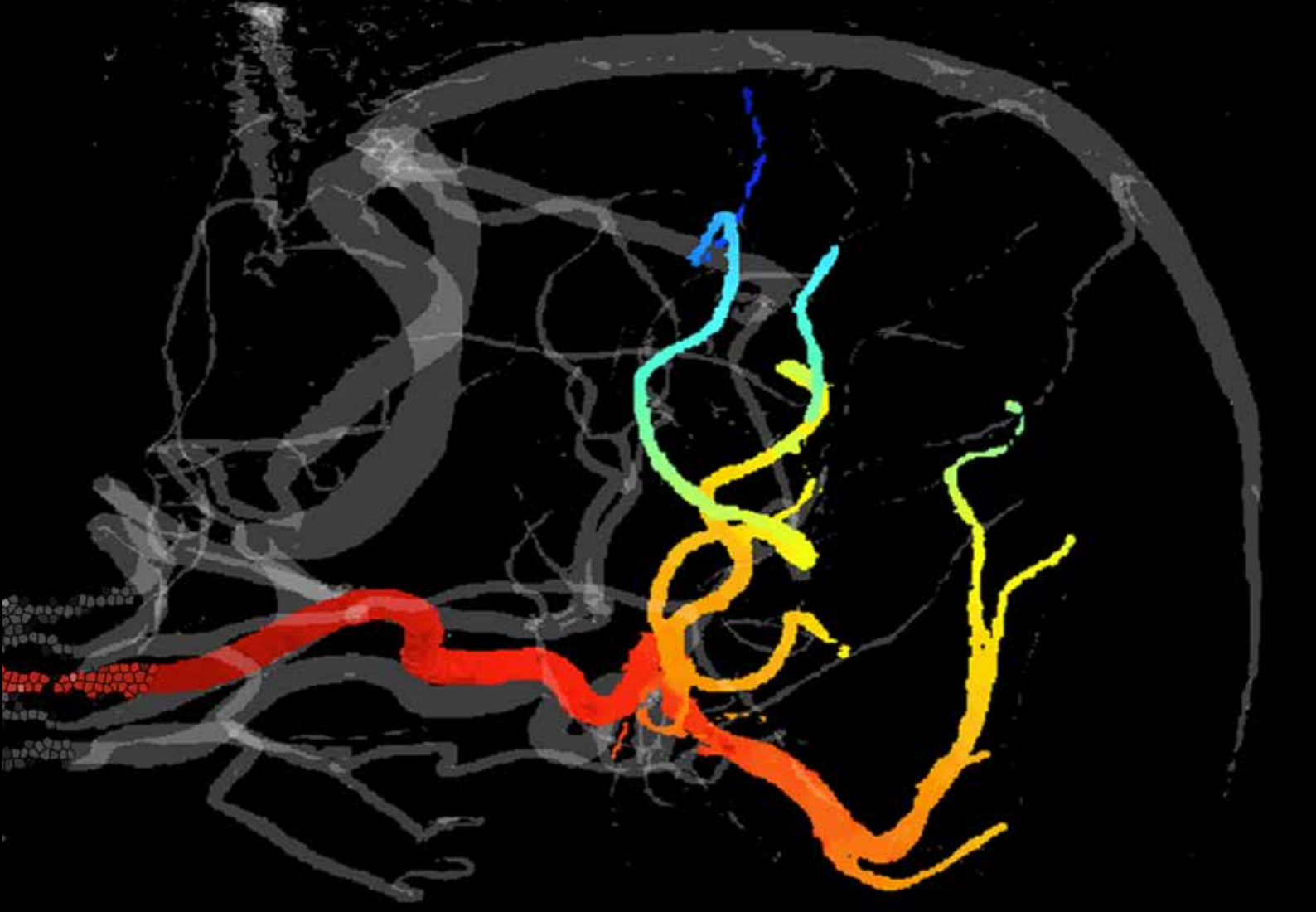

Umeå center for Functional Brain Imaging - UFBI

Annual Report 2017

UFBI
Umeå center for
Functional Brain Imaging

UFBI 2017 Annual Report

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Welcome to the Annual Report for 2017!

Some of us may remember 2017 as the year we had a cold summer, or a long winter with lots of snow. However, looking back with the UFBI glasses on, the year seems to have been quite 'hot'. In this report we try to summarize some of the many exciting events that happened at our centre.

We can again report a record-high number of clinical scans, along with a very productive scientific year in terms of research scanning activity and scientific production. The hard work of the MR-team 'down-under', along with engineers, technicians, radiologists, and physicists, is the foundation for this success. Together, they make it feel as if we have a 4T scanner every day!

Some of past year's research activities are presented in a bit more detail. Hanna Malmberg-Gavelin presents an overview of their work on stress-related exhaustion disorder within the RECO-study. An important feature of RECO is an intervention component. Intervention was also a cornerstone in two UFBI-related dissertations that were publicly defended during 2017. One of these, written by Lars Jonasson, focused on the role of physical activity in healthy aging. The other, written by Helena Fordell, presented evidence from studies using VR-technology to help chronic stroke patients to recover. Intervention is hard work, but also a unique method to obtain more causal insights into complex relations among various factors. We look forward to future intervention work at UFBI.

Other examples of past year's research efforts include studies in Betula on subfields of the hippocampus as summarized by Greger Orädd, a new wave of the COBRA study is described by Nina Karalija, work on the crucial role of feedback for test-enhanced learning is discussed by Carola Wiklund-Hörnqvist, and Madelene Holmgren presents a study in which 4D flow MR was used to scan the arteries connecting to the circle of Willis (beautifully illustrated on this report's cover image by Mikael Stiernstedt in collaboration with Anders Wåhlin).

An outstanding event during 2017 was that former UFBI graduate student C-J Olsson, now Boraxbekk, was appointed as full professor of Cognitive Neuroscience of Aging at CEDAR, affiliated with UFBI. In this report, CJ gives us an inspiring account of his past journey as well as a vision for the future. For sure, many important discoveries are waiting around the corner, and CJ also contributes a very interesting connection to the DRCMR in Copenhagen. Welcome!

Last but not least, several UFBI scientists had success securing grants to support their future research activities. UFBI co-director Johan Eriksson, who is one of those who was successful in the very hard competition for grants, presents an overview of 2017 UFBI-related grants. Congratulations!

Lars Nyberg, April 2017
UFBI Director (2001 - Present)

In short

In 2017 the members of UFBI produced:

19
clinical fMRI-scans

4
conference talks / posters

2
doctoral dissertations

367
fMRI-scans

1286
clinical MRI-scans

21
original articles

Research

Neural activation in stress-related exhaustion disorder

Stress-related illness is an increasing concern in society today. In Sweden, stress-related exhaustion disorder (ED) is one of the most common reasons for long-term sick-leave. ED has frequently been associated with cognitive impairments, mainly within the domains of working memory (WM), executive function and episodic memory. However, little is known about the neural underpinnings of these cognitive impairments and even less about how cognition-focused rehabilitative measures may influence brain functionality.

In a recent study, we sought to investigate the association between the key symptom of ED, i.e. burnout, and functional neural response during a WM task. Fifty-five patients with clinical diagnosis of ED were administered a WM task during fMRI scanning. After 12 weeks of stress rehabilitation, 27 patients returned for a second scanning. We found a positive association between burnout level and neural activation in the rostral prefrontal cortex, the posterior parietal cortex and the striatum. Following stress rehabilitation, the striatal activity decreased as a function of improved levels of burnout. No association between burnout severity and WM performance was found.

Our results indicate that for patients with ED, functional neural responses related to WM processing are modulated by burnout severity. Integrating these findings with the behavioural data, it seems that patients with high levels of burnout may need to recruit additional cognitive resources in order to uphold task performance at similar levels as patients with lower burnout severity. This is of particular interest from a clinical point of view, since patients with ED often report substantial cognitive deficits in their everyday life, as well as high levels of fatigue during cognitive tasks, despite generally showing small-moderate impairments in cognitive tests. Our results may provide an insight into the neural mechanisms underlying these clinical observations, as well as highlighting the need for more sensitive measures to better capture the cognitive deficits associated with ED.

Finally, in our study we also examined the neural effects of a computerized cognitive training intervention, completed by ten of the patients in the original sample. Eleven patients served as a treatment-as-usual control group. We found training-related increases in neural activation in WM-related regions during high WM load. Although the results from this analysis need to be interpreted with caution due to the small sample size and an exploratory analytical approach, they nevertheless indicate similar mechanisms for neural plasticity in patients with ED as those previously observed in healthy individuals.

This work is part of the Rehabilitation for Improved Cognition (RECO)-study, a randomized clinical trial conducted at the Stress Rehabilitation Clinic at the University Hospital in Umeå, in which we investigated the effects of cognitive training and aerobic exercise on cognitive, psychological, work-related and brain imaging outcomes for patients with ED. In this respect, it is a good example of how clinical research and brain imaging can join together within UFBI to target highly relevant clinical and societal questions.

Hanna Malmberg-Gavelin

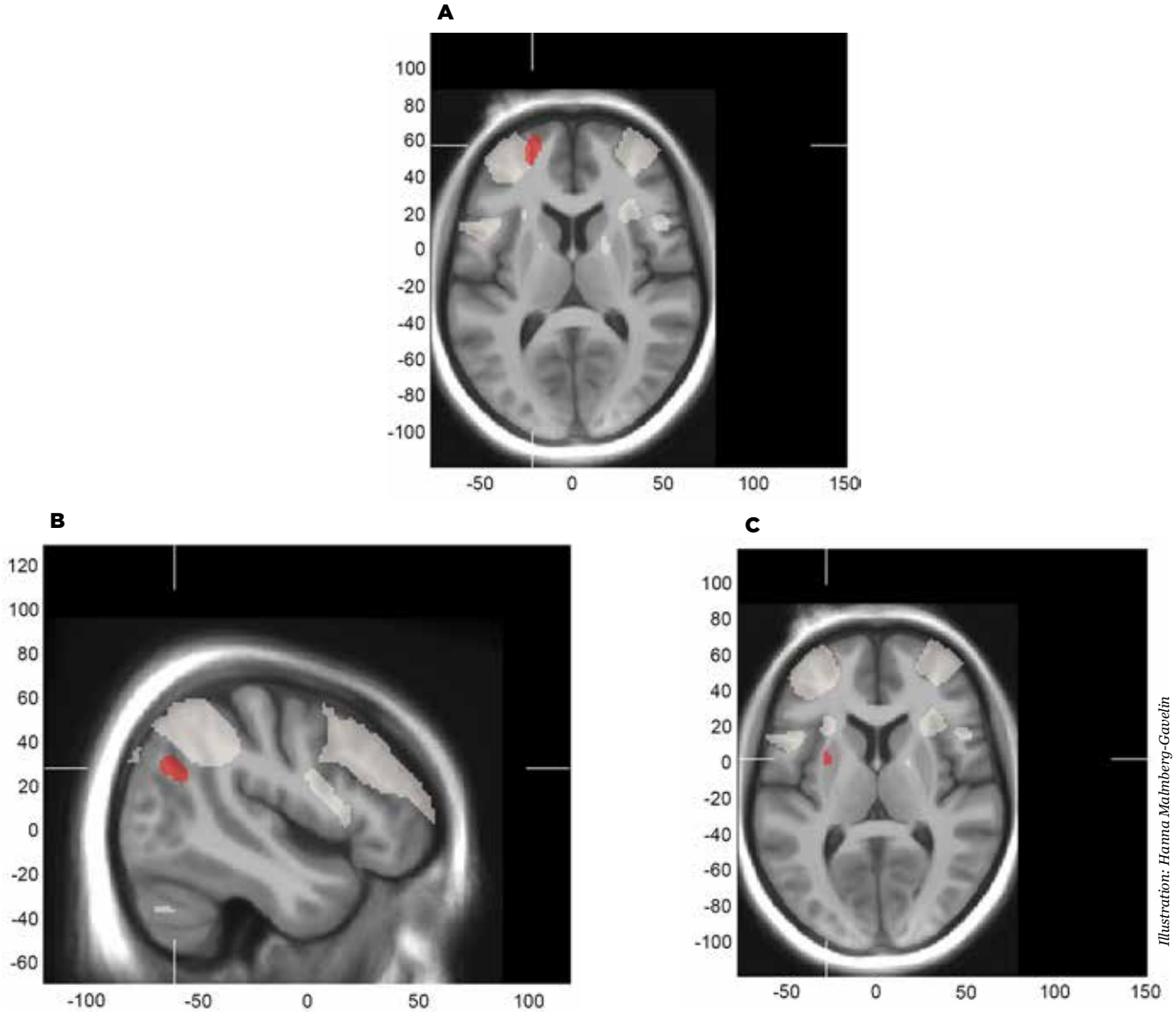


Illustration: Hanna Malmberg-Gavelin

Burnout was positively correlated with neural activation in (A) the left superior frontal gyrus, (B) the right angular gyrus and (C) the left putamen. Improved burnout following the rehabilitation period was associated with reduced neural activity in the left putamen.

Focusing on the hippocampus

The medial temporal lobe and, in special, the hippocampal area is important for memory function. In this study we aim to look at the subfields of the hippocampus (HC). The different parts of HC play different roles in memory processes known as pattern separation, in which similar inputs are separated into separate outputs, and pattern completion, where slightly different inputs are mapped onto the same output. The participants have earlier learned to pair faces to names. Now they are presented with the same faces, but with two modifications. The fragmented faces have parts of the face removed, while the morphed faces have been changed by mixing in features from a different face (Figure 1). The two types of modifications are supposed to activate the HC subfields differently.

In order to observe such differences we need to push the resolution for the functional protocol beyond that usually employed at 3T. The protocol therefore does not cover the whole brain, but rather a smaller part including the HC (Figure 2) with a voxel size of 1.5 mm. The protocol collects 470 volumes with a repetition time of 1.5 sec, resulting in a 12 min experiment in which the participants are presented with fragmented and morphed faces and asked whether they recognize the face or not.

Two additional structural volumes are used in an automated routine to divide the HC into its constituent subfields (Figure 2) and once the segmentation is complete, the functional signal from the separate subfields can be averaged and used in the analysis.

Since the voxel volume in the high resolution fMRI is only about 15% of the one commonly used at 3T it is difficult to obtain sufficiently high image quality to observe the small effects that we are looking for. We have therefore also looked into the possibility to take advantage of the higher signal and functional contrast that can be obtained at the national high-field 7T facility in Lund. Preliminary studies have shown that similar protocols can be used at the higher field strength but technical problems make it difficult to decrease the voxel size below 1.5 mm.

Greger Orädd

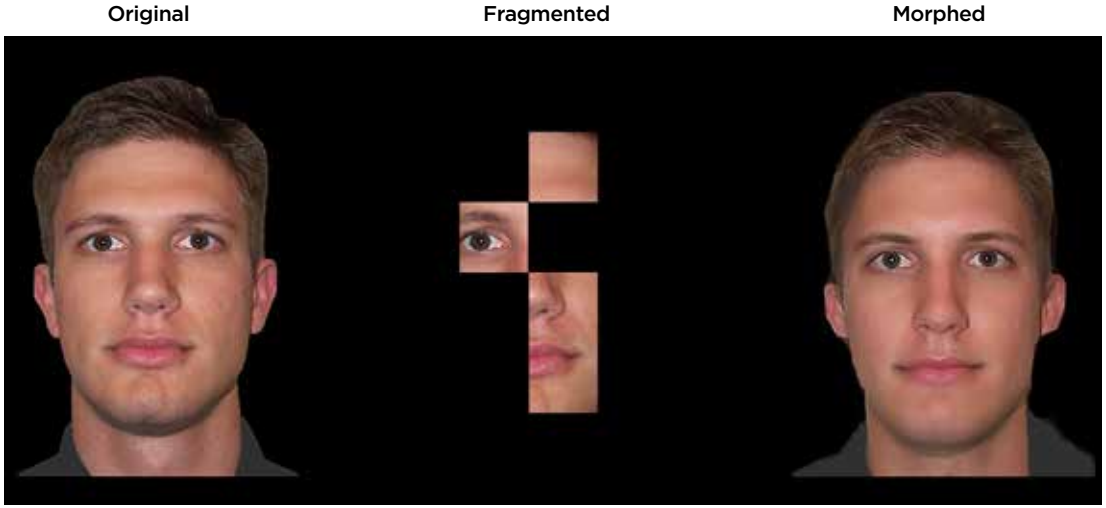


Figure 1. An example of a fragmented and morphed face, together with the original.

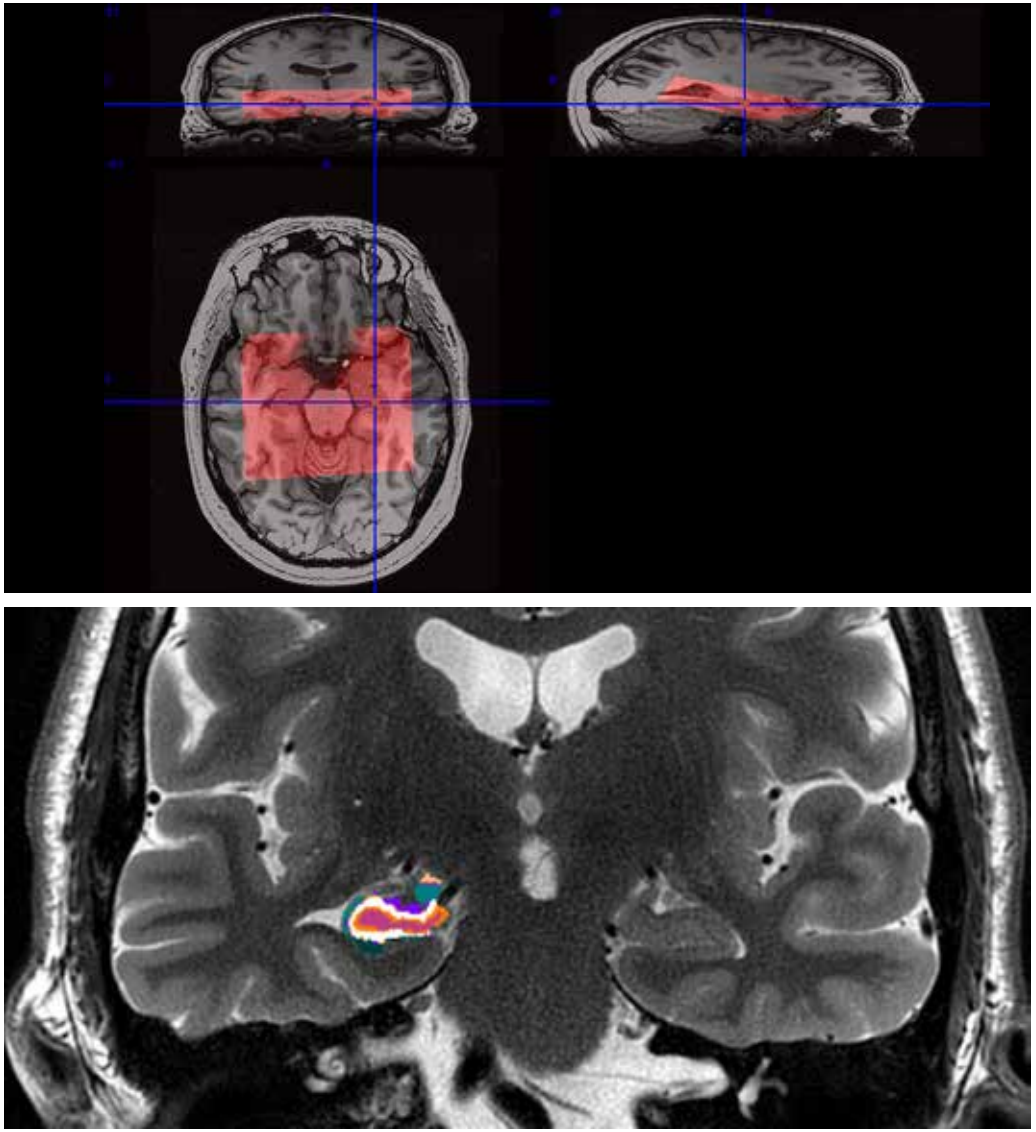


Illustration: Greger Orädd

Figure 2. Top: Coronal, sagittal and axial views of the T1 weighted volume with the crosshair located in the right hippocampus. Overlaid in red is the high resolution functional volume.
Bottom: A coronal T2 weighted slice with the hippocampus subfield segmentation overlaid for the left hippocampus. Dark green: subiculum, green: CA1, white: molecular layer, orange: GC/DG, violet: CA4.

The second wave of the Cognition, Brain, and Aging (COBRA) study is ongoing

The Cognition, Brain, and, Aging (COBRA) study is a joint effort initiated by researchers at UFBI, Karolinska Institute, and Max Planck Institute in Berlin. It aims at evaluating how cognitive functions change in healthy aging, and in particular, which underpinning brain mechanisms that drives successful and non-successful cognitive aging. The dopamine (DA) system has a central role in COBRA, due to previous indications of a DA-cognition link in aging. During 2012-2014, brain and cognitive data was collected for 181 healthy older adults (aged 64-68 years) living in Umeå. The participants underwent broad-ranged cognitive testing, positron emission tomography (PET) with 11C-raclopride to quantify DA D2 receptor availability in the brain, and magnetic resonance imaging (MRI) for estimates of white and grey matter structure, brain activation at rest and task, and cerebral blood flow. Also, genetic and lifestyle data was collected to consider the impact of such factors on cognitive and brain aging.

COBRA constitutes the largest PET study conducted so far and the cross-sectional data has rendered several interesting findings. Its multimodal design enables us to contribute with papers that interrelate various brain measures, genetics, and lifestyle when characterizing low- and high-performing individuals. In the first empirical paper, we reported that D2 receptor availability in caudate and hippocampus, and functional connectivity between these structures, predict episodic memory performance in a positive linear fashion (Nyberg et al 2016, PNAS). Other findings demonstrate a non-linear association between cognitive performance, particularly working memory, and D2-receptors, where a subgroup with poor performance had high D2-receptor availability but otherwise brain characteristics typical of low-performing individuals (Lövden et al 2017, Cereb Cortex). Furthermore, the MRI-based blood flow measurements of COBRA have been used to construct a stereotactic atlas of the cerebral arterial system (Dunas et al 2017, Neuroinformatics). Several manuscripts are in the process of being published. A few examples of such describe the neurocognitive profile of individuals with poor working memory, effects of physical exercise on DA and cognition, and the impact of genetic differences on the D2-cognition link, respectively.

Photo: Nina Karalija

Lars Bäckman giving a talk at the Cobra Open House-day, held at Norrlands Universitetssjukhus on March 22, 2017.

Even though the cross-sectional data of COBRA bring novel findings to the literature, longitudinal measures are key for statements of causality. For this reason, the second data collection wave was initiated in September 2017. Participants are scheduled to undergo the same procedure with 5 years between test sessions. Approximately 130 participants have responded that they are interested in participating in the second wave. Thus, we are optimistic about being able to respond the main research question of COBRA with sufficient power: is DA system changes over time a significant mechanism for age-related cognitive decline?

Nina Karalija

Accurate 4D flow MRI post processing for blood flow rate quantification in brain arteries

Recent improvements in MRI acquisition schemes allows for fast, time-resolved and high-resolution flow velocity quantification (4D flow MRI). Such scans quantify flow in all cerebral arteries in less than 10 minutes and could therefore become important when studying distal flow distributions in various diseases such as stroke and dementia. However, to fully benefit from this technique reliable and automatic post-processing methods are required.

During the autumn of 2017 we scanned 35 subjects to establish a material that can be used to develop and evaluate a new automatic method for segmentation and flow quantification for 4D flow MRI. All major cerebral arteries connecting to the circle of Willis were scanned with 4D flow MR. All vessels were additionally measured with standard 2D sequences (gold standard but too laborious to use clinically or in large scale).

An algorithm for post-processing of 4D flow MRI data was developed, which generated double-oblique cross-sections of the artery and segmented lumen by applying a local thresholding function. The unique material, with data from both methods, should allow tuning the automatic method to achieve results closely matching those obtained with the conventional method.

Madelene Holmgren

Illustration: Madelene Holmgren

Left: 4D flow generated angiogram of the cerebral vasculature. Right: A skeleton representation of the cerebral vasculature where measurement locations of the gold standard technique are showed by the black markers.

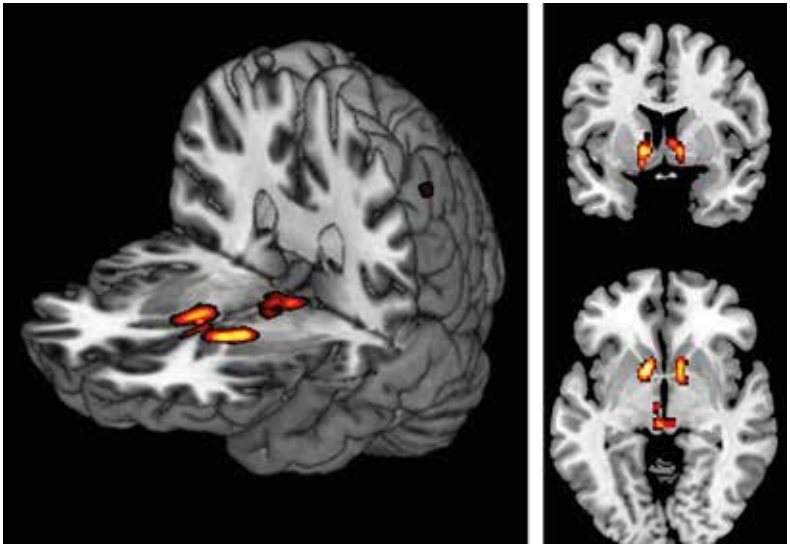
Zooming In

Wiklund-Hörnqvist, C., Andersson, M., Jonsson, B & Nyberg, L. (2017). Neural activations associated with feedback and retrieval success. npj Science of Learning, 2:12; doi:10.1038/s41539-017-0013-6

During the last decade substantial research in cognitive psychology has challenged the conventional view that tests merely assess knowledge, and are a neutral event for the process of learning. Evidence from laboratory and classroom studies have showed that taking tests (compared to a diversity of other pedagogical methods) during initial learning is superior as it improves retention of the to-be-learned material – which is the main goal in education. This empirical phenomenon is known as the "testing effect".

What are the critical factors involved? Two such factors are retrieval success and feedback. Given the basic idea with test-enhanced learning – "repeatedly test yourself during initial learning" – simply means that the initial knowledge level is generally low, so even if testing produces superior retention in the absence of feedback, correct answer feedback is a critical factor to support improvement in learning. Feedback compensates for unsuccessful retrievals, and retrieval changes the memory itself. Whereas behavioral evidence exist, less is known about the neuro-cognitive processes that produces the testing effect.

Here, we used a slow event related fMRI paradigm to examine functional brain activity related to test-enhanced learning with or without feedback. Akin to a school situation, subjects learned foreign vocabulary (Swahili-Swedish word-pairs) across three consecutive cued recall tests with or without correct-answer feedback. To compare feedback versus no feedback, and to minimize feedback expectancy across repetitions of the to-be-learned material, test items with feedback (correct target word) was uniquely interspersed with test items without feedback. Functional brain activity responses were analyzed in relation to both the test event (i.e. retrieval event) and the feedback event, respectively and across repetitions.



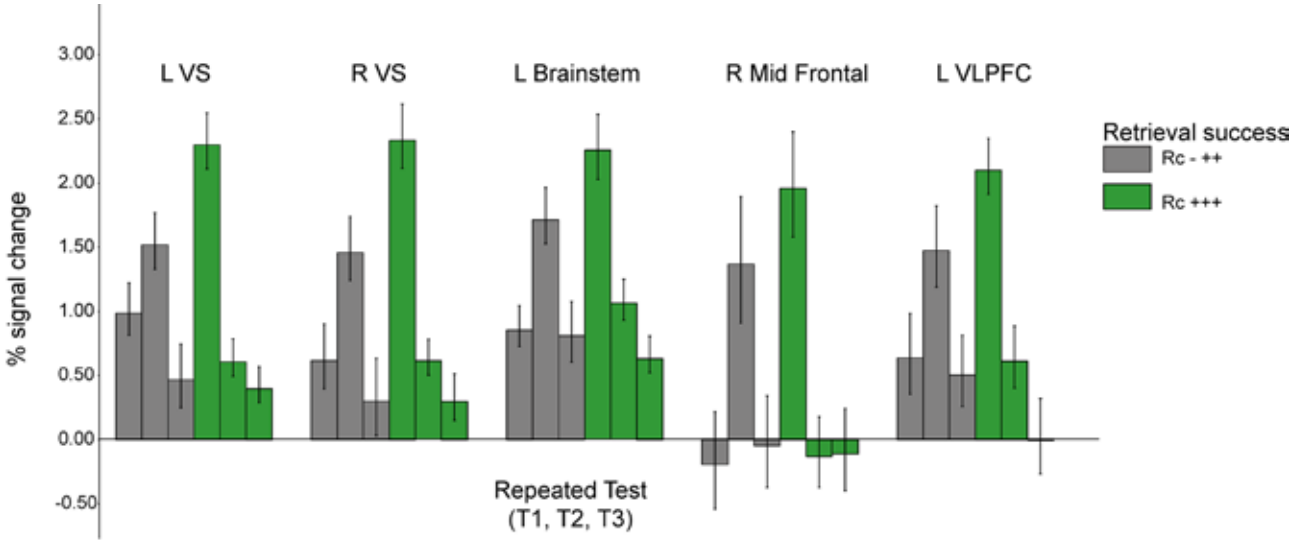
Illustrations: Carola Wiklund-Hörnqvist

Higher hippocampal activity was found for feedback compared to no feedback, and learning from feedback was related to increased activity predominantly in the insula. It is well established that hippocampus is a core region involved in learning and memory, and insula involved in successful encoding. For retrieval success, up-regulated activity in the left brainstem, and several fronto-striatal regions were evident at the first successful retrieval followed by a marked decrease across consecutive tests (see figure). Those regions are known to tax on executive functions, and are key regions involved in learning. These results indicate that while both feedback and retrieval success are key aspects that fosters the testing-effect; they operate at different functional levels in the brain.

Of particular interest was the finding that test-enhanced learning taxes executive processes early in the learning-phase, but becomes less executively demanding as a function of enhanced learning. This raises an important question: could test-enhanced learning be a pedagogical method that is equally effective for all students, independently of individual variations in cognitive proficiency (e.g. working memory)? To date, we have limited knowledge about how individual variations in cognitive proficiency influence the effectiveness of the testing effect. Some behavioral studies do suggest, in line with the results from the current study, that test-enhanced learning with feedback might be a specifically powerful way to improve learning for students with lower cognitive proficiency. Such knowledge is of both scientific and educational significance.

Fortunately, within the "Learning to engage the brain" project, we have collected fMRI data related to the testing effect in a sample of students from upper secondary school along with behavioral data comprising a comprehensive cognitive battery. The combined influences of cognitive proficiency and functional brain activity related to the (beneficial) effects of testing are in focus and currently under investigation at UFBI.

Carola Wiklund-Hörnqvist



New Professor of Cognitive Neuroscience of Aging

For my scientific career, and for myself, 2017 will always be remembered as a big year. I was appointed full professor of cognitive neuroscience of aging at the center for demographic and aging research (CEDAR) and UFBI, Umeå University. This confirms that hard and dedicated work actually pays off! The accomplished work leading up to this position would not have been possible without my collaborators and colleagues, in Umeå, in Sweden, and throughout the world. So first of all, Thank you!

The vision I have for my research is to identify and to optimize sustainable interventional strategies for improved or maintained brain health throughout the lifespan. We have done a good job in the past with interventions on: physical activity; diet; imagery; memory training; cognitive behavioral therapy; motor timing… and the list continues. By combining interventions with advanced brain mapping techniques and extensive behavioral testing we have provided some unique insights into the neuro-cognitive mechanisms of brain and cognitive aging. As professor of cognitive neuroscience of aging, this work will now continue with novel studies to understand life-long brain plasticity. I will continue emphasizing on multi-modal imaging, because I am certain that combining our different brain mapping modalities in sophisticated ways will help us to better understand brain and cognitive aging. I will also continue engaging in projects that requires a multi-professional work team, for me it is rewarding to work towards a common research goal, e.g. how to promote healthy aging, and to do so with different methods and from different disciplines.

Synergies across Umeå University and Scandinavia

I particularly believe that we in Umeå have unique opportunities to address brain aging from a population neuroscience perspective. With my professorship, brain imaging from UFBI will meet population science from CEDAR. There is huge potential in the combination of

Photo: Jorchr (Wikimedia Commons)

I expect future synergies between two of Europes leading imaging centers, the UFBI in Sweden, and DRCMR across the bridge in Denmark.

Photo: Angelica Sandström

cohort-based data and clever interventions, and I hope that such approach will be able to better tackle future societal and scientific challenges of the growing aging population, and to identify unique research questions and hypotheses.

As a novel intervention I would also like to include individually tailored brain stimulation techniques, such as transcranial alternating current stimulation (TACS). I have never done brain stimulation previously, and to set up such studies in a correct and scientifically sound way is not without challenges. For me this will be possible due to the interactions I have managed to build up when starting to work at the Danish Research Center for Magnetic Resonance (DRCMR). I will also in the future continue to share my time as professor in both Umeå and Copenhagen. I find it stimulating that in the age of data sharing and big data efforts, bridge two of Europe's strongest brain imaging centers.

The pre-professor time at UFBI has been fantastic, and I am now very much looking forward to the future opportunities. As always, I will try to tackle them by striving for high academic standards, innovative methods and techniques, and an ambitious, fun and diverse work environment. Training of new scientists is essential for any research field. At UFBI we have many brilliant young researchers at all levels, master students, PhD-students, postdocs, and senior researchers that are in the process of building up their own groups. I hope to, in my role as professor, inspire these talented people and provide support and education to help foster the next generation of cognitive neuroscientists.

Carl-Johan Boraxbekk
Professor of Cognitive Neuroscience of Aging

Dissertations

In the PHysical Influences on BRain in Aging (PHIBRA) project we studied the effects of physical exercise on the brain and cognitive functions. Sixty older adults in the Umeå region were delighted to take part in the project, and I was the fortunate graduate student given the opportunity to do exciting research within the project. Specifically, I could focus on cognition and my favorite neurotransmitter dopamine.

As a former tennis player teaming up with a former expert hurdler (CJ) I felt we made a really dynamic team. CJ did try to teach me to also slow down sometimes, something I tended to fail at. On the day when I defended my thesis however, I believe his lessons had finally managed to manifest. That was a very good lesson because the defense was a true joy, of course also due to magnificent Professor Emrah Düzel.

As I love the projects and work environment at UFBI I feel lucky to be able to stay for another few years, doing a post-doc with Anna Rieckmann. With Anna I will use simultaneous PET/fMRI to study factors relating to cognitive and brain aging. I believe this new technology can really make new and valuable additions to the field of cognitive neuroscience and am really thrilled to take part!

Lars Jonasson

As a neurologist, I became aware of the need to improve diagnostics and rehabilitation for spatial neglect on my very first day on the stroke ward. From then onwards, I sought to discover whether it might be possible to design a task-specific training program using VR-technology to stimulate a recovery of the neuronal activity in and between the attention networks in the chronic phase after stroke. This project to design, develop and evaluate RehAtt was successfully undertaken in collaboration with UFBI, HPC2N, Radiation Sciences and Pharmacology and Clinical Neuroscience and included an fMRI evaluation of training-related changes in neuronal activity during an attention task and during resting state.

It´s been a long journey but the satisfaction of ”bringing this ship home” and holding the thesis in my hand was beyond words. Specifically, the promising results from the behavioral and brain imaging measures that evaluated the effects of the RehAtt intervention method. The next step is now to set sail again and validate the methods in an international multi-center trial. The RehAtt methods for diagnostics and rehabilitation, which were evaluated in the thesis, are now in clinical use in 8 university hospitals within the EU. I am grateful for the eminent contribution and support from everyone at UFBI who has been involved. I especially wish to thank Urban Ekman, Anders Wåhlin, Johan Eriksson, Mikael Andersson and Lars Nyberg. And I will now continue the journey toward an improved means of diagnosis and rehabilitation for stroke-patients with spatial neglect in collaboration with neuroscientists in this field from Switzerland, UK, Italy, USA and Canada.

Helena Fordell

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.

At the annual UFBI lab day on June 13 more than 10 of our members gave presentations on their different projects, with subjects spanning from quantification of blood flow measurements in 4D flow MRI, to mental fatigue after traumatic brain injuries, just to mention a few. We also had the pleasure of having Idriz Zogaj, Captain of the Swedish National Memory Team, as a guest speaker.

Besides these in-house meetings, members of UFBI usually attend several meetings and conferences held in and outside Sweden. A list of attended conferences is shown on page 21. In addition to visiting conferences, members of UFBI are often invited to give talks and presentations to the public at different events. To the right is a list of some of the presentations that were given during 2017.

Public science presentations

Jonasson, L. (October 2017). Seminar presentation Aerobic Fitness and Healthy Brain Aging, at Brain Aging Neuroimaging Group seminar series. Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School, Boston, USA.

Jonasson, L. (October 2017). Fysisk aktivitet och hjärnans funktioner. Pensionärernas riksorganisation, PRO the Swedish National Pensioners' Organisation. Lycksele, Sweden.

Pudas, S. (October, 2017). Skolbetyg i barndomen och demensrisk – finns det ett samband? Presentation at Kunskapsveckan at Umeå University, Umeå, Sweden.

Nyberg, L. (October, 2017). Den lärande hjärnan. Presentation at Kunskapsveckan at Umeå University, Umeå, Sweden.

Wåhlin, A. och Öhberg, F. (September, 2017). Titta hur skelettet rör sig och hur hjärnan ser ut med medicinsk teknik. Presentation at Forskarfredag at Umevatoriet, Umeå, Sweden.

Nyberg, L. (September 6, 2017). Café minnesvärt - Finns det ett samband mellan diabetes och Alzheimers sjukdom? Talk given in Örnsköldsvik, Sweden.

Nyberg, L. (April 27, 2017). Det åldrande minnet och den åldrandet hjärnan. Seminar at Karlstad University, Karlstad, Sweden.

Jonasson, L., (April 2017). PRO Rundvik - Hur håller vi hjärnan i trim?

Nyberg, L. (March 24, 2017). Conversation between Lars Nyberg and choreographer Helena Franzén as a prelude to the dance-performance "What's left behind" at Norrlandsoperan, Umeå, Sweden.

Madelene Holmgren (left) and Idriz Zogaj (right) at the UFBI lab day June 13.

Grants approved during 2017

During 2017, several larger grants were approved for research proposals that wholly or partially include activities that will utilize the UFBI infrastructure in future research.

The COgnition, BRain, and Aging (COBRA) project (see also page 10) examines the relation between dopamine and other brain measures to cognitive performance and how this is affected by age, by following participants as they get older (longitudinal design). The first wave of data collection took place in 2012-2014, and the current grant from the Swedish Research Council (4.6 milj. SEK) to Lars Nyberg and others will support the second wave. Relatedly, the National E-infrastructure for Aging Research (NEAR), which involves a number of national nodes, including Umeå (Lars Nyberg and others), received support from the Swedish Research Council.

Karolina Kauppi received a starting grant (6 milj. SEK) from the Swedish Research Council to support a collaborative project between Umeå University and UC San Diego. The project aims to improve the understanding of various pathological and pharmacological mechanisms by applying a "network medicine and polypharmacolgy" framework, where genetic, protein, pharmacological, cognitive, and brain imaging information will be combined. The findings may enable better prediction of treatment responses and promote personalized treatments.

Anders Wåhlin also received a starting grant (3.2 milj. SEK) from the Swedish Research Council. As part of the aging process, the aorta becomes stiffer. This leads to altered blood flow dynamics in the brain, which can lead to brain damage and impaired cognition. The project aims to develop magnetic resonance imaging techniques to improve the measurement of deep cerebral arterial pulsatility, and will also compare the nature of brain damage associated with increased pulsatility to the types of dysfunction observed in aging and dementia.

Johan Eriksson, together with Lenita Lindgren, received a grant (3.7 milj. SEK) from the Swedish Central Bank Anniversary Foundation. "Being conscious" involves having conscious experiences, but also to be in a significant state of alertness/wakefulness. How these two aspects of consciousness are related is currently debated. The project aims to provide data that may help resolve such debate, by investigating how conscious and unconscious brain processes are affected when the state of wakefulness is manipulated.

Erik Rosendahl, together with CJ Boraxbekk, received a grant (3.45 milj. SEK) from the Swedish Research Council. The project aims to investigate the effects of high-intensity training on elderly individuals. A randomized controlled trial including high- versus low-intensity training groups will be evaluated after a 12-week intervention, measuring various cardiovascular and physiological parameters, as well as brain health, at baseline, three, and six months.

Charlotte Häger, also together with CJ Boraxbekk, received a grant (6.75 milj. SEK) from the Swedish Research Council. The project will continue to investigate effects of an injured anterior cruciate ligament (knee), by combining measures of movement kinematics and brain activity, as well as other measures. This may improve treatment evaluation and could promote individualized rehabilitation.

Anna Neely, together with Lars Nyberg, CJ Boraxbekk, and several others, received a grant (3.45 milj. SEK) from the Swedish Research Council. While motor symptoms in Parkinson's disease patients can be treated with medication, there are fewer options for associated cognitive deficits. The project will therefore evaluate a cognitive intervention, working-memory (updating) training, which has previously been demonstrated successful in healthy older and younger individuals. As part of the evaluation, brain activity will be measured before and immediately after the training intervention in a sample of 40 Parkinson patients.

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.

Original articles

Andersson, L., Claeson, A.-S., Nyberg, L., Nordin, S. (2017). Short-term olfactory sensitization involves brain networks relevant for pain, and indicates chemical intolerance. Int. J. Hyg. Environ. Health. DOI: https://dx.doi.org/10.1016/j.ijheh.2017.02.002

Bas-Hoogendam, J.M., van Steenbergen, H., Pannekoek, N., Fouche, J.-P., Lochner, C., Hattingh, C.J., Cremers, H.R., Furmark, T., Månsson, K.N.T., Frick, A., Engman, J., Boraxbekk, C.-J., Carlbring, P., Andersson, G., Fredriksson, M., Straube, T., Peterburs, J., Klumpp, H., Phan, K.L., Roelofs, K., Veltman, D.J., van Tol, M.J., Stein, D.J., & van der Wee, N.J.A. (2017). Voxel-based morphometry multi-center mega-analysis of brain structure in social anxiety disorder. NeuroImage: Clinical. DOI: https://doi.org/10.1016/j.nicl.2017.08.001

Berginström, N., Nordström, P., Ekman, U., Eriksson, J., Andersson, M., Nyberg, L., & Nordström, A. (2017). Using functional magnetic resonance imaging to detect chronic fatigue in patients with previous traumatic brain injury: Changes linked to altered striato-thalamic-cortical functioning. J. Head Trauma Rehabil. DOI: http://dx.doi.org/10.1097/HTR.0000000000000340

Bergström, F., & Eriksson, J. (2017). Neural evidence for non-conscious working memory. Cerebral Cortex. 1-12. DOI: https://doi.org/10.1093/cercor/bhx193

de Boer, L., Axelsson, J., Riklund, K., Nyberg, L., Dayan, P., Bäckman, L., & Guitart-Masip, M. (2017). Attenuation of dopamine-modulated prefrontal value signals underlies probabilistic reward learning deficits in old age. eLife, 6. DOI: http://doi.org/10.7554/eLife.26424

Dunås, T., Wåhlin, A., Ambarki, K., Zarrinkoob, L., Malm, J. & Eklund, A. (2017). A Stereotactic Probabilistic Atlas for the Major Cerebral Arteries. Neuroinformatics, 15, 101–110. DOI: http://dx.doi.org/ 10.1007/s12021-016-9320-y

Flodin, P., Jonasson, L. S., Riklund, K., Nyberg, L., & Boraxbekk, C. J. (2017). Does Aerobic Exercise Influence Intrinsic Brain Activity? An Aerobic Exercise Intervention among Healthy Old Adults. Frontiers in Aging Neuroscience, 9(August). DOI: http://doi.org/10.3389/fnagi.2017.00267

Gavelin, H. M., Neely, A. S., Andersson, M., Eskilsson, T., Järvholm, L. S., & Boraxbekk, C.-J. (2017). Neural activation in stress-related exhaustion: Cross-sectional observations and interventional effects. Psychiatry Research: Neuroimaging, 269(August), 17–25. DOI: http://doi.org/10.1016/j.pscychresns.2017.08.008

Gorbach, T., Pudas, S., Lundquist, A., Orädd, G., Josefsson, M., Salami, A., de Luna, X & Nyberg, L. (2017). Longitudinal association between hippocampus atrophy and episodic-memory decline. Neurobiology of aging, 51, p. 167-175. DOI: http://doi.org/10.1016/j.neurobiolaging.2016.12.002

Holmlund, P., Johansson, E., Qvarlander, S., Wåhlin, A., Ambarki, K., Koskinen, L.-O. D., ... Eklund, A. (2017). Human jugular vein collapse in the upright posture: implications for postural intracranial pressure regulation. Fluids and Barriers of the CNS, 14(1), 17. DOI: http://doi.org/10.1186/s12987-017-0065-2

Eriksson J.(2017). Activity in part of the neural correlates of consciousness reflects integration. Consciousness & Cognition, 55, 26-34. DOI: http://doi.org/10.1016/j.concog.2017.07.007

Jonasson, L., Axelsson, J., Riklund, K. & Boraxbekk, CJ. (2017). Simulating effects of brain atrophy in longitudinal PET imaging with an anthropomorphic brain phantom. Physics in Medicine & Biology, 62(13), 5212-5227. DOI: https://doi.org/10.1088/1361-6560/aa6e1b

Jonasson, L. S., Nyberg, L., Kramer, A. F., Lundquist, A., Riklund, K., & Boraxbekk, C. (2017). Aerobic exercise intervention, cognitive performance, and brain structure: Results from the Physical Influences on Brain in Aging (PHIBRA) study. Frontiers in Aging Neuroscience, 8(January), 336. DOI: http://doi.org/10.3389/FNAGI.2016.00336

Lindén, C., Qvarlander, S., Jóhannesson, G., Johansson, E., Östlund, F., Malm, J., & Eklund, A. (2017). Normal-Tension Glaucoma Has Normal Intracranial Pressure. Ophthalmology, 1–8. DOI: http://doi.org/10.1016/j.ophtha.2017.09.022

Lövdén, M., Karalija, N., Andersson, M., Wåhlin, A., Axelsson, J., Köhncke, Y., Jonasson, L., Rieckman, A., Papenberg, G., Garrett DD., Guitart-Masip, M., Salami, A., Riklund, K., Bäckman, L., Nyberg, L. & Lindenberger, U. (2017). Latent-Profile Analysis Reveals Behavioral and Brain Correlates of Dopamine-Cognition Associations. Cereb Cortex. Sep 25, 1-14. DOI: https://doi.org/10.1093/cercor/bhx253

Månsson, K., Salami, A., Carlbring, P., Boraxbekk, CJ., Andersson, G. & Furmark, T. (2017). Structural but not functional neuroplasticity one year after effective cognitive behaviour therapy for social anxiety disorder. Behaviour in Brain Research, 318, 45-51. DOI: http://dx.doi.org/10.1016/j.bbr.2016.11.018

Pudas, S., Josefsson, M. Rieckmann, A. & Nyberg, L. (2017). Longitudinal Evidence for Increased Functional Response in Frontal Cortex for Older Adults with Hippocampal Atrophy and Memory Decline. Cerebral Cortex, 1-13. DOI: https://doi.org/10.1093/cercor/bhw418

Ragnarsson, O., Stomby, A., Dahlqvist, P., Evang, J. A., Ryberg, M., Olsson, T., Bollerslev, J., Nyberg, L. & Johannsson, G. (2017). Psychoneuroendocrinology Decreased prefrontal functional brain response during memory testing in women with Cushing ' s syndrome in remission. Psychoneuroendocrinology, 82, 117–125. DOI: http://doi.org/10.1016/j.psyneuen.2017.05.010

Rieckmann, A., Pudas, S. & Nyberg, L. (2017). Longitudinal Changes in Component Processes of Working Memory. eNeuro, 4 (2), 1-9. DOI: https://doi.org/10.1523/ENEURO.0052-17.2017

Stomby, A., Otten, J., Ryberg, M., Nyberg, L., Olsson, T., & Boraxbekk, CJ. (accepted). A Paleolithic diet with and without combined aerobic and resistance exercise increases functional brain responses and hippocampal volume in subjects with type 2 diabetes. Frontiers in Aging Neuroscience.

Wiklund-Hörnqvist, C., Andersson, M., Jonsson, B. & Nyberg, L. (2017). Neural Activations associated with Feedback and Retrieval Success. Npj Science of Learning, 2. DOI: http://dx.doi.org/10.1038/s41539-017-0013-6

Review articles / Book chapters

Nyberg, L. (2017). Neuroimaging in aging: brain maintenance. F1000Research, 6(F1000 Faculty Rev): 1215. DOI: https://doi.org/10.12688/f1000research.11419.1

Dissertations

Jonasson, L. (2017). Aerobic fitness and healthy brain aging: cognition, brain structure, and dopamine. Doctoral dissertation, Umeå University.

Fordell, H. (2017). Virtual Reality for Enriched Rehabilitation of Stroke Patients with Spatial Neglect: Diagnostics and the Rehabilitation Effect on Spatial Attention and Neuronal Activity. Doctoral dissertaion, Umeå University *[contains data from UFBI]*.

Conference proceedings

Awad, A., Blomstedt, P., Westling, G. & Eriksson, J. (June 29, 2017). Functional imaging of Essential Tremor treated with Deep Brain Stimulation In the caudal Zona incerta. Oral presentation at the World Society for Stereotactic and Functional Neurosurgery, Berlin, Germany.

Nyberg, L (May 31, 2017). Brain maintenance. Talk presented at Symposium on Cognitive Neuroscience of Aging and Dementia, Montreal, Canada.

Berginström, N., Nordström, P., Ekman, U., Eriksson, J., Andersson, M., Nyberg, L. & Nordström, A. (March, 2017). Fatigue after traumatic brain injury is linked to altered striato-thalamic-cortical functioning. Talk presented at the 12th World congress on brain injury, New Orleans, USA.

Jonasson, L., Karalija, N., Axelsson, J., Riklund, K. & Nyberg, L. & Boraxbekk, C-J. (March 27, 2017). Dopamine D2/3 receptor binding with [11C]-raclopride in extrastriatal regions show good to excellent six month test-retest reliability. Poster presented at Society for neuroscience 2016, San Diego, USA.

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