.

In this new format we also put more emphasis on the different groups that are working within UFBI. Each Principal Investigator (PI) have their own page (*bottom right image*) where their focus of research is presented, along with the members of the group. The current projects that UFBI are involved in now has a separate page with overview descriptions of each project (*bottom left image*). Welcome to visit our new site at:

www.ufbi.umu.se

Members

◆ Group Boraxbekk ◆

Name: Carl-Johan Boraxbekk
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: Hanna Malmberg-Gavelin
Discipline: Cognitive neuroscience
Research and work: I am a PhD student in the RECO-project (Rehabilitation for Improved Cognition). My main focus concerns the impact of stress on cognition and treatment of cognitive impairments in patients with stress-related illness. The aim is to examine the possibilities of using computer-based cognitive training for improving cognitive functions.

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: 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.

> **Other people affiliated to group Boraxbekk:**
> Andreas Stomby (PhD student), Peter Lundström (research assistant), Kristoffer Månsson (PhD student).

◆ Group Eriksson ◆

Name: Johan Eriksson
Discipline: Cognitive Neuroscience
Research and work: I am a researcher and scientific coordinator at UFBI and use fMRI to study the neural correlates of consciousness, several forms of memory and other cognitive functions, and to perform preoperative mapping of brain functions.

Name: Urban Ekman
Discipline: Cognitive Neuroscience
Research and work: I am a PhD 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: 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.

> **Other people affiliated to group Eriksson:**
> Amar Awad (student), Matilda Naesström (PhD student).

◆ Group Nyberg ◆

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: 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: Karolina Kauppi
Discipline: Neuroscience
Research and work: I am currently on a postdoc at the NORMENT center, Oslo University, working on brain imaging and genetics in relation to psychiatric disorders. In 2015 I will start a VR funded post-doc project in San Diego in collaboration with UFBI and NORMENT.

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 my research I 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: 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.

Name: Sara Pudas
Discipline: Cognitive Neuroscience
Research and work: I am a post doc at the Department of Integrative Medical Biology at Umeå University, where I currently investigate lifespan cognitive and neuroimaging changes in the context of two population-based longitudinal data sets: the Brainchild study on children and adolescents, 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: Carola Wiklund-Hörnqvist
Discipline: Psychology
Research and work: I am a PhD 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.

Other people affiliated to group Nyberg:
Lars-Göran Nilsson (professor and main PI for the Betula study).

Group Karlsson

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: 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: 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.

Other people affiliated to group Karlsson:
Maria Israelsson (student).

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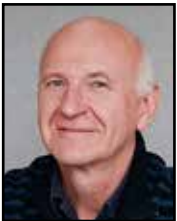
Name: Roland Johansson
Discipline: Sensorimotor control in humans
Research and work: I am a professor of physiology working with analysis of neural mechanisms supporting planning and control of dexterous object manipulation with emphasis on sensory, mnemonic and predictive mechanisms. I am also a member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

Name: 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: Per Nordmark
Discipline: Physiology
Research and work: I am a PhD student and hand surgery resident. My research focuses on functional and structural changes in the central nervous system in persons that have suffered peripheral nerve injury to their upper limb.

Other people affiliated to group Johansson:
Carola Hjältén (project assistant), Anders Bäckström (engineer), Per Utsi (research engineer).

◆ Group Åhlström Riklund ◆

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.

Photo: VLL

Name: Jan Axelsson
Position: PET physics and image analysis
Research and work: I am working with the COBRA and the PHIBRA projects as the PET expert. This involves data acquisition, pharmacokinetic modeling, methodological questions and method development. I have been working with PET physics since 2003.

Name: Mats Eriksson
Position: X-ray technician/research nurse
Assignments: I have worked with MR between 1989-93 and since 2003 onwards. Since 2011 I work as a research nurse part-time with studies of the brain. These studies also include cognitions testing and examinations in PET/CT. As x-ray technician I work most of my time with MR.

Name: Kajsa Burström
Position: X-ray technician/research nurse
Assignments: I have been working in the x-ray department since autumn 1999 with CT and general studies. Before that, from jan -93 I worked at Neurocentre, nursing (surgery, medicin and rehab). Since autumn 2011 have I been working part time as a research nurse with different brain studies that includes MR, PET/CT and different cognition tests.

Photo: Erik Mo

Name: Susanna Jakobson Mo
Discipline: Radiology and Nuclear medicine
Research and work: I am an associate senior lecturer/consultant physician, specialist in Radiology and Nuclear medicine. My research is within the field of functional imaging with nuclear medicine methods such as SPECT and PET in parkinsonian diseases. I have been working with the NYPUM project since 2004.

◆ Group Eklund ◆

Photo: Gudrun Furtenback

Name: Anders Eklund
Discipline: Biomedical engineering
Research and work: I am a professor of Biomedical engineering at Umeå University. My main areas of interest are physiological measurement techniques, with a focus on measuring, modeling and signal processing with applications in neuroscience and ophthalmology.

Photo: Gudrun Furtenback

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.

Other people affiliated to group Eklund:
Khalid Ambarki (PhD), Jan Malm (professor), Tora Dunås (PhD student), Laleh Zarrinkoob (PhD student).

◆ MR staff and other UFBI members ◆

Name: Micael Andersson
Discipline: 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: 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: 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: 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: 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 since 2000. 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: 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: 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 am a PhD and use fMRI to investigate fundamental learning processes from a neuroscientific perspective. I have investigated brain activity related to direct and indirect effects of testing in two projects. My current project deals with the role of relational processing in comprehension during mathematics learning.

Publications

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

Awad, A., Levi, R., Lindgren, L., Hultling, C., Westling, G., Nyberg, L., & Eriksson, J. (accepted). Preserved somatosensory conduction in a patient with complete cervical spinal cord injury. Journal of Rehabilitation Medicine.

Andersson, L., Claeson, A.-S., Nyberg, L., Stenberg, B., & Nordin, S. (2014). Brain responses to olfactory and trigeminal exposure in idiopathic environmental illness (IEI) attributed to smells — An fMRI study. Journal of Psychosomatic Research, 77, 401–408.

Bergström, F., & Eriksson, J. (2014). Maintenance of non-consciously presented information engages the prefrontal cortex. Frontiers in Human Neuroscience, 8, 938.

Ekman, U., Eriksson, J., Forsgren, L., Domellöf, M. E., Elgh, E., Lundquist, A., & Nyberg, L. (2014). Longitudinal changes in task-evoked brain responses in Parkinson's disease patients with and without mild cognitive impairment. Frontiers in Neuroscience, 8.

Eriksson, J., Stiernstedt, M., Öhlund, M., & Nyberg, L. (2014). Changing Zaire to Congo: the fate of no-longer relevant mnemonic information. NeuroImage, 101, 1–7.

Fernandes, C. P. D., Westlye, L. T., Giddaluru, S., Christoforou, A., Kauppi, K., Adolfsson, R., Nilsson, L.-G., Nyberg, L., Johansen Lundervold, A., Reinvang, I., Steen, V. M., Le Hellard, S., & Espeseth, T. (2014). Lack of association of the rs1344706 ZNF804A variant with cognitive functions and DTI indices of white matter microstructure in two independent healthy populations. Psychiatry Research, 222(1-2), 60–6.

Jonasson, L. S., Axelsson, J., Riklund, K., Braver, T. S., Ögren, M., Bäckman, L., & Nyberg, L. (2014). Dopamine release in nucleus accumbens during rewarded task switching measured by [11C]raclopride. NeuroImage, 99, 357–64.

Kauppi, K., Nilsson, L.-G., Persson, J., & Nyberg, L. (2014). Additive genetic effect of APOE and BDNF on hippocampus activity. NeuroImage, 89, 306-313.

Månsson, K., Frick, A., Boraxbekk, C-J., Marquand, A., Williams, S., Carlbring, P., Andersson, G. & Furmark, T. (accepted). Predicting Long-term Outcome of Internet-delivered Cognitive Behavior Therapy for Social Anxiety Disorder Using fMRI and Support Vector Machine Learning. Translational Psychiatry

Nevalainen, N. Riklund, K., Andersson, M., Axelsson, J., Ögren, M., Lövdén, M., Lindenberger, U., Bäckman, L. & Nyberg, L. (in press). COBRA: A prospective multimodal imaging study of dopamine, brain structure and function, and cognition. Brain Research.

Nyberg, L., Andersson, M., Kauppi, K., Lundquist, A., Persson, J., Pudas, S., & Nilsson, L.-G. (2014). Age-related and genetic modulation of frontal cortex efficiency. Journal of Cognitive Neuroscience, 26, 747-754.

Nyberg, L., & Salami, A. (2014). The APOE e4 allele in relation to brain white-matter microstructure in adulthood and aging. Scandinavian Journal of Psychology, 55(3), 263–7.

Persson, J., Pudas, S., Nilsson, L.-G., & Nyberg, L. (2014). Longitudinal assessment of default-mode brain function in aging. Neurobiology of Aging, 35(9), 2107–17.

Pudas, S., Persson, J., Nilsson, L.-G., & Nyberg, L. (2014). Midlife memory ability accounts for brain activity differences in healthy aging. Neurobiology of Aging.

Thompson, P. M., Stein, J. L., Medland, S. E., Hibar, D. P., Vasquez, A. A., Renteria, M. E., ... Nyberg, L., ... Drevets, W. (2014). The ENIGMA Consortium: large-scale collaborative analyses of neuroimaging and genetic data. Brain Imaging and Behavior, 8(2), 153–82.

Vestergren, P., & Nyberg, L. (2014). Testing alters brain activity during subsequent restudy: Evidence for test-potentiated encoding. Trends in Neuroscience and Education, 3(2), 69–80.

Dissertations

Ekman, U. (2014). Functional brain imaging of cognitive status in Parkinson's disease. Doctoral dissertation, Umeå University.

Wiklund-Hörnqvist, C. (2014). Brain-based teaching. Behavioural and neuro-cognitive evidence for the power of test-enhanced learning. Doctoral dissertation, Umeå University.

Conference proceedings

Sjölie, D., Kalpouzos, G., & Eriksson, J. (2014, December). Neural correlates of disrupted presence: Strange disruptions in a naturalistic virtual environment. Talk presented at ICAT/EGVE 2014, Bremen, Germany.

Andersson, L., Israelsson, M., Karlsson, L., Juslin, P., Stillesjö, S., Eriksson, J. (2014, November). The conjunction fallacy is stable across repeated probability and frequency judgments. Poster presented at the Society for judgment and decision making annual meeting, Long Beach, USA.

Karlsson, L., Stillesjö, S., Eriksson, J., Juslin, P., & Nyberg, L. (2014, November). Testing assumptions of multiple-cue judgment models by investigating brain activity overlap between instructed and spontaneously

adopted models. Poster presentated at the Society for judgment and decision making annual meeting, Long Beach, USA.

Stomby, A., Boraxbekk, CJ., Nording, A., Nilsson, L-G., Adolfsson, R., Nyberg, L. & Olsson, T. (2014, November). High salivary cortisol levels are associated with reduced volume of prefrontal cortex in men and women. Talk presented at Society for Neuroscience, Washington DC, USA.

Nyberg, L. (2014, June). En framgångsrik skola, seminar participation at Almedalsveckan, Almedalen, Sweden.

Axelsson, J., & Sörensen, J. (2014, May). The 2D Hotelling filter - a quantitative noise-reducing principal-component filter for dynamic PET data, with applications in patient dose reduction. Talk presented at the 13th Turku PET Symposium, Turku, Finland.

Jonasson L. S., Axelsson, J., Riklund, K., Braver, T. S., Bäckman, L. & Nyberg, L. (2014, May). Increased Dopamine Release in Nucleus Accumbens during Rewarded Task-Switching. Poster presented at the 13th Turku PET Symposium, Turku, Finland.

Karlsson, L. (2014, May). Learning mathematics without a suggested solution method: durable effects on performance and brain activity. Talk presented at Symposium on Cognitive neuroscience in education. Stockholm, Sweden.

Nevalainen, N., Riklund, K., Andersson, M., Axelsson, J., Ögren, M., Lövden, M., Lindenberger, U., Bäckman, L. & Nyberg L. (2014, May). Cognition and brain in aging (COBRA): a longitudinal PET and MRI study. Poster presented at the 13th Turku PET Symposium, Turku, Finland.

Nyberg, L. (2014, May). Learning by testing: the neural correlates and potential usefulness of the testing effect. Talk presented at Symposium on Cognitive Neuroscience in education, Stockholm, Sweden.

Månsson, NT. K., Carlbring, P., Frick, A., Engman, J., Olsson, C. J., Bodlund, O., Furmark, T., & Andersson, G. (2014, May). Multi-voxel patterns in fear network regions predict clinical outcome one-year after cognitive behavior therapy for social anxiety disorder-A support vector machine fMRI study. Poster presented at the 69th annual conference of the Society of Biological Psychiatry, New York, USA.

Stomby, A., Olsson, CJ., Nyberg, L. & Olsson, T. (2014, May). Diet-induced weight loss improves episodic memory and alters brain activity in overweight postmenopausal women. Talk presented at SRP Diabetes/Endomet Retreat, Karolinska Institutet, Stockholm, Sweden.

Wåhlin, A., Schrauben, E., Wieben, O., Ambarki, K. Malm, J. & Eklund, A. (2014, May). Distal cerebral arterial pulsatility using 4D Flow MRI. Poster presented at ISMRM 2014, Milano, Italy.

Nyberg, L. (2014, January). Hidden factors behind apparent age-related reduction in hippocampus recruitment during memory tasks. Talk presented at Donders symposium Cognitive ageing across the Themes, Nijmegen, Netherlands.

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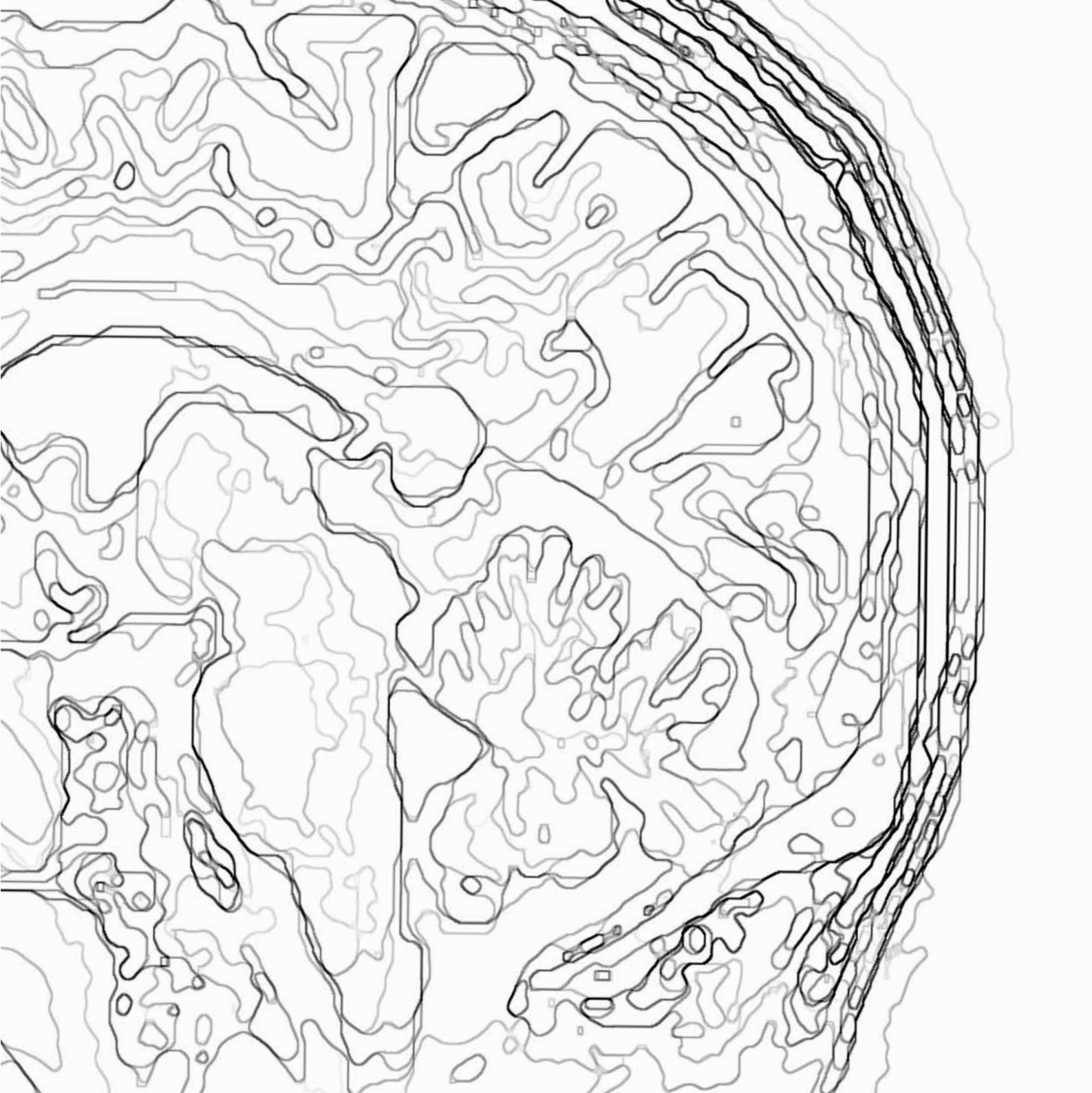
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