Conference program

The 13th Nordic Meeting in Neuropsychology
Stockholm, 2018

The Plastic Brain – Changes in Brain, Cognition and Behaviour
Welcome!

On behalf of the Swedish Neuropsychological Society and the local organizing committee, I am glad to invite you to the beautiful city of Stockholm in the summer of 2018. The 13th Nordic Meeting in Neuropsychology will be held at Hotel Clarion Sign in central Stockholm, August 22-24.

Our main topic, “The Plastic Brain – Changes in Brain, Cognition and Behaviour – from basic neuroscience to clinical applications within pediatric and adult neuropsychology”, will offer broad insights into the development and plasticity of the brain.

Our aim is to bring together researchers and clinicians in child and adult neuropsychology for fruitful interaction. There will be three days of keynote lectures, symposia, oral sessions and poster presentations. There will also be social events in evenings catching the unique atmosphere of Stockholm.

Welcome to Stockholm!

Bengt Persson
Conference president
Chairman of the Swedish Neuropsychological Society
Practical information

The main conference is held at Clarion Hotel Sign in Central Stockholm at Östra Järnvägs gatan 35, 10126 Stockholm. The hotel is situated a few minutes walk from Stockholm Central Station with underground/subway, commuter trains, buses and the Arlanda Express airport express trains. If you have any questions regarding the facilities please contact the Clarion Hotel Sign directly:

- Phone: +46 8 676 98 00
- E-mail cl.sign@choice.se

The preconference workshops are held at Danderyd University Hospital

Visiting address:
Danderyd Hospital, Mörbygårdsvägen, 182 88 Stockholm

How to travel to Danderyd University Hospital by:

- **Subway**
  At the hospital there is a subway station called Danderyds sjukhus. Travelling from T-centralen: Take the red line towards Mörby. The second last stop is Danderyd hospital (Danderyds sjukhus). Take the front exit towards the main building (huvudentrén).

- **Car**
  Drive the E18 towards Mörby and get off at the traffic station Danderyds hospital. After that it is signposted to the hospital.
  GPS coordinates
  RT90: X: 6587859, Y: 1626969
  WGS84: Lat N 59 ° 23 '31 "Lon E 18 ° 2' 23"
  Decimal: 59.3922, 18.0400

  Parking is available at the main entrance.

- **Taxi**
  There is a taxi station outside the hospital’s main entrance.

- **Bus**
  Adjacent to the hospital is a major bus station. Most buses that go to the north pass Danderyd Hospital.

You can plan your trip with SL travel planner [https://sl.se/en/](https://sl.se/en/)
Conference Program

August 21 Pre conference workshops

Location: Danderyd University Hospital

09.00 – 12.00 (Conference room: Hjärtat, House 18, 5th floor)

ADHD, or not: Addressing Clinical Dilemmas
Professor Ida Sue Baron, University of Virginia School of Medicine, USA

Putative ADHD is one of the most likely reasons for referral in pediatric neuropsychology and a diagnosis of ADHD is a prevalent conclusion. Such referrals often raise more questions than answers about the etiology of the behavior of concern. It is essential to determine whether ADHD is the primary or secondary response, or masks an as yet undiagnosed neurological or psychiatric disorder. Without a single test measure that reliably identifies this behavioral diagnosis, history-taking, performance-based tests, and third party behavioral measures assume critical importance to avoid the adverse consequences for the child and family that will result from an erroneous diagnosis. This workshop will address the issues related to valid case formulation through case data that are sensitive to developmental issues. Emphasis will be placed on knowledge of typical brain development, parental perspectives, and academic influences, as well as the possibility of neurological disorder.

As opportunity to receive special services in the school increases the diagnosis prevalence increases in parallel. Also, as younger children were referred it became clear that understanding of normal individual variation was often not present and an unfortunate diagnostic label was applied that the child would carry as a label through the early school years. This presentation will briefly review diagnostic criteria, models of ADHD, assessment methods, developmental expectations.

Cases of when ADHD was accurately diagnosed and cases of when brain pathology was detected in the NP evaluation that better explains the value of pediatric neuropsychological assessment to avoid leaping to an unwarranted ADHD diagnosis will be presented.
Psychological Trauma: Clinical Considerations for Neuropsychologists
Professor Jennifer J. Vasterling, Boston University School of Medicine, USA & Clinical Assistant Professor Kevin Brailey, Boston University School of Medicine, USA

This workshop will address assessment and treatment issues commonly confronted by neuropsychologists engaged in assessment and treatment of patients who have been exposed to psychological trauma and developed subsequent stress-related psychopathology. The workshop will review the full spectrum of stress-related motional responses to psychological trauma, but will focus in particular on posttraumatic stress disorder (PTSD). Topics covered will include: assessment of PTSD, neuropsychological consequences of PTSD and implications for differential diagnosis, overview of PTSD treatment options with an emphasis on psychosocial interventions, implications of neuropsychological compromise for psychosocial PTSD interventions, and cultural considerations. The workshop will incorporate research findings from the scientific literature, case examples, and presentation of select clinical tools.

Goal Management Training (GMT)
Jan Stubberud, PhD, University of Oslo, Norway & Sveinung Tornaas, PhD, Sunnaas Rehabilitation Hospital, Norway

Executive functions (EFs) help formulate goals, initiate goal-directed behavior, anticipate consequences, and organize, monitor, and adapt behavior through top-down control of cognition, emotion, and motivation. These skills are affected in conditions such as traumatic brain injury, stroke, dementia, multiple sclerosis, and psychiatric disorders. Goal Management Training (GMT) is a standardized metacognitive rehabilitation program designed to improve EF. GMT contains approximately 20h of training, including psychoeducation, narrative examples, mindfulness practice, and assignments completed both between and within sessions. The main objectives of GMT are to train individuals to periodically “STOP” what they are doing, attend to task goals, evaluate their performance, and monitor or check their performance as they proceed. GMT’s effectiveness has been demonstrated in a number of samples, including older adults, acquired brain injury patients, schizophrenia, substance dependence, ADHD, spina bifida and post-critical care patients. During this workshop, participants will learn: the theory underlying GMT and the evidence base that supports the use of GMT in treating executive dysfunction, the core elements of GMT (or GMT concepts), and step-by-step instruction and background for GMT sessions.
Brain mechanisms of chronic pain, human and animal studies
Professor A. Vania Apkarian, Northwestern University, Feinberg School of Medicine, England

The workshop will review the current state of the art regarding mechanisms of chronic pain, both human and animal studies will be reviewed, with the intention of expounding causal mechanisms, opportunities for novel treatments, and concepts regarding the brain circuitry engaged. Brain critical circuits for predicting risk of chronic pain, and its adaptations during the transition to chronic pain will be reviewed, emphasizing the potential of reversing these with adequate therapies.

Developmental language disorders: Intervention and outcomes
Professor Courtenay Frazier Norbury, PhD, University of London, England

Recent research confirms that language disorders are persistent, and that changing language competence takes time and effort. What should the goals of intervention be, and how can we measure the impact of intervention if the goal is not ‘cure’? In this workshop, I will present evidence-based ideas on when to intervene, how to intervene, and how to measure the impact of interventions on language, and other aspects of development including education, attention and behaviour, quality of life, and social, emotional and mental health. We will work through case history examples and look at different outcome measures and planning tools. Finally, we will review methods for evaluating quality of published intervention findings to support evidence-based decisions.

Get together at the lobby bar at Clarion Sign
19.00
A possibility to meet and socialize with hosts and old friends. You pay for yourself.
9.00-10.00 - Registration and coffee

10.00-10.30 - Welcome and practical information *(Conference room: Plenum)*

10.30-11.30 - Keynote *(Conference room: Plenum)*

**Neuropsychology of Preschoolers: A Focus for the Future**
*Professor Ida Sue Baron, University of Virginia School of Medicine, USA*

A foundational neuropsychology of preschoolers remains a late development in pediatric neuropsychological research and practice. This has in many ways delayed our understanding of the consequences of adverse fetal conditions over the course of early child neurodevelopment. It is imperative that lessons learned from developmental neuroscience and infant and child development specialists become a regular and consistent focus of pediatric neuropsychologists. The influence of these critical maturational years on outcomes at older age and across the lifespan emphasizes the importance of extending our diagnostic and therapeutic skills downward to earlier ages.

11.30-12.30 - Keynote *(Conference room: Plenum)*

**When Psychological and Neural Trauma Co-occur: PTSD and Mild Traumatic Brain Injury**
*Professor Jennifer J. Vasterling, Ph.D, Boston University School of Medicine, USA*

Events leading to mild traumatic brain injury (mild TBI) or concussion may also be psychologically traumatic (e.g., motor vehicle accidents) or occur in the context of on-going psychological trauma (e.g., war, political torture, domestic violence). In such circumstances, mild TBI and posttraumatic stress disorder (PTSD) may co-occur. This presentation will address the impact of mild TBI on the development, course, and clinical management of PTSD, as well as how PTSD may influence recovery from mild TBI. Both diagnostic and treatment considerations will be discussed.
12.30-13.30 - Lunch *(Clarion Hotel Sign – lunch restaurant)*

13.30 - 15.00 - Parallel symposia

1. Symposium - New perspectives and methods in neurorehabilitation - in a life time perspective - symposium organized by the Danish Neuropsychological Society and Danish Pediatric Neuropsychological Society *(Conference room: B1)*

*MSc Birthe Rusike, Chair*

This symposium will address how well-known symptoms and challenges within the field of neurorehabilitation can be addressed by combing systematic data-collection and application of new methods and tools. The symposium will include studies on subgroups of children, young people and elderly, to promote the linking of new perspectives and methods in neurorehabilitation across subgroups.

1. Ditte Jeppesen, MSc Centre for Rehabilitation of Brain Injury, Denmark
   **Commotio in the developing brain – newest research and preliminary results from a structured treatment program**
   As part of the development of our treatment program for children and adolescents with commotion, we have reviewed the newest research in commotio in the developing brain. We will present the current thinking and evidence from the published literature, present experiences from our own newly started treatment program, and share our vision for the future of treatment and research in this area.

2. Anne Norup, MSc PhD, Rigshospitalet, Copenhagen University Hospital, Denmark.
   **Fatigue following acquired brain injury among adolescents and young adults:** prevalence, severity and physical exercise as a possible intervention
   This talk will present the results of several studies investigating fatigue following acquired brain injury (ABI) among adolescents and young adults. In a nationwide study, the patients *(n = 334)* reported higher scores than healthy controls *(n = 168)* on all 20-item Multidimensional Fatigue Inventory subscales with adjusted mean differences ranging from 1.7 to 4.7 and a higher prevalence of pathological fatigue *(73% versus 29%)*, PPRadj 2.7 (95% confidence interval 2.1–3.5). Possible treatments will be presented, including the results of a pilot study investigating an intervention consisting of high intensity interval training on bicycles ergometer.
3. Laila Øksnebjerg, MSc, Danish Dementia Research Centre, Denmark
Technology-based cognitive rehabilitation for people with early stage dementia. Results from the ReACT project.
Various forms of technology are recognized to have potential to support cognitive and functional ability of people with cognitive disability, including people with dementia, e.g. touch-screen technology with easy-to-use mobile applications (apps). A growing number of such apps are being promoted, but the actual deployment and continued use of such technology in everyday life, is rarely addressed. The ReACT study aims to investigate how a mobile app, can be designed to meet the needs of people cognitive disability due to dementia, and how this technology can be successfully deployed in the daily life of the users through different methods, including a programme of cognitive rehabilitation. Results from the iterative innovation process and proof-of-concepts studies will be presented.

2. Symposium - Brain plasticity as a function of social phobia and its treatment (Conference room: B2)

Professor Håkan Fischer, chair

1. Andreas Frick, Stockholm University and Uppsala University, Uppsala, Sweden
Neurotransmitters in anxiety and fear
Anxiety disorders are characterized by excessive fear and anxiety and impose considerable suffering for the individual and high societal costs. Although much progress has been made in the search for the neurobiological underpinnings of fear and anxiety, crucial information is still lacking. Largely based on animal and pharmacological studies, both the serotonergic and substance P/neurokinin-1 (SP/NK1) systems have been implicated in the underlying pathology of excessive anxiety. However, it is not established if anxiety syndromes like social anxiety disorder (SAD) are characterized by an over- or underactive serotonin system, and the interplay between neurotransmitter systems has seldom been investigated. In this talk, data from recent studies from our group addressing the role of serotonin and SP/NK1 in SAD and posttraumatic stress disorder (PTSD) will be discussed. Taken together, the findings are consistent with the view that serotonin in the amygdala induces, rather than reduces, anxiety and fear-circuit activity, and links exaggerated anxiety to an overactive presynaptic serotonin system. In addition, PTSD symptomatology was better accounted for by interactions between the serotonergic and SP/NK1 systems in the amygdala than by each system separately. Collectively, the findings support multifaceted underpinnings of fear and anxiety and that normalization of the couplings between the serotonin and SP/NK1 systems may be a relevant treatment target. In general, interactions between neurotransmitter systems should be given more attention in the context of fear and anxiety.

2. Tomas Furmark, Uppsala University, Sweden

The 13th Nordic Meeting in Neuropsychology, Stockholm 2018
Treatment effects on brain measures in social anxiety

The amygdala has long been implicated in human fear and anxiety. In patients with social anxiety disorder (SAD), neuroimaging trials have demonstrated an exaggerated amygdala reactivity, or altered amygdala functional connectivity, to disorder-relevant stimulation like harsh or fearful faces or symptom provocation challenges like public speaking. Neuroimaging treatment studies have also reported that amygdala hyperresponsiveness in patients with SAD is attenuated after pharmacological as well as psychosocial treatments, which correlates with symptom improvement and may be influenced by brain serotonin. Moreover, there is neuroimaging evidence supporting that brain activity parameters are superior to behavioral or clinical measures in predicting treatment success. In particular, machine-learning approaches may be used to guide clinical decision making, allowing for accurate predictions of treatment outcome at the individual level. Initial activity levels in the dorsal anterior cingulate cortex, before treatment, have been linked to the outcome of cognitive-behavior therapy both when given as monotherapy and when combined with antidepressants. In this talk, the neural effects of treatment for social anxiety, as well as the use of neuroimaging to predict treatment outcome, will be further discussed.

3. Kristoffer N.T. Månsson, Stockholm University; Karolinska Institutet and Uppsala University, Sweden

Neuroplastic changes within a few minutes? A randomized within-subject study on rapid alterations in human gray matter volume

The gray matter volume of the brain can be delineated with standard structural image acquisition techniques with magnetic resonance imaging (MRI). MRI is commonly used to assess brain atrophy in normal aging and in degenerative diseases, and a plethora of neuroplasticity studies suggest remarkable volumetric alterations induced by weekly physical activity and motor-training to mention a few. However, we don’t know how fast plastic brain changes occur and if faster changes could be detected with MRI. To test if brain volume, assessed with a standard T1-weighted 3 Tesla MRI sequence, alters within minutes, we conducted a simple manipulation while acquiring anatomical images. Healthy subjects underwent two (in randomized order) T1-weighted image acquisitions: at rest (open eyes fixation-cross), and while passively viewing pictures. T1-weighted images were preprocessed with voxel-based morphometry (VBM) in SPM12. Within-subject (rest vs pictures), whole-brain voxel-wise analysis suggest larger volume in occipital regions of the visual cortex when images were acquired while viewing pictures, relative to rest. This study shows compelling evidence that gray matter volume alters within a few minutes and that T1-weighted VBM images may be a more sensitive measure than previously thought. In this presentation we will present the main results and discuss the implications for our understanding of the plastic brain.
3. Oral presentations - Developmental disabilities *(Conference room: C4)*

**PhD Taina Lehtonen, Chair**

1. *Ilkka Järvinen, University of Helsinki, Finland*
   Persistence of coordination problems from childhood into middle age. A 40-year cohort study

2. *Maija Juntunen, University of Turku, Finland*
   Association between early cognition and preliminary academic skills within Finnish very low birth weight children born in the 2000’s

3. *Mairi Männamaa, Children’s Clinic of Tartu University Clinics, Estonia*
   Gender Differences in Developmental Outcomes of Estonian Preterm and Full-Term Children at the Age of Five Years

4. *Marie Adamsson Norrland University hospital, Sweden*
   Chronic conditions and health care needs of adolescents born moderately preterm at 32-36 weeks’ gestation: a Swedish regional population based case control study

5. *Randi Starrfelt, University of Copenhagen, Denmark*
   Faceblind: Characterising the cognitive profile(s) in developmental prosopagnosia

6. *Jenni Heikkilä, University of Helsinki, Finland*
   Audiovisual recognition memory from childhood to older age

7. *Anu Haavisto, University of Helsinki, Finland*
   Longitudinal cohort study of developmental patterns in children with extremely low birth weight

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15.00 - 15.30 - **Coffee break and poster session** *(Conference room: B3)*

15.30 - 17.00 - Parallel Symposia
1. Symposium organized by the Swedish Neuropsychological Society

*Fatigue and daytime sleepiness in neurological diseases* *(Conference room: B1)*

**PhD Stefan Winblad, Chair**

1. **Stefan Winblad, University of Gothenburg, Sweden.**
   **Measuring and treating fatigue in neurological diseases - conceptual and methodological challenges.**
   Fatigue often occurs in the context of various neurological diseases, interferes with patients’ daily living, and has a major negative impact on quality of life. Currently, there exists inconsistencies in defining and assessing fatigue and a lack of evidence based treatments. Consequently, fatigue is a challenging condition for both health-care professionals and patients. This presentation includes a short summary of current definitions of fatigue, assessment tools and treatment options. Furthermore, a study on Myotonic dystrophy type 1, a neuromuscular disorder associated with severe fatigue, is presented with the aim to illustrate challenges in defining and measuring the cause and consequences of fatigue in neurological disease.

2. **Marika Möller, PhD, Danderyd University Hospital & Karolinska Institutet, Sweden.**
   **Fatigue and fatigability in mild traumatic brain injury and its relation to visuomotor functions, attention and brain connectivity.**
   Although the majority of patients suffering from a mild traumatic brain injury recover well, one of the most frequent long-term symptoms is fatigue. However, as there is a lack of a gold standard of how to describe and measure fatigue, there is a need of a standardized taxonomy and assessment approaches that address distinct aspects of fatigue. Previous studies have shown that fatigue is linked to controlled attention and to altered connectivity in attention networks. We have found that both fatigability (energizing or reduced performance over time) and monitoring (performance instability) are associated to self-rated state fatigue when performing a visual attention task. However, as the attention task is based on visual stimuli, and saccadic eye movements and attention work in a coordinated fashion, disturbances in the saccadic system could affects the results. Saccadic eye movements have been suggested to be useful for investigating cognitive control.

   In this presentation, different aspects of fatigue in mild traumatic brain injury is discussed in relation to attention, visuomotor functions and brain connectivity.

3. **Birgitta Johansson, Sahlgrenska University hospital & University of Gothenburg, Sweden**
   **Mental fatigue: measurement and interventions.**
   Mental fatigue is a frequently occurring symptom after an acquired brain injury, irrespective of severity. Such mental fatigue may become a long-lasting, irrespective of severity and even after recovery from other neurological or psychiatric symptoms. People struggle to return to work and also in their efforts to find a balanced workload which is sustainable over a longer period. Today, fatigue is assessed with subjective scales and it has been proven difficult to measure fatigue objectively. Traditionally,
neuropsychological tests measure cognitive functions at a single time-point and do not take into account changes in cognitive performance over time. Mental fatigue is challenging for both health-care professionals and patients, and we need to improve knowledge in terms of understanding and be able to assess mental fatigue better.

4. Jan Stubberud, Lovisenberg Diaconal Hospital & Oslo University Hospital, Norway  
**Can Goal Management Training help remediate fatigue after brain injury?**  
Fatigue is one of the most frequent and persistent sequelae of acquired brain injury (ABI), including traumatic brain injury and cerebrovascular accidents. As post-ABI fatigue is a complex symptom influenced by a mixture of biological, physical, psychological and behavioural factors, including interactions between these, the management of fatigue remains challenging. In fact, despite areas of promise, there is insufficient evidence to recommend or contraindicate any treatments of post-ABI fatigue.  
Goal Management Training (GMT) is a compensatory intervention that relies on metacognitive strategies for improving problem solving and attention. The intervention particularly addresses deficits in sustained attention, which are assumed to be central in post-ABI fatigue. It has received empirical support in studies with various neurological conditions. In addition to improving cognitive function (e.g., executive function and attention), GMT has also been associated with improved emotional health, including psychological distress. Our pilot results suggest that multifaceted group-based interventions, including GMT, may have the potential to alleviate symptoms of fatigue, anxiety and sleepiness after ABI.

2. **Symposium - The many facets of brain plasticity** *(Conference room: B2)*

*Professor Lars Nyberg, Chair*

The term “plasticity” has a very long tradition in psychology and brain sciences (see Lövdén et al., 2010, Psych. Bull.). In this symposium three perspectives on plasticity will be discussed.

1. **Lars Nyberg, Umeå University and Umeå Center for Functional Brain Imaging, Sweden.  
   Plasticity in the aging brain**  
Lars Nyberg will discuss plasticity in the aging brain, with a particular focus on successful memory aging. Recent work (Nyberg & Puas, in press, Ann. Rev. Psychol.) suggest that successful memory aging may be accomplished via multiple paths. One such path is via brain maintenance, or relative lack of age-related brain pathology. Through another path, successful memory aging can be accomplished despite brain pathology by means of efficient compensatory and strategic processes. Genetic, epigenetic, and lifestyle factors
influence memory aging via both paths. Throughout the lifecourse, some of these factors can be promoted. In the presentation, Nyberg will discuss both paths towards successful memory aging.

2. **Martin Lövdén, Karolinska Institutet, Sweden**

   **Effects of education on brain and cognition in younger and older age**

   Martin Lövdén will discuss the effects of education on brain and cognition in younger and older age. Out of the many behavioral factors proposed to increase cognitive ability, an effect of formal education has received the most solid support. Lövdén will review the evidence for this effect, exemplifying with their own studies using historical reforms of the Swedish educational system as an instrument to assess causal effects of education on intelligence and late-life dementia risk. He will also report recent studies that leverage foreign language learning in a formal setting as a paradigm to study effect of education on cognitive performance and brain structure in younger and older age. The results show that schooling results in increases in cognitive performance that are maintained through adulthood, resulting in reduced dementia risk in older age. The shorter language interventions are however, neither in younger nor in older age, resulting in improvements of cognitive performance, although structural brain changes related to learning are observed. Together, these results paint a comprehensive picture of how education influence lifespan development of cognitive abilities.

3. **Fredrik Ullén, Karolinska Institutet, Sweden.**

   **Cultural activities and brain plasticity – a gene-environment perspective**

   Fredrik Ullén will discuss music as a window to the plastic brain, with examples from expertise and creativity. Neuroscientific studies of music and other art forms can have a wide range of rationales, from an intrinsic interest in the basis of aesthetic phenomena as such, to the development of clinical interventions. Here, he will emphasize a third perspective, i.e. how music can be used as a model domain to address general problems in cognitive neuropsychology. The focus will be on research from their own group and other laboratories, which combines neuroimaging with techniques from behavior genetics. First, Ullén will discuss recent work on expertise, which illustrates the importance of gene-environment interactions and covariation for human specialization, skill learning and its neural mechanisms. He will also introduce their recently proposed model for expertise, the Multi-factorial Gene-environment Interaction Model (MGIM), which we believe can accomodate recent findings as well as provide a useful framework for future studies. The second part of the talk will be focused on creativity. Ullén will summarize some key findings from recent studies of neural mechanisms of improvisation as well as recent twin modelling of creative achievement in the arts and the sciences. Based on these findings, he will argue for a Dual Process Model of creativity, according to which the neuropsychological mechanisms of creative problem solving differ depending on the specific traits and training of the individual, as well as the cognitive demands of the task and the domain. More specifically, the suggestion is that when a creative task is relatively unconstrained and task-specific expertise is high — such as in some forms of artistic creativity — demands on top-down control may be reduced. Creative cognition can to a high degree rely on spontaneous free associations, and activity in fronto-parietal networks during performance will remain relatively low. In domains characterized by such
tasks, individual differences in creative achievement will also, in relative terms, tend to show stronger phenotypic and genetic relations with personality (openness-to-experience) and weaker associations with intelligence. Conversely, in domains and tasks with high levels of cognitive constraint and demands on top-down control, creative performance will be accompanied by higher fronto-parietal activity. In such domains, individual variation in creative achievement will also tend to show stronger relation to intelligence, and weaker relations to openness-to-experience.

3. Symposium organized by the Finnish Neuropsychological Society
Prospective memory – remembering unattended intentions

(Conference room: C4)

Professor Laura Hokkanen, Chair

Prospective memory can be defined as the ability to remember to perform a planned action or intention in the future. Examples of are easy to find in our everyday life; remembering to mail a letter on the way home, remembering to deliver a message to a friend, and remembering to take medicine before going to bed in the evening all require prospective memory. Prospective memory impairment has been found to be common following e.g. traumatic brain injury, and it has been suggested to have predictive power in early dementia. In routine neuropsychological assessment this form of memory is seldom examined however.

The symposium will review current knowledge on the concept of prospective memory, describing the differences between event-based and time-based prospective memory, the differences between tasks performed in laboratory and those set out in naturalistic environment, and the associations between prospective memory and other cognitive domains such as attention and executive functions. Assessment strategies are presented, including a new measure of prospective memory used in the Perinatal Adverse Events and Special Trends in Cognitive Trajectory (PLASTICITY) –project. Participants are part of a risk cohort born in 1971–1974, prospectively followed from birth, now at the age of 40. The impact of low birth-weight and other perinatal risks on prospective memory performance in adulthood will be examined in this cohort.

1. Laura Hokkanen, professor, University of Helsinki, Finland

Prospective memory or memories? – overview of theory and measurement

Introduction: Prospective memory (PM) can be defined as the ability to remember to perform a planned action or intention in the future. It is not a unitary concept however. A separation between vigilance / monitoring, habitual responses, and prospective memory proper has been suggested. PM can also be divided further into event-based and time-based prospective memory. PM tasks are performed either in laboratory or out in a naturalistic environment.

Methods: A new PM measure, Proper Prospective Memory Test (PROPS), is validated using participants in the Perinatal Adverse Events and Special Trends in Cognitive Trajectory (PLASTICITY) –project.
Trajectory (PLASTICITY)—project. Participants (n = 458) are part of a risk cohort born in 1971–1974 and controls, prospectively followed from birth, now at the age of 40.

**Results:** A confirmatory factor analysis resulted in two factors corresponding time-based and event-based PM. The model was fitted by adding the residual correlation between the naturalistic subtests.

**Conclusions:** New tools to assess PM are needed in clinical practice. Laboratory-based tasks can be embedded into the neuropsychological assessment routine with very little extra time required. The challenge to develop valid naturalistic tasks remain.

**Grant Support:** The Diabetes Research Foundation, The Jalmari Ahokas foundation, The Juho Vainio Foundation, The Signe and Ane Gyllenberg foundation, The Social Insurance Institution of Finland (Kela), and The Yrjö Jahnsson foundation.

2. **Eliisa Lehto presenting E.Lehto, M. Virta, J. Launes & L. Hokkanen, University of Helsinki, Finland**

**Perinatal risks and prospective memory performance - association with cognitive domains**

**Introduction** Perinatal risks, eg. low birth-weight (LBW), asphyxia, hyperbilirubinemia, have been found to associate with cognitive deficits from early childhood to young adulthood. The aim of this study was to assess the effects of perinatal risks on prospective memory (PM) performance in midlife. Also, the cognitive domains (executive functions, episodic memory, working memory) associated with time-based (TBPM) and event-based prospective memory (EBPM) were explored.

**Methods** Participants of a prospective birth-risk cohort (PLASTICITY) were studied at the age of 40. The groups were LBW (n=72), asphyxia (n=98), hyperbilirubinemia (n=126), hypoglycemia (n=19), neurological symptoms (n=29), maternal diabetes (n=31) and controls with no birth risks (n=82). PM performance was assessed using the new Finnish Proper Prospective Memory Test (PROPS), which includes TBPM, EBPM, laboratory-based and naturalistic tasks. Cognitive domains were assessed with neuropsychological tests and the BRIEF self-report. We used ANCOVA and stepwise multiple linear regression analysis.

**Results** Adjusted for age, sex and education, the controls outperformed the LBW group in PM laboratory-based tasks (p = <.01). Other perinatal groups were similar to controls in PM. Executive functions assessed with the BRIEF BRI explained 28 % of the variance (p <.001) in TBPM. Episodic memory tests explained 7 % of the variance (p = .02) in EBPM.

**Conclusions** Of the perinatal risks groups, only LBW was associated with impaired laboratory-based PM performance. Cognitive domains associated with PM performance showed diverse patterns: TBPM was related to everyday executive problems, EBPM to episodic memory domain. Majority of the variance was unique, not explained by other domains.
3. Anett Kretschmer-Trendowicz presenting Kretschmer-Trendowicz, A., Schnitzspahn, K. M., Ellis, J., Reuter, L., & Altgassen, M. , Technische Universitaet Dresden, Germany; Radboud University, The Netherlands; University of Reading, England; University of Aberdeen, Scotland

**Effects of episodic future thinking on children’s prospective memory in typical lab-based and (rather) naturalistic task setting**

This research investigated effects of Episodic Future Thinking (i.e., mentally projecting the self into future situations, EFT) at encoding on the performance of delayed intentions (prospective memory, PM) in children. Study 1 included 41 preschool and 39 primary school children. PM was assessed using a standard paradigm with a picture-naming task as the ongoing activity in which the PM task was embedded. Half of the participants in each age group used EFT as a strategy to encode the PM task, while the others received standard PM instructions. Results revealed a significant age effect, with school-aged children significantly outperforming preschoolers and a significant effect of encoding condition with overall better performance when receiving EFT instructions compared to standard encoding. Even though the interaction between age group and encoding condition was not significant, planned comparisons revealed first evidence that compared to younger children, older children’s PM benefitted more from EFT. Overall, results indicate that children can use EFT encoding strategies to improve their PM performance once EFT abilities are sufficiently developed. Study 2 tested whether the beneficial effects of EFT encoding extend from lab-based to more complex tasks with real life demands. Overall, 56 children were included who were randomly assigned to either an EFT or control condition. Children participated in a ‘sightseeing tour’ (ongoing activity) inside the lab with various PM tasks embedded. Results showed significantly higher PM performance in the EFT compared to the control group and thus suggest that EFT is an effective strategy to improve children’s everyday PM.

This research was funded by the German Research Foundation (grant: SFB 940/1).

4. Anett Kretschmer-Trendowicz presenting Kretschmer-Trendowicz, A., Altgassen, M., Ariese, L., Wester, A., & Kessels, R. Technische Universitaet Dresden, Germany; Radboud University, the Netherlands

**How can we help individuals with Korsakoff’s syndrome to remember their intentions?**

Korsakoff’s syndrome is associated with severe deficits in episodic memory and executive functions. Both cognitive functions are required to successfully remember to execute intended actions after a delay (prospective memory). In this study, we investigated the effects of varying executive control demands on prospective memory to explore a possible interdependence of memory and executive functions in Korsakoff’s syndrome. Twenty-five patients with Korsakoff’s syndrome and 23 chronic alcoholics (without amnesia) worked on a categorization task into which a prospective memory task was embedded that put either high or low demands on executive control processes (using low versus high visually salient prospective memory cues).

Overall, Korsakoff patients showed fewer correct prospective memory responses than alcoholic controls. Across groups, participants had fewer prospective memory hits when
cues were low salient as compared to high salient. Korsakoff patients showed better prospective memory performance when highly salient cues were presented than cues of low salience, while there were no differential effects for alcoholic controls.

Thus, overall Korsakoff patients’ showed a global PM deficit, however, the extent of this deficit was moderated by the specific executive control demands of the task. These findings support the notion of an interrelation of executive functions and memory performance in Korsakoff.

19.00 - 21.00 - Reception City Hall

For those who signed up for the event and received an invitation upon registration at Clarion Hotel Sign (limited number according to the City Hall rules).

Professor Erin Bigler, Brigham Young University Provo, USA

Neuropsychology emerged in an era that pre-dated any contemporary neuroimaging, where measures of motor, sensory-perceptual and cognitive functioning were based on physical exam, observation, paper-pencil and psychometric test results. While computed tomography (CT) was introduced in the early 1970’s and magnetic resonance imaging (MRI) in the 1980’s, their influence on neuropsychology was initially restricted to simple qualitative classification schemas such as presence/absence of an abnormality, its location or size, including lateralization issues of damage. With 21st Century improvements in quantitative neuroimaging analysis there are a host of image analysis methods now available for use by neuropsychologists. Many contemporary quantitative neuroimaging methods have become more 'user friendly' and widely available, where the majority of these methods involve various levels of automation, including fully automated methods that will yield region of interest findings to address volume, thickness, surface area as well as shape and contour of any brain structure along with analyses from diffusion tensor imaging (DTI), which permit white matter and pathway analyses. A variety of lesion analysis programs exist that provide metrics to assess lesion burden. This lecture will overview quantitative neuroimaging methods of structural MRI findings relevant to 21st Century neuropsychology and the lecture will plot a future course where neuroimaging information is fully integrated with neuropsychological test findings, in research as well as clinical application.

10.00 – 10.30 - Coffee break

10.30 - 12.30 - Symposium Brain plasticity in clinical practice

Professor Aniko Bartfai, Chair

The starting point of this symposium is to present some recent findings on studies influencing brain plasticity through different forms of cognitive cognitive training and to
present an overview of contemporary neuroimaging methods that interface with neuropsychology, symptom/clinical presentation, treatment and outcome. The aim of the panel discussion is to discuss if and how these findings can be translated into clinical neuropsychological practice and to identify areas where experiences and findings in basic neuroscience and in clinical research can mutually benefit from each other in future studies.

1. Erin D. Bigler, Professor, Brigham Young University, USA

Neuroimaging in TBI

Neuroimaging has become an integral part of all aspects of clinical and research studies in neuropsychology. In the area of traumatic brain injury (TBI) most patients have had some form of brain imaging, mostly designed to assess structural integrity. However, contemporary methods using magnetic resonance imaging (MRI) provide a much greater opportunity to examine not only brain structure, but neural networks and function. A brief review of MRI techniques appropriate for evaluating structural and functional outcome in the TBI patient will be presented. These analyses including volumetric, thickness and shape analyses that target specific regions of interest in brain structures susceptible to injury, methods sensitive to white matter integrity including diffusion tensor imaging as detection of white matter abnormalities, including white matter hyperintensity analysis using T2-fluid attenuated inversion recovery sequences along with detecting shear lesions, with susceptibility weighted imaging. How these findings can be presented in three-dimensional image displays in comparison to a normative sample will be presented. From the perspective of clinical practice and assessing neural adaptation and plasticity after brain injury, an emphasis will be placed on how to identify clinically relevant information from brain MRI studies in the TBI patient using these various techniques. Several applied recommendations will be made on how best to utilize neuroimaging findings in the clinical practice of neuropsychology.

2. Torkel Klingberg, Karolinska Institutet, Sweden

Working memory training as a clinical tool to improve WM capacity and attention in everyday life

Working memory (WM) is the ability to temporary store and manipulate information. The neural mechanisms of visuo-spatial WM are to a large extent identical to those of controlled, or top-down, attention. The similarities between WM and attention is also evident from behavioral studies. In particular are the inattentive symptoms of ADHD associated with deficits in WM capacity. It is also these inattentive symptoms and WM deficits that are the strongest predictors of academic failure in children and adolescents with ADHD.

It was previously assumed that WM capacity was a fixed characteristic of the individual. However, research first carried out by Klingberg and collaborators have shown that intensive training on WM tasks over several weeks can enhance performance also on non-trained WM tasks. This training is also associated with improvement in attention as measured by standard neuropsychological tasks, but also ecologically more relevant tasks,
such as tests of the ability to remember and carry out instructions. This suggests that
improved WM capacity is in itself relevant to functions in daily life.

The neural basis of training is presumably related to the plasticity of prefrontal and parietal
cortex and the basal ganglia. Studies with positron emission tomography, as well as genetic
studies, have implicated dopaminergic transmission as a key factor in this plasticity.

Improvement in attention has been measured with neuropsychological tests, as well as
questionnaires of attention in everyday life, such as ratings of inattention according to the
diagnostic criteria of DSM, Conner’s rating scales, The Cognitive Failure Questionnaire, and
direct observer ratings. The studies, conducted by several independent research groups,
include typically developing children and adults, children with ADHD, children born
prematurely and children with cognitive deficits as a result of cancer treatment. There are
now five, randomized, controlled trials showing improvement of attention after working
memory training. A recent meta-analysis of 12 studies using the Cogmed WM training
method showed that, across different population, inattentive symptoms decrease with an
effect size of around 0.4, although effects differ among different child populations.

WM training is an experimental paradigm to study cognitive plasticity, but is also clinically
useful in order to improve WM and attention in everyday life of individuals with impaired
WM and inattention.

3. Matti Laine, Åbo Akademi University, Finland

Working memory training, where are the limits?

Introduction and methods This presentation summarizes research on adaptive
computerized working memory (WM) training in adults conducted in our 4-year
BrainTrain project (www.braintrain.fi). We have undertaken empirical training studies
(with or without task-related brain activity measures) mostly using rather specific training
tasks, such as the n-back paradigm, to be able to draw conclusions on the nature of
transfer effects. We have also performed meta-analyses on both the behavioral and
brain activation outcomes of WM training.

Results Both our empirical studies and the behavioral meta-analysis on n-back training
indicate that more substantial training-related pre-post task performance improvements
are limited to the trained task itself and to the untrained versions of that task paradigm.
This pattern was seen both in healthy and clinical adult groups. The behavioral meta-
analysis documented also statistically significant far transfer to other WM tasks and to
other cognitive domains, but the effect sizes were small (g = ca 0.2). This pattern of mostly
task-specific transfer raised the issue of the role of participant-generated task-specific
strategies in these effects. In recent short-term experiments, we have been able to show
that both an effective externally given WM strategy as well as the level of detail and type
of a self-generated explicit strategy are powerful predictors of task-specific training
outcomes.

Conclusions In its present form, computerized adaptive WM training yields mostly only
task-specific transfer. These WM training effects appear to come close to general skill
learning effects both at behavioral and brain level, including the "curse of specificity" in
transfer that characterizes skill learning. A major factor explaining an individual’s WM
training outcome appears to be his/her strategy use. The development of task-specific
strategies during training would explain why more substantial transfer is limited to the
practiced WM task paradigm.
Grant Support Academy of Finland (#260276) and the Åbo Akademi University Endowment.

4. Aniko Bartfai, Danderyd University Hospital and Karolinska Institutet, Sweden

Training of attention, what have we learned? In a prospective, randomized, controlled study 120 patients were randomized to 20 hours of intensive attention training by Attention Process Training (APT) or by standard, activity based training. All patients were within the first year after brain injury and had among other symptoms mild or moderate impairment of attention following stroke or traumatic brain injury. Patients participating in the study received attention training in addition to in traditional multidisciplinary in- or outpatient rehabilitation. Neuropsychologists and occupational therapists collaborated in the study using quantitative and qualitative measures. The study was registered at ClinicalTrials.gov protocol NCT02091453. The aim was to study effects on function, activity and return to work. APT appeared to be more beneficial both in quantitative and qualitative evaluations, but methodological issues obscure the results.

Panel discussion
Moderator: Håkan Nyman

Brain plasticity, cognitive training and clinical practice
The discussion will start with a short presentation by Marika Möller, of the current recommendations by the Swedish Board of Health and Welfare regarding cognitive training after stroke. In addition to symposium presenters, Martin Lövdén, and Gabriela Markovic will also participate and present their views. Conference participants are encouraged to participate in the discussion and share experiences.

12.30 -13.30 - Lunch (Clarion Hotel Sign – lunch restaurant)

13.30 -14.30 - Keynote (Conference room: Plenum)

Stability and change in developmental language disorders

Professor Courtenay Frazier Norbury, Royal Holloway, University of London Egham, England

In this talk I will argue that child language is characterised by both stability and change: change in that language skills improve from year to year, but nevertheless stable, in that the rank order of children within a language distribution is relatively unchanged over time. In other words, children with low language competence at school entry tend to remain 2-3 years behind their typically developing peers. I will present evidence from my own work, and that of other scholars, indicating that the rate of language growth is parallel at the top
and bottom of the language distribution, regardless of child cognitive, behavioural, or environmental factors. As a consequence, 'narrowing the gap' between more and less able children presents significant challenges. If language itself is malleable, but rate of language learning is not, what are the implications for clinical and educational services? I will consider this, and what this research tells us about the biological origins of language disorder.

14.30 – 15.00 - Coffee break and poster session (Conference room B3)

15.00 - 16.00 - Parallel Symposia

1. Symposium - Interventions for people with neurodevelopmental disorders and their significant others across lifespan (Conference room: B1)

Ass. Professor Tatja Hirvikoski, Chair

1. Tiina Holmberg Bergman, Center for Neurodevelopmental Disorders at Karolinska Institutet (KIND) and Habilitation & Health, Stockholm, Sweden.

Navigator ACT - acceptance and commitment therapy groups for parents to children with disabilities

Objective: Parents of children with disabilities report high amounts of psychological distress, e.g., depression, anxiety and parenting stress. However, there are only a few evidence-based interventions available. The aim of this study is to evaluate the feasibility, treatment satisfaction and preliminary efficacy of the manualized 5-session Acceptance- and Commitment Therapy (ACT) intervention, Navigator ACT.

Methods: 94 parents were allocated to treatment. The criteria for good feasibility was defined as 75 % of the parents participating in at least 4/5 sessions. Parent satisfaction was measured by session evaluations. Pre, post and 3-month follow-up was conducted to collect efficacy-related measures.

Results: 80 % of the parents attended at least 4/5 sessions. Treatment satisfaction was good and stable over the five sessions. The preliminary efficacy measures showed statistically significant increases with moderate to large effect-sizes in psychological/behavioral flexibility and mindfulness skills as well as reductions in symptoms of depression and anxiety.

Conclusions: The Navigator ACT is a feasible intervention in the outpatient disability services context. Promising results regarding preliminary efficacy were observed. We are currently conducting a pragmatic multi-center randomized controlled trial including several disability services clinics in Sweden.
2. Anna Backman, Center for Neurodevelopmental Disorders at Karolinska Institutet (KIND) and Habilitation & Health, Stockholm, Sweden.

**SCOPE internet delivered psychoeducation for youths with ASC**

*Objective:* Information about autism spectrum condition (ASC) at a young adult age is an important provision for a target group who are transitioning from childhood into adulthood. The aim of current project is to examine the feasibility, efficacy, and effectiveness of SCOPE, an internet-based psychoeducational intervention for youths with ASC (without intellectual disability, i.e. high-functioning ASC).

*Method:* An open feasibility study (n = 28; 16 – 25 years of age) was conducted in an outpatient clinical context. The internet-based psychoeducational intervention, consisting of eight ASC themed modules, was developed in cooperation with youths with ASC in a pre-study phase. The internet-based delivery was chosen to utilize the interactive pedagogical potential of the Swedish national platform for internet-delivered treatment. The intervention included weekly contact with experienced and trained clinicians via a message-function. The youths completed self-rating scales measuring knowledge about ASC, mental well-being, as well as acceptance of their diagnosis and quality of life.

*Results:* Treatment feasibility was good in the clinical context: 88% of the participants completed all modules in the program. Treatment credibility was good and increased significantly from pre- to post-treatment. Participants’ knowledge about ASC also increased significantly from pre- to post-treatment, without causing harm for the participants’ well-being. Three-month follow-up showed that the participants retained the knowledge they had gained. No important adverse effects or side effects were observed.

*Conclusions:* Internet-delivered psychoeducation is a promising method for youths with ASC. In the future, we hope to increase treatment availability for individuals not taking part in traditional health care interventions. We are currently conducting a randomized controlled trial to further investigate the potential benefits and effects of the intervention.

3. Tatja Hirvikoski, Center for Neurodevelopmental Disorders at Karolinska Institutet (KIND) and Habilitation & Health, Stockholm

**PEGASUS psychoeducational groups for adults with ADHD and their significant others.**

*Objective:* Information about ADHD and treatment options is important after established diagnosis at adult age. Until now, no interventions included significant others. We have examined the feasibility, efficacy, and effectiveness of PEGASUS, a group-based structured psychoeducation for adults with ADHD and their significant others.

*Method:* An open feasibility study (n = 108; 51 with ADHD and their 57 significant others) and a pragmatic parallel group add-on design multicenter randomized controlled trial were conducted. In the RCT, the 8-session treatment with PEGASUS (allocated n = 97; 48 with ADHD and 49 with significant others) was compared to treatment as usual (TAU,
allocated n = 82; 39 with ADHD and 43 significant others). Both studies were conducted in an psychiatric outpatient context. Self-rating scales were used to measure outcome.

**Results:** Over 90% of the participants completed the program. Overall treatment satisfaction was good among both individuals with ADHD and their significant others. Knowledge about ADHD increased following PEGASUS participation. Improvements were also observed in secondary outcomes e.g. global life satisfaction, relationship quality and psychological well-being. No important adverse effects or side effects were observed.

**Conclusions:** Group-based structured psychoeducation PEGASUS for adults with ADHD and their significant others is a feasible, efficacious, and effective treatment option to increase ADHD knowledge and general life satisfaction in psychiatric outpatient care. The PEGASUS program has been translated into Norwegian language and other translations are in progress.

4. Therese Lindström, Center for Neurodevelopmental Disorders at Karolinska Institutet (KIND) and Habilitation & Health, Stockholm, Sweden

**Parents with own ADHD diagnosis – needs and interventions**

**Objective:** Research indicate parental ADHD symptoms to be associated with the use of less effective parenting strategies, lower levels of parenting efficacy and impaired family function. As part of a larger project undertaken on commission by the Swedish National Board of Health and Welfare we have sought to increase the understanding of the challenges, characteristics, efficacy and availability of behavioural parent training (BPT) interventions for parents with ADHD.

**Method:** Information was collected and weighed in accordance with principles of evidence-based practice. More specifically, we conducted group and individual interviews with parents from the target population as well as representatives of different professions of relevance, and performed a systematic literature review.

**Results:** Interviewees unanimously maintained that parenting interventions need to address a broader range of the many co-occurring practical, psychosocial and relational challenges that parents with ADHD face. While research provide some support for clinical observations stating that parental ADHD symptoms may complicate the delivery of conventional BPT, we did not identify a single BPT program prospectively developed and/or adapted for parents with ADHD.

**Conclusions:** BPT programs may have to be adapted specifically for parents with ADHD in order to generate beneficial effects - and minimize the risk of failures and unforeseen, negative consequences. Therefore, we are now in the process of testing and further developing the forms of a new PT program for parents with ADHD.
2. Symposium - Healthy Aging *(Conference room: B1)*

Professor Ove Almkvist, Chair

1. **Ingunn Bosnes, Norwegian University of Science and Technology (NRNU), Norway**  
   *Predictors of cognition in well-functioning elderly*  
   Aging can be divided into pathological and normal aging. Normal aging can be subdivided into usual and successful, where “usual aging” means aging with some decline and risk of disease and disability, and “successful aging” as aging with minimal or no physiological loss (Rowe and Kahn, 1987). Cognitive changes in normal aging are characterized by a primary decline in fluid cognitive functions, while crystallized functions like general knowledge and vocabulary remain stable or even expand over the life-course. Diseases common in aging may affect cognitive function negatively, while an active and healthy lifestyle may positively affect cognitive aging.

2. **Marie Grønkjær, University of Copenhagen, Denmark,**  
   *Lifestyle factors and non-pathological age-related cognitive decline*  
   Modifiable predictors of cognitive changes provide a promising potential to prevent or postpone age-related cognitive decline. Using data from a recently established 41-year follow-up study of 2,616 Danish men, we found that the mean cognitive decline was relatively modest from young adulthood (mean age=20 years) to midlife (mean age=62 years) but individual differences were substantial. In addition to a re-administration of the exact same validated intelligence test as completed in young adulthood, the midlife follow-up included collection of data on several lifestyle factors, such as alcohol consumption, smoking, and physical activity. Results of the associations between lifestyle factors and cognitive changes observed in the present study will be presented and discussed.

3. **Sara Stormoen, Karolinska Institutet, Stockholm, Sweden**  
   *Medical decision-making by elderly individuals: possible concerns and recommendations*  
   Medical decision-making capacity (MDC) refers to the ability to make decisions in medical settings, such as informed consent. Healthy adults are assumed to possess the capacity to make autonomous decisions, while the capacity may be crucially impaired in various age-related diseases such as dementia. A growing aging population alerts ethical challenges of how to interpret decisional capacity and deal with the consequences. To increase the autonomy among elderly, at risk to develop a neurodegenerative disease, the opportunity to appoint a future proxy should preferable be discussed before their MDC is in doubt.
3. Symposium in memory of Anne-Lise Christensen (Conference room: C4)

Professor Jarl Risberg, Chair

1. Jarl Risberg, University of Lund, Sweden

Milestones in her career

Anne-Lise Christensen was born in 1927. She graduated from high school in 1945, married Niels Egmont Christensen in 1946 and gave birth to her son Mads in 1947. She started to study psychology at the University of Copenhagen in 1952 followed by a one year stay at Harvard University, where her husband was guest researcher. Returning to Denmark she graduated with a cand. psych.-exam in 1957 and started to work as a clinical psychologist at Rigshospitalet in Copenhagen. In 1959 she followed her husband to Århus University, where he had been appointed professor of philosophy. She worked as a clinical psychologist at the department of neurosurgery and became increasingly interested in the relationship between brain and behaviour.

In 1966 Alexander Luria published “Higher cortical functions in man”, introducing his dynamic neuropsychological model. Anne-Lise was fascinated by his theories and met him at a congress in London 1969. Luria invited her to visit him in Moscow and the following year she spent one month at his institute. In 1974 she published her ground breaking book “Luria’s Neuropsychological Investigation”, which was very well received and translated to many languages, including Russian. Anne-Lise’s heavy impact on neuropsychological theory and methodology in the Nordic countries will be described in detail by Aniko Bartfai, Jens Egeland and Ritva Laaksonen. In 1980

Anne-Lise moved to Copenhagen and worked as a research psychologist at Rigshospitalet until 1985, when she founded Center for Brain Injury Rehabilitation at the University of Copenhagen. The present director of the Center, Frank Humle, will tell us about her important contributions to the holistic and multi-professional rehabilitation model that was developed. Finally Jaana Sarajuuri will describe how Anne-Lise’s engagement in the holistic model strongly influenced the development of neurorehabilitation in many European countries.

Anne-Lise Christensen passed away February 11, 2018.

2. Aniko Bartfai, Karolinska Institutet, Sweden

Anne-Lise Christensen’s impact on Swedish neuropsychology

Anne-Lise’s influence in the 1970-ies in Sweden in a way predated neuropsychology, as we know it today. The translation of her handbook on Luria’s Neuropsychological Investigation was underway and a group of enthusiastic clinical psychologists formed around Birgitta Stegmann in Stockholm for peer-supervision and to support the learning process. A similar process evolved a few years later concerning her vision of holistic neuropsychological rehabilitation. Psychologists, within different areas, such as rehabilitation after brain injury, developmental disabilities, return to work, who became involved in the assessment of cognitive impairment, looked for different ways to help their patients to cope with cognitive limitations and improve everyday functioning. The concept...
of holistic neuropsychological rehabilitation was particularly malleable, suiting the needs of patients in widely different groups. She was also very generous with her international contacts, providing courses easily accessible from Sweden and in helping us, Swedish neuropsychologists, to become part of the international neuropsychological community, and to form a professional identity.

3. Ritva Laaksonen, private practice, Finland

**Impact on Finnish neuropsychology**

Anne-Lise Christensen’s first contacts with Finnish neuropsychology date back to the 1970’s. The interactions were based on previous personal contacts with Anna-Riitta Putkonen, the pioneer in Finnish neuropsychology. The joint interest in clinical work and the theoretical framework of A.R. Luria was the origin of later developments of life long collaboration and friendship with Anne-Lise. She soon became our role model for scientific interests and clinical practices. By the turn of the 1980’s time was ripe for Nordic and wider international meetings in neuropsychology. Anne-Lise was a true cosmopolitan who brought together many international icons during her years at the Center for Brain Injury in Copenhagen. The empowering enthusiasm was the basis for continuous developments in approaches of neuropsychological investigation, rehabilitation and research. Due to Nordic collaboration the tradition of this meeting today was established. In Finland neuropsychology was included in University teaching programs and new rehabilitation settings emerged. The contributions of Anne-Lise’s personality and several writings and texts have had deep-rooted influences in the present status in the many subspecialities of neuropsychology in Finland. She had a strong impact on holistic rehabilitation programs as well as new conceptualizations in neuropsychotherapy.

I personally have experienced Anne-Lise’s influence and support in many ways. In the 1990’s we participated European research projects of rehabilitation of memory: 1981-1982 we were members in the E.S.C.A.P.E./Biomed 1. in Germany. In 1993-1995 we continued in Biomed 1. 2nd phase in Germany and Cambridge, GB. The project leaders in respective countries were Reiner Kaschel and Barbara A. Wilson. During our traveling Anne-Lise and I had the possibility to strengthen our friendship beyond professional grounds. The final highlight was our joint conference trip to Hawayi in the first decade on 2000. Anne-Lise got honours for life-time work and I introduced her by the invitation of I.N.S.

4. Jens Egeland, University of Oslo, Norway

**Impact on Norwegian neuropsychology**

Anne Lise Christensen’s (ALC) work impacted directly or indirectly two aspects of Norwegian neuropsychology: By introducing the methodology of Alexander Luria in Scandinavia and by establishing the first Scandinavian centre for cognitive rehabilitation of brain injury. Internationally neuropsychological rehabilitation programs started in the mid nineteen-eighties, increasing in the US from 60 in 1985 to 600 in 1993. Centre for Brain Injury in Copenhagen was established in 1985, and the presentation will show that this Centre and the writings of ALC heavily impacted the psychologists that started the first Norwegian programs in Oslo, Stavanger and Tønsberg in the mid nineties. Norwegian Neuropsychology was at that time dominated by the Halstead-Reitan methodology advocated by Hallgrim Kløve, while today the dominating paradigm could be
described as adhering to the quantitative process approach. Historically, the Luria-methodology represents an important step towards the present model. The present paper will present the results of the Nordic Test use-survey published in 2016 and discuss the influence of ALC and Luria and that of Kløve and Halstead Reitan. Today more Luria tests are used in Norway than in Denmark, and the claim is that there has been a fusion of methodologies where Norwegian neuropsychologists has become more flexible and process oriented that can be traced to the Luria methodology (but with a detour through Boston) while still applying many tests, which is the remaining heritage of the Halstead Reitan approach.

5. Frank Humle, Center for Hjerneskade, Københavns Universitet, Denmark
Anne-Lise and Center for Hjerneskade
When, late in her professional career at age 58, Anne-Lise Christensen founded the Center for Rehabilitation of Brain Injury within the Institute of Psychology at the University of Copenhagen in 1985, she had what it took to do so. Anne-Lise was an experienced and proficient psychologist with extraordinary acumen and a great desire to help people with acquired brain injury.

The CRBI was the first of its kind, not only in Denmark, but also in Europe. Inspired by the teachings of A.R. Luria as well as experiences of American pioneers Diller and Ben-Yishay, Anne-Lise’s interdisciplinary team created a new and holistic rehabilitation program for people with acquired brain injury, thus setting new standards for neuropsychological rehabilitation. The novel approach of the CRBI challenged the conventional wisdom of treatment and rehabilitation – thus necessitating a keener focus on evidence-based rehabilitation. Just a few years after the Center’s inauguration, a socio-economic cost-benefit study carried out by the Danish government-based research Institute showed that investing in holistic rehabilitation paid off.

Anne-Lise secured a grant from the Egmont Foundation, thereby not only funding the establishment and development of the CRBI, but also setting aside a sum for the Center’s possible liquidation in the event of failure to provide successful rehabilitation.

In the early years, the group around Anne-Lise was small – a few psychologists, a physiotherapist and a special education teacher. Concurrent with the Center’s successful expansion, the group soon grew. Thanks to Anne-Lise’s outstanding networking abilities and her exceptional gift of understanding people and connecting with them, the CRBI’s work rapidly gained acclaim not only in Denmark, but also abroad. Anne-Lise became a highly respected and internationally esteemed expert. Based at the CRBI in Copenhagen, Anne-Lise travelled the world, presenting the holistic CRBI rehabilitation program and, simultaneously, creating an impressive network of expert collaborators all over the world.

The rehabilitation approach at the CRBI has always attached pivotal importance to each individual brain-injured person as well as his or her significant others and surroundings. This principle still holds true today, where the CRBI’s staff of approximately 70 annually performs examinations of and delivers rehabilitation to approximately 500 individuals with acquired brain injury. The legacy of the path laid out by Anne-Lise more than three decades ago has proven to be enduring and resilient. Persons with acquired brain injury, their families as well as the staff at the CRBI can bear witness to the influence of her work and her dreams on a daily basis.
6. Jaana Sarajuuri, University of Helsinki, ProNeuron, Neuropsychiatry therapy and medical center, Finland

Contributions to holistic neurorehabilitation programs and treatment of traumatically brain injured patients

“If one is to succeed in guiding a person from one state to another, one must first ensure that one can identify where the person is to be found and start there. This is the true secret of helping. All true helping begins with humility. The helper must first humble himself to the person that he wishes to assist and from this position understand that helping is not to dominate but to serve.” This quotations from the Danish philosopher Sören Kierkegaard was of special interest to Anne-Lise, quoted often in her presentations as in her speech in 2012 when IBIA honoured her with Lifetime Achievement Award, and in line with her conception of neurorehabilitation as keeping the central focus on phenomenology of human behaviour. Observing Alexander Luria at Burdenko University Hospital, in Moscow, applying his sophisticated method of investigation allowed Anne-Lise to evaluate impairments in neuropsychological functioning of patients, to learn to integrate clinical findings and insights into a comprehensive picture of the patient, and moreover, “to relate the patients genuinely with utmost respect in profound appreciation of his/her experience”.
During her lifelong career Anne-Lise developed many international collaborations with colleagues. In the seventies Yehuda Ben-Yishay and Leonard Diller in New York, and George Prigatano in Oklahoma pioneered the holistic neurorehabilitation programs for TBI patients. In Europe, resulted from these collaborations, Anne-Lise established a holistic program at Copenhagen in 1985. In the years coming several similar programs were established in Europe. The European Holistic Rehabilitation Working Group was founded in 2001, Anne-Lise as the legitimated honorary member.

According to her humane personality Anne-Lise preferably encouraged and supported also us younger colleagues to learn to serve people with brain injuries, and to keep on to improve the future of neuropsychological rehabilitation. I personally have experienced Anne-Lise’s gentle affect as a member of the holistic neurorehabilitation community. Since 2000 we have been members of the Euroacademica Multidisciplinaria Neurotraumatologia. In the 2000’s and 2010’s we have participated research projects as members of an international TBI Task Force to develop the first TBI-specific instrument to assess health-related quality of life, the QOLIBRI, and further related reasearch. Anne-Lise’s role has been outstanding in advancing our understanding and treatment of people with brain injury. Her efforts have inspired us and provided far reaching influence on succesful neurorehabilitation.

19.00 - Conference dinner at Münchenbryggeriet

For those who have signed up for conference dinner
Conference program - August 24

9.00 -10.00 - Keynote *(Conference room: Plenum)*

**Connectomics of chronic pain.**
*Professor A Vania Apkarian, Feinberg School of Medicine, USA*

Complementary human and animal studies now provide convincing evidence regarding brain mechanisms involved in the development of chronic pain. Multi-modal human brain imaging studies now show that that brain properties determine risk for development of chronic pain, and also brain anatomy and functional responses and connectivity carve the chronic pain state. Consistent and complimentary evidence is now also available in rodent models of chronic pain, where brain reorganization is now unraveled for receptor gene expression, cellular excitability, and synaptic efficacy, as well as whole-brain functional connectivity, all of which are beginning to unravel novel targets for drug development. I will review these ideas with especial emphasis on mechanistic concepts and clinical implications of these new advances in the field.

10.00 – 10.30 - Coffee break

10.30 – 12.00 - Parallel symposia

1. Oral presentations Acquired brain injury *(Conference room: B1)*
*MSc Laila Øksnebjerg, Chair*

1. *Mikael Ledin, Danderyd University Hospital, Sweden*
   Growing up with an acquired brain injury –

2. *Dornonville de la Cour, Frederik Lehman, Rigshospitalet, Copenhagen University Hospital; Brain Injury Centre BOMI; University of Copenhagen, Denmark*
   On the Relation between Dimensions of Fatigue and Depression in Adolescents and Young Adults with Acquired Brain Injury

3. *Birgitta Johansson, University of Gothenburg, Sweden*
   Mental fatigue after an acquired brain injury and impaired cognitive function over time
4. Gabriela Markovic, Karolinska Institutet, Sweden  
   The influence of attention training on learning and memory after acquired brain injury

5. Joel Gerafi, University of Gothenburg, Sweden  
   A cohort study of presence of neglect sub-acute and 7 years post-stroke –

6. Kaisa Mäki, University of Helsinki, Finland  
   Perceived injustice after mild traumatic brain injury –

2. Symposium - Using eye tracking to understand brain development and plasticity in infants and children  (Conference room: B2)  

   Professor Terje Falck-Ytter, Chair

1. Marcus Lindskog, Uppsala University, Sweden  
   The role of active exploration in the development of infant’s numerical abilities  
   Individual differences in infants’ number sense (ANS) are related to later mathematical ability. We propose an active exploration hypothesis regarding the origin of this variability. Specifically, gaining the ability to reach for and manipulate objects increases infants’ attention to magnitudes and quantities, providing a training ground for the ANS. The hypothesis is tested with data from a longitudinal study evaluating infants’ potential to explore objects at 6-months and their attention to magnitudes and ability to discriminate numerosities at 6- and 10-months. We find that infants’ active exploration of objects facilitates early numerical abilities by providing opportunities for learning about magnitudes.

2. Joshua Juvrud, Uppsala University, Sweden  
   The role of emotional context in infants’ visual attention  
   Emotions convey information that helps individuals focus attention to relevant stimuli in the environment. The effects of emotional stimuli on subsequent distribution of attention during infancy, particularly emotions conveyed by a primary caregiver, are still poorly understood. The current study examined the effects of emotional priming and maternal anxiety on a visual search eye-tracking task in 9-month-old infants (n=77). Results suggest that emotional facial expressions have a unique impact infants’ distribution of attention, and these facial expressions impact infant attention may also relate to maternal anxiety and affect.
3. Johan Lundin Kleberg, Uppsala University, Sweden

Social anxiety, attention to emotional faces and response to cognitive behavioral treatment

Socially important information in the environment influences attention and perception, even at the very earliest stages of processing. This knowledge can contribute to an understanding of psychiatric conditions characterized by atypical social cognition and behaviors such as autism and social anxiety disorder. I will present research in child and infant populations where eye tracking and pupil dilation are used to study rapid shifts of attention to and from social stimuli such as emotional faces. This research aims at understanding the development of atypical social attention, as well as the mechanisms underlying treatment changes after cognitive behavioral treatment.

4. Terje Falk-Ytter, Uppsala University & KIND at Karolinska Institutet, Sweden

Using eye tracking to understand early development in autism

Autism is a neurodevelopmental condition with symptoms emerging over the first years of life. Longitudinal studies of infants at risk can reveal developmental pathways leading to the diagnosis, facilitate early detection and provide new leads on intervention targets. I will present some recent results from this literature, highlighting emerging findings suggesting that gaze and pupillometry measures are sensitive to group differences before the age that overt behavioral symptoms typically emerge, and discuss how these infant friendly measures can facilitate our understanding of early development in autism.

3. Oral Presentations - Neuropsychology in adults and in the elderly

(Conference room: C4)

PhD, Docent of Neuropsychology Mervi Jehkonen, Chair

1. Asta Håberg, St. Olav’s University Hospital, Norway
   Is physical fitness associated with better mental health, cognition and brain structure in middle aged and older adults?

2. Ove Almkvist, Karolinska Institutet, Sweden
   Working and declarative components of subjective memory impairment in dementia: a population-based HUNT study

3. Karin Jonasson, University of Gothenburg, Sweden
   Concurrent validity of the Barrow Neurological Screen for Higher Cerebral Functions (BNIS) at the chronic stage post-stroke
4. Johanna Nukari, University of Helsinki, Finland
   Neuropsychological interventions of adult dyslexia improve cognitive functioning in both individual and group format – results from an RCT study

5. Riis Jens Østergaard, Aalborg University, Denmark
   Shunt operation of elderly NPH patients improves cognitive functioning one year after

12.00 – 13.00 - Lunch (Clarion Hotel Sign – lunch restaurant)

13.00 – 14.30 - Parallel symposia

1. Symposium organized by the Norwegian Neuropsychological Society
   Effect of physical fitness on cognition (Conference room: B1 )
   Professor Jens Egeland, Chair

1. Jens Egeland, Vestfold Hospital Trust/ University of Oslo, Norway

   Introduction: Why expect physical fitness to impact cognition
   Research relating physical fitness to cognition has been snow-balling within various fields of psychopathology, aging and sports and physical training is suggested as a way to treat cognitive impairment. The research could be divided into three types, which will be addressed in the symposium: Studies of the immediate effect of exercise, naturally occurring associations between cognitive and physical fitness, and effects of interventions.
   Why should one expect that physical fitness impact cognition? Following Voss (2016) four possibly overlapping causative models will be presented. Given that this is new research with a positive publication bias, some methodological issues in this research also needs to be discussed.
   The Cardiovascular fitness hypothesis suggests a direct relation between oxygen uptake or cardiorespiratory fitness and cognition, a finding that has received support in large non-clinical studies. An implication of the hypothesis is that cognition can benefit from increased fitness, i.e. giving a rationale for the many intervention studies.
   The motor fitness hypothesis claims that motor learning from physical activity, even without increased respiratory fitness, increases perceptual and higher level cognitive processing.
   Also the cerebrovascular reserve hypothesis suggests that physical activity can be beneficial without a necessary increase in cardiovascular fitness. The reserve element is referring to the organism’s reactivity to metabolic demands by increasing chemical and
neural activity. Physical activity can prevent reduction of the reserve for instance during aging.
The Bioenergetic effects model bridges the immediate and chronic effects of physical activity on cognition. Activity immediately improves cellular energy metabolism and reduces oxidative stress which is beneficial for effective cognition. BDNF transcription and signaling is expected to be a critical mediator. The positive publication bias refers to the difficulty of publishing negative studies in a new field. Research on physical activity cannot be double blinded, resulting in possible negative effects in comparison groups.

2. Alexander Olsen, Martin Wohlwend, Asta Håberg, Helen Palmer, Norwegian University of Science & Technology, Norway

The acute effects of exercise on cognitive control function

Introduction: Cognitive control functions rely on rapid and dynamic communication between wide-spread brain regions, and are key to our goal directed regulation of thoughts, actions, and emotions. Cognitive control dysfunction is a common vulnerability factor across several neurological and neuropsychiatric conditions, and has been linked to physical fitness. However, we lack a complete understanding of how such functions are altered by acute exercise. Here we investigated how cognitive control performance was affected during and after different intensity levels of treadmill running.

Methods: Thirty (15 male) healthy young adults (age 24.3 ± 3.3 years) were included in this randomized multilevel cross-over experiment. Participants performed a total of six sessions of running exercises on three different levels; low intensity (LI), Moderate Intensity (MI), and High Intensity (HI). Intensity levels were individualized and work load was balanced based on VO2max and HRmax. Speed and accuracy on a Not-X Continuous Performance Test with a duration of 14 minutes was used as measures of cognitive control function at baseline, during exercise, and 5 minutes after exercise for each intensity level. The order of exercise bouts at different intensity levels was balanced in a randomized fashion, and a 1-week inter-session interval was used to ensure a wash-out period.

Results: Changes in accuracy related to exercise intensity were only present during exercise, with participants demonstrating lower accuracy during MI than LI exercise. In the post-exercise phase, response speed decreased linearly with increased exercise intensity. A post-hoc test evaluating time-on-task effects after HI revealed a linear recovery to normal levels within the first 20 minutes of exercise.

Conclusions: Cognitive control function was negatively affected by exercise intensity during running, which is likely to reflect the increased demand on dual-tasking. However, higher exercise intensity seems to be related to processes that transiently facilitate neuronal efficiency in the post-exercise phase.

Grant support: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Naturally occurring association between physical fitness and cognitive functions in schizophrenia

Objective: Schizophrenia is associated with reduced cardio-respiratory fitness (CRF), and impaired cognition is a core feature of the disorder. Despite their particular significance to schizophrenia disparately, the relationship between these two variables has not previously been thoroughly explored. In this study we aimed to investigate naturally occurring associations between CRF and all cognitive domains within this patient population. Furthermore, we examined whether such an association would be general, or due to selective relationships between CRF and specific aspects of cognitive function.

Method: Eighty outpatients with schizophrenia spectrum disorders participated. Neurocognition was assessed with the Wechsler Adult Intelligence Scale version 4 General Ability Index (WAIS GAI) and the MATRICS Consensus Cognitive Battery (MCCB). CRF was assessed with peak oxygen uptake measured through a maximal exercise test, using a modified Balke protocol. Clinical symptoms were assessed with the Positive and Negative Syndrome Scale (PANSS). Hierarchical multiple regression analyses were conducted, controlling for sex and age, and negative symptom levels. Subsequently, a factor analysis was conducted on all utilized subtests of the WAIS GAI and the MCCB, and the factors were subjected to separate regression analyses with CRF as predictor.

Results: CRF explained 8.2% and 9.0% of the variance in general intellectual ability and state-sensitive cognitive functions respectively, beyond the impact of negative symptom load. Furthermore, the factor analysis identified three factors: one speed/attention/executive function factor, one verbal factor, and one perceptual factor. Regression analyses showed that maximal oxygen uptake explained a significant amount of variance in the verbal factor only ($R^2 = .06$, $\beta = .329$, $p=.03$).

Conclusion: The study indicates a direct relation between CRF and cognition in schizophrenia. Moreover, this relationship appears selectively tied to a modality-specific association between CRF and verbal cognitive abilities. These findings have implications for understanding the relation between cognitive factors and physical health in schizophrenia.

Effect of high intensity physical training compared to cognitive training in schizophrenia: Effects on cognition

Introduction: Cognitive improvement after aerobic high-intensive interval training (HIIT) is documented by experimental and clinical research, including RCTs on schizophrenia. A challenge in these RCTs, where the control-group is not receiving an intervention, is to differentiate whether the cognitive improvement is an effect of the exercise-factor or an effect of other changes due to participating in the intervention (frame-factors).
Furthermore, meta-analyses have shown that decreasing results in control-groups may underlie some of the group difference. Hitherto, some HIIT-studies fail to show significant improvement in maximal oxygen uptake in people with schizophrenia, in contrast to studies on the general population. There is a need to refine the interpretation of cognitive improvement after HIIT-intervention RCTs in schizophrenia research.

Method: This EPHAPS-subproject compares cognitive change after a HIIT-intervention with a motor-cognitive sports-gaming intervention (Nintendo-WII). Both groups received supervised standardized interventions 2 times per week for 12 weeks. Maximal oxygen-uptake and cognitive functions were assessed at baseline and immediately after the intervention period.

Results: Detecting beneficial effects of exercise is complicated by participant heterogeneity. Both groups showed a significant increase in cognitive composite-scores. A tendency towards higher effect-sizes and increase on more subdomain-scores in the HIIT-group will be further analyzed, as will heterogeneity in exercise-response.

Discussion: Preliminary results in the HIIT-group are consistent with findings in meta-analyses showing cognitive improvement following supervised HIIT-intervention. Can the improvement be attributed to the HIIT-factor? Is the cognitive improvement significantly higher than the change found in a control-group receiving the same intervention-frames, but a motor-cognitive intervention? The current results partially support the hypothesis of cognitive improvement following HIIT, but differ from the enthusiastic first studies in the field by providing a conditional answer: It may depend on exercise qualities and baseline characteristics. Novel and unpublished results will be presented at the conference.

Grant: HelseSørØst.

5. Asta Kristine Håberg, Norwegian University of Science & Technology/St. Olav’s Hospital Trust, Norway

Is physical fitness associated with better mental health, cognition and brain structure in middle aged and older adults?

Decreasing levels of physical fitness in the population is a major public health concern, and may also affect brain function. Physical fitness is measured with variable methodology from self-report, estimated based on clinical measures such as resting heart rate and waist circumference, as well as objectively as VO\textsubscript{2}, i.e. the maximum or peak amount of oxygen that a person can utilize during maximal exercise. Physical fitness is associated with a number of favorable physiological changes in the body e.g. a more ideal weight and reduction of cardiovascular disease risk factors, which may exert their own effect on brain function and structure independent of physical fitness.

To gain an understanding of the unique contribution of physical fitness, versus general health factors, on mental health, dementia risk, changes in cognition over time and the brain’s grey and white matter we have studied two cohorts: the general populations based Health Survey of North Trøndelag and a subsample participating in the randomized intervention study Generation 100.
We find that physical activity almost three decades earlier reduces the risk of dementia particularly in those suffering from psychological stress when younger. Further, persisting or increasing physical activity is associated with larger brain volumes in middle age. Increasing VO2 exerts a unique effect on brain structure, independent of factors such as cardiovascular risk factors and waist circumference. Physical activity even at low levels appear to have a longer window of opportunity for exerting positive effects on brain function and structure in contrast to several other risk and beneficial factors.

2. Symposium - Sign language and brain plasticity  (Conference room: B2)

Professor Jerker Rönnberg, Chair

1. Jerker Rönnberg, The Swedish Institute for Disability Research, Linnaeus Centre HEAD, Sweden

Working memory for sign and speech

Introduction In the same way as for spoken language, sign language is a language with all levels of language preserved. The current presentation focuses on working memory (WM) for sign and speech, the driving force being the potential modality specificity and plasticity of WM for sign.

Method Rönnberg et al (2004) used bilingual participants to study WM (serial recall) for signs and speech (i.e. audiovisual speech or signs produced by a sign language interpreter). Brain activity was measured with PET. Rudner et al. (2007) used an fMRI, n-back design, using unimodal and mixed lists and bilingual participants. In Cardin et al (2017), deaf participants watched moving point-light displays of signs and nonsense objects. Again, fMRI and n-back were employed.

Results Rönnberg et al (2004) demonstrate that similar laws apply to short-term retention, evidenced by serial position analyses. However, brain imaging show e.g. modality specific bilateral parietal activation patterns for signs. In Rudner et al (2007), the specific bilateral pattern was replicated for unimodal lists and for bilinguals, whilst the mixed lists, show a middle temporal pattern where the meaning of signs and speech presumably connect in an episodic buffer. Recent WM work by Cardin et al (2017) reveals interesting brain plasticity in deaf native sign language users such that STC is recruited bilaterally to a larger extent than for hearing individuals. This deafness effect is also demonstrated in resting state connectivity analyses.

Conclusions Although there are sign-specific patterns of activation for bilingual participants (Rönnberg et al., 2004; Rudner et al, 2007), and suggestions of an episodic buffer translating signs into speech, the most compelling plastic effect is that of a bilateral STC activation for deaf individuals, deviating from the typical fronto-parietal patterns for a normal WM signature.

Financial support From the Swedish Research Council (i.e., Linnaeus Centre HEAD).
2. Mary Rudner, Swedish Institute for Disability Research, Linnaeus Centre HEAD, Linköping University, Sweden

Linguistic and cognitive representation – lessons from sign language

Introduction Sign language has the same function as spoken language and similar neural representation. However, working memory (WM) for sign language shows subtle differences in both function and representation. Pre-existing semantic and phonological representation facilitate WM for speech-based language. We have shown that semantic representation, i.e. knowing the meaning of the sign stimuli, facilitates WM but found no empirical evidence of a similar advantage for phonological representation, i.e. familiarity with sublexical components of sign stimuli.

Methods This study reviews the behavioural and imaging literature on WM for linguistic and non-linguistic gestures and considers the effects of linguistic and cognitive representation on WM across language modalities.

Results Phonological representation does not seem to facilitate WM for signs and reported detrimental effects of phonological similarity may be caused by visuomotor features. Further, deafness confers a benefit for sign-based WM irrespective of pre-existing semantic and phonological representation, probably due to expert knowledge of sign language and/or reliance on visual information which in turn may be related to cross-modal plasticity in auditory cortex.

Conclusions Phonology does not seem to provide a key basis for representation in WM for sign language. Forms of cognitive representation linked to cross-modal plasticity in the auditory cortex of deaf individuals should be investigated.

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3. Emil Holmer, Swedish Institute for Disability Research, Linnaeus Centre HEAD, Linköping University, Sweden

Signs for developing cognition

Introduction Linguistic representations provide structure and content for higher-order cognitive processes, such as working memory, and play an important role in their development. Sometimes the conditions for language development changes due to sensory loss, such as in cases of deafness. With proper environmental input, the brain can flexibly adapt to such conditions and a mental lexicon that is sign-based instead of speech-based emerges. The topic of the present talk is the role of sign language in developing cognitive skills.

Method In Holmer et al. (2016; 2017), behavioural measures were used to assess linguistic, cognitive and literacy skills longitudinally in a group of deaf and hard-of-hearing (DHH) signing children. Sign language skills were assessed with a comprehension test, an imitation paradigm and a phonological awareness test.

Results Sign-based representations that are in place seem to support further development of the mental lexicon (Holmer et al., 2016), possible reflecting a mechanism of learning
unbound to modality (c.f., Storkel et al., 2006). More specifically, DHH signing but not hearing non-signing children improved their imitative precision of manual gestures between two test occasions (Holmer et al., 2016). In addition, sign language skills might promote developing cognitive skills such as reading (Holmer et al., 2017).

**Conclusion** Existing linguistic representations influence the way in which novel exemplars of similar percepts are represented. Once in place, linguistic representations can be used for learning and higher-order reasoning regardless of the modality in which they are formed.

14.30 – 15.00

**Creative networking** *(Conference room: B3)*

15.00 – 15.15

**Poster prize and closing words by the president of the Swedish Neuropsychological Society** *(Conference room: Plenum)*

*Bengt Persson, PhD*

15.15 – 15.45 - Grab and go coffee
13th Nordic Meeting in Neuropsychology, Stockholm 2018

Abstracts

Oral presentations

Developmental disabilities

1. Persistence of coordination problems from childhood into middle age. A 40-year cohort study

Ilkka JÄRVINEN, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Satu Immonen, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Nella KORHONEN, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Eliisa LEHTO, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Maarit VIRTA, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Jari LIPSANEN, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Katarina MICHELSSON, Children’s Hospital, University of Helsinki, Helsinki, Finland; Jyrki LAUNES, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Laura HOKKANEN, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland

Introduction Developmental coordination problems afflict 5–20 % of children. They are associated with a lack of exercise and poor physical health, as well as learning disorders and mental health problems. The cause of coordination problems is inadequately understood but they can be associated with perinatal risks. Little is known about the long-term course of the problems. Our study aimed to determine the extent to which coordination problems persist into adulthood.

Method As part of a prospective cohort study, we studied 300 participants exposed to perinatal risks. Their coordination skills were examined at the age of 9 with a validated test of coordination: 235 were classified in the normal-coordination group, 52 in the mild-problem group, and 16 in the marked-problem group. At the age of 40, their coordination skills were assessed.

Results According to bootstrapped ANOVAs, the marked-problem group had worse postural balance (p< .001), manual dexterity (p< .001), and visuomotor skills (p= .010), compared with the normal-coordination group. The marked-problem group also had worse balance (p< .001) and fine motor skills (p= .003) than the mild-problem group. The mild-problem group did not differ from the normal-coordination group.

Conclusions In people exposed to perinatal risks, marked coordination problems still manifest in middle age as performance deficits on several measures of coordination. The results highlight the need for interventions in childhood and beyond.

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JUNTUNEN, Maija, Department of Psychology, University of Turku / Department of Child Neurology, Turku University Hospital, Finland; KORHONEN, Tapio, Department of Psychology, University of Turku, Finland; AHTOLA, Anarilla, Department of Psychology, University of Turku, Finland; MUNCK, Petriina, Department of Psychology, University of Turku, Finland; NIEMI, Pekka, Department of Psychology, University of Turku, Finland; HAATAJA, Leena, University of Helsinki, Finland / Department of Child Neurology, Helsinki University Hospital, Finland; LEHTONEN, Liisa, Department of Pediatrics, Turku University Hospital / University of Turku, Finland; LAPINLEIMU, Helena, Department of Pediatrics, Turku University Hospital / University of Turku, Finland; MATOMÄKI, Jaakko, Clinical Research Centre, Turku University Hospital, Finland; KOIVISTO, Mari, Clinical Research Centre, Turku University Hospital, Finland; RAUTAVA, Päivi, Department of Public Health, University of Turku / Clinical Research Centre, Turku University Hospital.

Introduction There is a good concordance between early measures of cognitive development and later IQ-scores within Very Low Birth Weight Children (VLBW, ≤ 1500g). However, it is uncertain whether early cognitive development predicts academic skills and their precursors when children are entering school. Aim for this study was to examine how early cognitive development predicts VLBW children’s preliminary academic skills at school entrance. Also, various risk factors for lower than average performance within preliminary academic skills was studied.

Method A regional cohort of 158 Finnish VLBW children and 155 full-term controls born between 2001-2006 were followed up using Mental Development Index (MDI) of Bayley Scales of Infant Development-II at two years of corrected age. At school entrance at seven years of age, five reading related and three arithmetic related academic skill measures were used.

Results MDI explained 23% of the variance within reading related skills, and 12% of arithmetic related skills. MDI and risk factors together explained 30% of reading related skills, and 19% of arithmetic related skills. MDI <85 (<1SD) was a risk factor for lower than average achievement within preliminary academic skills. VLBW boys were at risk for lower achievement in reading related skills.

Conclusions Predictive accuracy of MDI on preliminary academic skills seems to be modest, even when accompanied by various risk factors. However, low (<1SD) MDI can identify those VLBW children who need intensive follow-up and educational support.

Grant Support: State Funding for University Level Health Research.
3. Gender Differences in Developmental Outcomes of Estonian Preterm and Full-Term Children at the Age of Five Years

MÄNNAMAA Mairi, Children’s Clinic of Tartu University Clinics, Tartu, Estonia; TROSSMANN Kaili, Children’s Clinic of Tartu University Clinics, Tartu, Estonia; Lee Krislin, Clinics of Paediatrics, Tallinn Children Hospital, Tallinn, Estonia; Utsal Ülle, Children’s Clinic of Tartu University Clinics, Tartu, Estonia; Varendi Heili, Children’s Clinic of Tartu University Clinics, Tartu, Estonia; Toome Liis, Clinics of Paediatrics, Tallinn Children Hospital, Tallinn, Estonia

Introduction Premature children, especially boys, have an increased risk for poor outcomes in several areas of development. The purpose of the study was to evaluate the neurodevelopmental and motor outcomes and gender differences of PT children at the age of five and compare the results with full-term (FT) controls.

Method The study group consisted of 40 preterm children (GA<29 weeks, BW<1000g; 19 boys and 21 girls) and 64 FT controls (28 boys and 36 girls). Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition UK (WPPSI™-IV UK) was used to assess the children’s cognitive development and Movement ABC, Second Edition (M-ABC2) to evaluate outcomes in motor skills.

Results PT group showed significantly lower scores in both outcome measures compared with age-matched FT controls. PT and FT boys differed significantly in scores of general intellectual ability, verbal comprehension, visuo-spatial abilities, working memory and processing speed. FT boys also outperformed PT boys in overall motor development, manual dexterity, balance and aiming-catching movement. There were no significant differences between the groups in terms of scores for verbal comprehension, working memory, balance and aiming-catching movement among girls.

Conclusions Neurodevelopmental and motor outcomes have revealed emerging difficulties for both PT boys and girls. Female advantage may change in time as they may grow into their difficulties and further assessment at school age is necessary to detect the specific developmental problems.

Grant support This study was financed by the Horizon 2020 Programme "Screening to improve Health In very Preterm infants in Europe".

4. Chronic conditions and health care needs of adolescents born moderately preterm at 32–36 weeks’ gestation: a Swedish regional population based case control study

Marie ADAMSSON, Psychologist, Norrland University hospital, Sweden

Introduction Children born moderately preterm constitute an epidemiologically large group of preterm children and NICU graduates, yet the extent of adverse outcomes in their school years remains underresearched. We examined chronic conditions, functional limitations, and special health care needs in 12-14 year old adolescents born moderately preterm children (MPT; 32–36 weeks’ gestation) at three different hospitals in Sweden.
Method 258 consecutive MPT children born between 2000 and 2003 in Swedish were compared with equal number of term-born controls. Identification of children with functional limitations and special health care needs was based on a validated questionnaire/interview with parents. Categorization of medical diagnoses and developmental disabilities was based on child examinations and cognitive assessment (WISC-IV), and medical record reviews.

Results In logistic regression analyses adjusting for social risk factors and sex, the MPT children had significantly more chronic conditions than the term-born controls, including functional limitations (16.4% vs 5%; \( P = 0.001 \)), compensatory dependency needs (30% vs 17%; \( P = 0.04 \)), and services above those routinely required by children (36% vs 20%; \( P < .001 \)). Significantly more MPT adolescents than controls were receiving full time special education (5.5% vs 0.9%; \( P=0.023 \)) and had school difficulties in mainstream schools (22% vs 13%; \( P = 0.01 \)). Specific diagnoses and disabilities for the MPT group vs controls included, respectively, asthma (19% vs 5.8%; \( P = .004 \)), IQ < –2 SD (9% vs 3.3%; \( P < .001 \)) and borderline intelligence (FSIQ scores < -1 SD to > –2SD, 22.4% vs 12%; \( P <.001 \)).

Conclusions MPT children have considerable long term health and educational needs. Very few had severe impairments that curtailed major activities of life. There is a need for standard follow up of MPT infants through childhood and school years in order to identify children with special needs.

5. Faceblind: Characterising the cognitive profile(s) in developmental prosopagnosia

Randi STARRFELT, Dept. of Psychology, University of Copenhagen, Denmark; Christian GERLACH, Dept. of Psychology, University of Southern Denmark

Introduction It is well known that impairments in face recognition can arise following acquired brain injury (prosopagnosia). Recently it has become clear that prosopagnosia also exists in a developmental form: Developmental prosopagnosia (DP), estimated to affect about 2% of the population. People with DP have severe problems with recognizing the faces of others, including friends, family, and sometimes even themselves in a mirror.

Method Following media coverage of prosopagnosia in Denmark, we were contacted by a number of people who describe major difficulties in recognizing other people. We have now tested 24 DPs and matched controls with a battery of diagnostic and experimental tests and questionnaires tapping a range of cognitive and perceptual abilities. We will present results from a range of the included tests and questionnaires, aiming to draw a cognitive profile of this group. To this aim we use both group and single case statistics.

Results While reading and visual attention is generally intact in DP, performance in other domains is affected in some DPs but not others (e.g., topographical orientation). Object processing is impaired on a group level, and there seems to be a relationship with delayed processing of global shape information and deficits in face and object processing.

Conclusion All DPs have severe difficulties in recognizing faces. Performance on other visual and cognitive tests are more varied. A core problem is related to the timing of visual processes, and key impairment may be in deriving global shape information from faces and objects alike.

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6. Audiovisual recognition memory from childhood to older age

Jenni HEIKKILÄ, University of Helsinki, Finland; Kaisa TIIPPANA, University of Helsinki, Finland

Introduction Previous studies have shown that audiovisual information can improve memory encoding in young adults. However, less is known about the benefits of audiovisual encoding in children and older adults, and how they utilize audiovisual memory cues compared to young adults.

Method We studied the effects of audiovisual encoding on later unisensory recognition memory performance using both verbal and non-verbal stimuli. We compared how audiovisual encoding affects recognition memory performance in school-aged children (mean age 10;4 years) and young adults (mean age 25 years), and in older adults (mean age 71 years) and young adults.

Results The recognition memory performance was better in all age groups when the memorized stimulus was initially presented with a semantically congruent stimulus in the other modality than when it was presented with a non-semantic or unisensory stimulus. There were no differences in how children and young adults utilized audiovisual information in memory encoding. However, older adults and young adults differed in the combinations of audiovisual stimuli that were beneficial for memory performance.

Conclusions These findings show that semantically congruent audiovisual experiences can enhance memory encoding not only in young adults but also in children and older adults. Adult-like benefits on audiovisual memory encoding can occur already at childhood, and the ability to utilize audiovisual memory cues changes during normal aging. These results might be useful when developing educational practices for children and young adults, as well as when designing practical applications to improve memory problems due to normal aging.

7. Longitudinal cohort study of developmental patterns in children with extremely low birth weight

Anu HAAVISTO; Liisa KLENBERG, Department of Psychology and Logopedics, University of Helsinki, Helsinki, Finland; Aulikki LANO; Viena TOMMISKA; Kaija MIKKOLA; Vineta FELLMAN, Children’s Hospital, University of Helsinki and Helsinki University Hospital, Helsinki, Finland

Introduction This longitudinal prospective study assessed cognitive functions in a national cohort of extremely low birth weight (ELBW, < 1000 g) children at preschool and preteen years. The objective was to find subgroups of children with different developmental trajectories.

Method A total of 115 ELBW children born in Finland in 1996-1997 participated in individual cognitive assessments at a mean of 5.0 and 11.6 years. A standardized test of intelligence (WPPSI-R, WISC-III) was administered at both time points and additionally a comprehensive neurocognitive test battery (NEPSY-II) at age 11.
Results Four subgroups were detected ranging from above average intellectual performance to significant delay compared to test norms. Significant decrease in intelligence scores was noted over time particularly among ELBW children with average performance at 5 years. Children with significant delay at preschool age showed stable development. The level of performance at 5 years of age was associated with overall level of performance in specific neurocognitive tasks at 11 years. Decreasing gestational weeks, being small for gestational age, a diagnosis of intraventricular haemorrhage and lower maternal education were all risk factors for cognitive development.

Conclusions ELBW children are a heterogeneous patient population and subgroups with different levels of cognitive performance were detected. These had, however, similar developmental trajectories, with decreasing intelligence scores between preschool and preteen years, with the exception of low performers with stable development. More studies are needed to confirm these findings. However, catch-up growth does not seem likely to occur in the ELBW population, which should be noted in clinical work.

Acquired brain injury

1. Growing up with an acquired brain injury

Mikael LEDIN, Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden; Ingrid RYDMARK, Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden; Azra RAMOVIC, Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden/Karolinska Institutet, Stockholm, Sweden; Marika C. MÖLLER, Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden /Karolinska Institutet, Stockholm, Sweden; Alison GODBOLT, Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden /Karolinska Institutet, Stockholm, Sweden.

Introduction In Sweden, children with acquired brain injury (ABI) are supported by special teams for children, but at the age of 18, this support ceases for those with predominantly cognitive impairments. An inter professional team for young adults (age 18-25 years) with ABI started in 2012 at the Division of Rehabilitation Medicine Stockholm, with the aim to support the transition to independent adult life based on every individual's needs strengths and weaknesses. Selected data from the patient register will be presented.

Method Patients who during 2012-2017 underwent a rehabilitation period with systematic team-based interventions adapted to their individual cognitive level, and participated in pre- and post evaluations, were included. The main outcome measures were Mayo-Portland Adaptability Inventory (MPAI-4), the Canadian Occupational Performance Measure (COPM), and goal completion in the individual rehabilitation plan (IRP).
Results 49 patients, 20 women and 29 men, aged 18-25 years (mean 20 years) were included. Mean postinjury time at the time of enrollment was 4.2 years (range 0.4 – 19.5 years). For MPAI-4 (n = 36) and COPM (n = 31), significant improvements (p<.001) were achieved for all included measures. The results for goal achievement in the IRP (n = 42) were 81% fully achieved goals, 13% partially achieved goals and 6% unachieved goals.

Conclusions The results show that young adults with cognitive impairments after acquired brain injury can improve their overall functional level and improve their degree of autonomy a long time postinjury. Key factors for success in rehabilitation were personalized interventions adjusted to cognitive level, focus on different forms of strategy training, a holistic approach incorporating external networking, and the pursuit of increased participation and independence.

2. On the Relation between Dimensions of Fatigue and Depression in Adolescents and Young Adults with Acquired Brain Injury

DORNONVILLE DE LA COUR, Frederik Lehman; FORCHHAMMER, Hysse Birgitte; NORUP, Anne: National study of young brain injury survivors, Department of Neurology, Rigshospitalet, Copenhagen University Hospital, Denmark / Brain Injury Centre BOMI, Denmark / The Unit for Cognitive Neuroscience (UCN), Department of Psychology, University of Copenhagen, Denmark; Jesper MOGENSEN, The Unit for Cognitive Neuroscience (UCN), Department of Psychology, University of Copenhagen, Denmark

Introduction Complaints of fatigue following acquired brain injury (ABI) are often associated with depression. However, the nature of this relationship is unclear. Furthermore, research among young patients with ABI is limited. The objectives of this cross-sectional study were (1) to investigate levels of fatigue and depression in young outpatients with ABI (15-30 year old) and (2) to determine how different dimensions of fatigue relate to symptoms of depression.

Method Fatigue was assessed in five dimensions with the Multidimensional Fatigue Inventory (MFI-20): General Fatigue (GF), Physical Fatigue (PF), Mental Fatigue (MF), Reduced Motivation (RM), and Reduced Activity (RA). Symptoms of depression were assessed with the Major Depression Inventory (MDI). Mann-Whitney U-tests and multiple regression analyses were conducted.

Results The patient group (n=105), on average 23.7 year old (SD=4.2) and 31 months post-injury (SD=61), had elevated levels of fatigue and depression compared to a convenience sample of 160 healthy controls (all p’s<.001). Controlling for shared variance in multivariate analyses, the predominantly mental dimensions of fatigue, GF, MF, and RM, were independently associated with MDI (all p’s<.01), while the physical dimensions, PF and RA, were not.

Conclusions Fatigue and depression are common and related symptoms in young patients with ABI. However, distinctions within the concept of fatigue (mental/physical fatigue) may be important in relation to depression, and future research could benefit from adopting a
multidimensional approach in the development of more targeted and effective treatments of fatigue and depression following ABI.

**Grant Support** The work was supported by the Danish Ministry of Health.

3. Mental fatigue after an acquired brain injury and impaired cognitive function over time

*Birgitta JOHANSSON, Sahlgrenska University hospital/Institute of Neuroscience and Physiology, University of Gothenburg, Sweden*

**Introduction** Mental fatigue is a frequently occurring symptom after an acquired brain injury, irrespective of severity. Such mental fatigue may become a long-lasting problem, irrespective of severity and even after recovery from other neurological or psychiatric symptoms. People struggle to return to work and also in their efforts to find a balanced workload which is sustainable over a longer period. Today, fatigue is assessed with subjective scales and it has been proven difficult to measure fatigue objectively. Traditionally, neuropsychological tests measure cognitive functions at a single time-point and do not take into account changes in cognitive performance over time.

**Method** The intention of this study was to investigate whether it is possible to measure mental fatigueability using a test and re-test design. This study included 32 controls with no mental fatigue and 42 well rehabilitated participants who suffered from long-term mental fatigue following stroke, traumatic brain injury, encephalitis or meningitis and late effects after brain tumor.

**Results** The repeated analysis comparing pre- and post-test showed significant interaction effects for tests measuring processing speed, working memory and attention. The control group improved, while the mental fatigue group remained on a similar level, or showed a tendency to decline.

**Conclusions** This study indicates impaired cognitive performance during an extended test session for those suffering from mental fatigue after an acquired brain injury, and this may have critical implication for managing ordinary living. Mental fatigue is challenging for both health-care professionals and patients, and it is an important research field.

4. The influence of attention training on learning and memory after acquired brain injury

*Gabriela MARKOVIC, Institution of clinical sciences, KIDS, Aniko BARTFAI, Institution of clinical sciences, KIDS, Simon NUSS, Psychiatric Outpatient Care, Karlstad, Sweden*

**Introduction** Common symptoms after acquired brain injury (ABI) include cognitive dysfunctions affecting attention and memory. Current understanding of brain plasticity supports cognitive training specific to the dysfunction, whether training is restorative or compensatory in nature. Attention dysfunction may improve with targeted training. As there
is a close link between attention and memory, it is of importance to analyze the transfer effect of attention training on learning and memory after an ABI.

**Method** A randomized control trial of 29 patients with ABI undergoing Attention Process Training (APT) and 30 patients activity-based attention training within four months post-injury with neuropsychological testing pre- and postintervention and at six months follow-up. The outcome measure, Rey Auditory Verbal Learning Test was analyzed to evaluate the influence of attention training on verbal memory and attention lapses during learning.

**Results** Substantial improvement in verbal memory was confirmed in both groups (p<.001). The results did not differ between the interventions at follow-up ($\chi^2(1, N=52) = 35.976, p=.331$). Attention lapses during learning were significantly reduced at follow-up for the group receiving APT (p=0.001).

**Conclusions** APT resulted in a more stable learning process than activity-based attention training without affecting immediate and delayed recall. The results indicate that attention training has limited transfer effect on learning and memory. It does however have a positive effect on the stability of the learning process. These findings give a closer understanding of the transfer effect of attention training to different aspects of memory function.

**5. A cohort study of presence of neglect sub-acute and 7 years post-stroke**

Joel GERAFI, Department of Psychology, Faculty of Social Sciences, University of Gothenburg; Hans SAMUELSSON, Department of Psychology, Faculty of Social Sciences, University of Gothenburg; Christina JERN, Institute of Biomedicine, The Sahlgrenska Academy, University of Gothenburg; Christian BLOMSTRAND, Institute of Neuroscience and Physiology, The Sahlgrenska Academy, University of Gothenburg, Katarina JOOD, Institute of Neuroscience and Physiology, The Sahlgrenska Academy, University of Gothenburg / Department of Neurology, The Sahlgrenska University Hospital

**Introduction** The presence of visual neglect following stroke has often been described during the first year after stroke but the frequency of neglect several years after stroke has not been systematically studied. The aim of the present study was to investigate presence of neglect at the sub-acute stage and 7 years after the stroke.

**Methods** A longitudinal study was conducted for a cohort of stroke survivors consecutively recruited from one stroke unit in the Sahlgrenska Academy Study of Ischemic Stroke (SAHLSIS). Presence of neglect at the early stage and at 7 years post-stroke was assessed by conventional cancellation tests. Possible predictors of neglect at follow-up were also investigated. Patients with a recurrent stroke during the follow-up were excluded leaving a total of 233 stroke survivors included in the study (mean age 53.8 ±10.6 at index stroke).

**Results** At the early stage post-stroke 49 (21%) had non-lateralized inattention and 33 (14%) had lateralized neglect. In the same type of tests administered at 7 years post-stroke, 19 (8%) exhibited non-lateralized inattention and 14 (6%) had lateralized neglect. Of 33 participants with lateralized neglect at the early stage 31 had follow-up data from cancellation tests and of those 86% had recovered to no symptoms (70%) or non-lateralized inattention (16%).
Conclusions For a large consecutive cohort of stroke patients, the presence of lateralized neglect in cancellation tests 7 years post-stroke was about half of the frequency observed at the early stage.


6. Perceived injustice after mild traumatic brain injury

Kaisa MÄKI, Clinical Neurosciences, University of Helsinki and Helsinki University Hospital; Taina NYBO, Clinical Neurosciences, University of Helsinki and Helsinki University Hospital; Marja HIETANEN, Clinical Neurosciences, University of Helsinki and Helsinki University Hospital; Susanna MELKAS, Clinical Neurosciences, Helsinki University and Helsinki University Hospital

Introduction: Perceptions of injustice are known to be associated with psychiatric symptoms after musculoskeletal injury. Less is known about perceived injustice after mild traumatic brain injury (mTBI). The purpose of this study was to examine self-reported perceived injustice in a cohort of mTBI patients in comparison with orthopedic controls.

Method: Patients with mTBI (n=61) and orthopedic controls (n=19) completed self-report measures assessing perceived injustice (IEQ), post-concussion symptoms (PCL-C), depressive symptoms (BDI-II), fatigue (BNI), resilience (RS14), and perceived social support (modified MOS-SSS) 3 months after injury.

Results: The mTBI group reported more post-concussion symptoms than controls. There were no statistically significant differences in perceived injustice between the mTBI and control groups, neither did the two groups differ in any of the other measures. In the mTBI group, perceived injustice had significant positive correlations with post-concussion symptoms, fatigue, depressive symptoms, post-traumatic stress symptoms (r = .578 to .759, p< 0.01), and significant negative correlations with resilience and perceived social support (r = -.354 to -.362, p< 0.01). In the control group, greater perceived injustice was associated with greater post-traumatic stress symptoms (r = .839, p< 0.01) and lower resilience (r = -.469, p<0.05).

Conclusions: Symptom endorsement for perceived injustice was similar in mTBI patients and controls with orthopedic injuries. In the mTBI group greater perceived injustice was associated with greater post-concussive symptoms, fatigue, psychiatric symptoms, and lower resilience and perceived social support. The data will be analyzed further to examine the association between perceived injustice and clinical outcomes following mTBI.

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Neuropsychology in adults and in the elderly

1. Is physical fitness associated with better mental health, cognition and brain structure in middle aged and older adults?

Asta HABERG, St. Olavs hospital, Norway

Introduction Decreasing levels of physical fitness in the population is a major public health concern, and may also affect brain function. Physical fitness is measured with variable methodology from self-report, estimated based on clinical measures such as resting heart rate and waist circumference, as well as objectively as VO$_2$, i.e. the maximum or peak amount of oxygen that a person can utilize during maximal exercise. Physical fitness is associated with a number of favorable physiological changes in the body e.g. a more ideal weight and reduction of cardiovascular disease risk factors, which may exert their own effect on brain function and structure independent of physical fitness.

Method To gain an understanding of the unique contribution of physical fitness, versus general health factors, on mental health, dementia risk, changes in cognition over time and the brain’s grey and white matter we have studied two cohorts: the general populations based Health Survey of North Trøndelag and a subsample participating in the randomized intervention study Generation 100.

Results We find that physical activity almost three decades earlier reduces the risk of dementia particularly in those suffering from psychological stress when younger. Further, persisting or increasing physical activity is associated with larger brain volumes in middle age. Increasing VO2 exerts a unique effect on brain structure, independent of factors such as cardiovascular risk factors and waist circumference. Physical activity even at low levels appear to have a longer window of opportunity for exerting positive effects on brain function and structure in contrast to several other risk and beneficial factors.

Conclusions Aerobic capacity has a unique positive effect on the brain, and physical activity offers an opportunity to modify risk factors associated with reduced brain structure and function from early adulthood into old age.

2. Working and declarative components of subjective memory impairment in dementia: a population-based HUNT study

Ove ALMKVIST, Karolinska Institutet, Dept NVS, Stockholm, Sweden

Introduction Self-reported memory concern is a common symptom in elderly individuals that may predict neurocognitive disorder/dementia as documented in previous research, although contradictory results exist. This study investigated the predictive power of working and declarative aspects of subjective memory in dementia compared to normal aging.

Methods All patients in Nord-Trøndelag county in middle Norway diagnosed with dementia after a hospital-based examination were included in the study (n=117) together with an individually matched group of normal elderly individuals (n=117). All participants had completed the Meta-Memory Questionnaire (MMQ) in the HUNT third wave epidemiological
health survey. Age varied from 53 to 93 years. The MMQ test was divided into two components, one associated with declarative memory, i.e., episodic and semantic, and another associated with working memory. The study was approved by the Regional Ethics Committee.

Results. A MANOVA with the two MMQ components as within-subject factor and group (demented vs. normal elderly) as between-subject factor showed that demented and normal elderly individuals differed significantly in subjective memory in favor of the normal elderly group (p<0.001), that the components differed significantly showing more impairment in the working memory component (p<0.05) and that the group-by-component interaction was significant with a larger component difference in the demented group (p<0.05). Demographic characteristics (age, gender and education) were not analyzed because groups were matched. Adding depressive symptoms as a covariate did not change the pattern of results.

Conclusion. Unexpectedly, self-reported impairment in working memory, rather than declarative memory, differentiated dementia from normal aging.


3. Concurrent validity of the Barrow Neurological Screen for Higher Cerebral Functions (BNIS) at the chronic stage post-stroke

Karin JONASSON, Section for Rehabilitation Medicine, Uddevalla Hospital, NU Hospital group, Sweden; Lina-BUNKETORP-KÄLL, Center for Brain Repair and Rehabilitation, Department of Clinical Neuroscience, Institute of Neuroscience and Physiology. The Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden/Center for Advanced Reconstruction of Extremities C.A.R.E. Institute of Clinical Sciences, Sahlgrenska University Hospital/Mölndal, Sweden; Åsa LUNDGREN-NILSSON, Center for Brain Repair and Rehabilitation, Department of Clinical Neuroscience, Institute of Neuroscience and Physiology. The Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden/Stroke Centre West. Department of Clinical Neuroscience, Institute of Neuroscience and Physiology. The Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden; Karin BLOMVĒ, Occupational Health Care Unit (Hälsan och Arbetslivet), Region Västra Götaland, Gothenburg, Sweden; Marcela PEKNA, Center for Brain Repair and Rehabilitation, Department of Clinical Neuroscience, Institute of Neuroscience and Physiology. The Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden / Florey Institute of Neuroscience and Mental Health, Parkville, Melbourne, Australia/Hunter Medical Research Institute (HMRI) and University of Newcastle, Newcastle, Australia; Milos PEKNY, Center for Brain Repair and Rehabilitation, Department of Clinical Neuroscience, Institute of Neuroscience and Physiology. The Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden/Florey Institute of Neuroscience and Mental Health, Parkville, Melbourne, Australia /Hunter Medical Research Institute (HMRI) and University of Newcastle, Newcastle, Australia; Christian BLOMSTRAND, Center for Brain Repair and
Introduction Post-stroke cognitive impairments have a negative impact on the patient’s independent functioning. The Barrow Neurological Screen for Higher Cerebral Functions (BNIS) has indicated a high prevalence of cognitive impairment at a chronic stage post-stroke. However, the validity of the BNIS as a test of cognitive functions late after stroke has not yet been fully established. The aim of this study was to determine concurrent validity for BNIS in a stroke sample late after stroke.

Methods Spearman correlation was used to examine associations between BNIS (total score and subscale) and other neuropsychological tests measuring attention, processing speed, working memory and visual memory. The data are baseline assessments from a recent rehabilitation study and the participants (n=123) had suffered a stroke > 10 months and < 5 years before testing.

Results The BNIS Total Score was significantly (p-values <.05) associated with all the neuropsychological tests and the strongest associations were observed with the visual processing speed, working memory and attention (absolute correlation values ranging between .61 to .68). For the BNIS subdomains, the strongest correlations with these three neuropsychological tests were observed for the subscales Language (.40 to .60), Attention (.47 to .56), Visuospatial function (.36 to .50) and Memory (.47 to .56).

Conclusions The results show that BNIS is a valid screening test of cognitive functions in the chronic stage after stroke.

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4. Neuropsychological interventions of adult dyslexia improve cognitive functioning in both individual and group format – results from an RCT study

NUKARI Johanna, Rehabilitation Foundation, Helsinki, Finland; POUTIAINEN Erja, Rehabilitation Foundation, Helsinki, Finland / Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Finland, ARKKILA Eva, Department of Otorhinolaryngology and Phoniatrics, Head and Neck Surgery, Helsinki University Hospital
Introduction The purpose of this study was to evaluate the effectiveness of a relatively short individual or group based neuropsychological intervention for young adults on cognitive aspects of dyslexia. The intervention consisted of 12 sessions and focused on strategy learning, supporting self-esteem, using psychoeducation and in group format also peer support.

Method 120 dyslexic young adults (between 18-35 years) were randomized into individual intervention, group intervention or wait-list control group. Psychometric testing and self-report questionnaires were used to assess cognitive symptoms at baseline, after the intervention/wait-list control time at five months and at ten months. Long-term status was checked via mailed inquiry 15 months post intervention.

Results Both interventions had a positive effect on processing speed and attention compared to the control group (p = 0.024). The effect remained five-months after the intervention. In self-reported cognitive symptoms, a positive trend was evident in self-reported reading habits and minor self-evaluated benefits reached up to 15 months post intervention. There were no significant differences between the results of individual and group interventions.

Conclusions Both individual and group based neuropsychological interventions improved the cognitive performance of dyslexic young adults and the effects were still evident after follow-up. Neuropsychological interventions should be administered also to adults who struggle with dyslexia.

Grant Support: This study was supported by the Social Insurance Institution of Finland.
Method 52 patients consecutively included after meeting diagnostic criteria for NPH surgery were given the MMSE and the Symbol Digit Modality test (SDMT) several days in advance of surgery. One year later, a postoperative clinical evaluation included a repeated testing. Selected patients and relatives were interviewed about their subjective experience of benefit.

Results For patients tested one year post surgery, only one patient scored lower on the MMSE and the median score rose from 22.5 to 25.5. On the SDMT test, only four patients scored lower and the median score rose from 12.5 to 15.

Conclusions It is concluded that even patients with a very low pre-operative score on dementia rating scales have a high probability of improving their post-operative cognitive functioning despite the fact that slight deterioration might otherwise have been expected. On interviewing patients and relatives, their evaluations related in particular to gait function and social functions. The SDMT is recommendable for evaluating cognitive function in patients with NPH as it is less strenuous for elderly patients and yields comparable results to the MMSE.
1. Neural correlates of working memory storage for signs with poor visual resolution

**ANDIN Josefine, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University; HOLMER Emil, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University; STENBÄCK Victoria, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University; RUDNER Mary, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University**

**Introduction** In a recent study (Rudner et al., 2015), we showed that, in a sign-based working memory (WM) task, poor visual stimulus resolution had a negative effect on performance that was greater when WM load was higher. This is analogous to the effect of signal degradation on auditory verbal WM. Here we investigate whether cross-modal similarity in behavioural results extends to WM storage mechanisms in the parietal lobes in deaf signers and hearing non-signers.

**Method** During functional Magnetic Resonance Imaging (fMRI), Swedish deaf early signing (DES) and hearing non-signing (HNS) participants performed an n-back WM task based on signs lexicalized in Swedish Sign Language. Load was manipulated at 3 levels (n=1-3) and the visual resolution of the stimuli was either high or low and manipulated orthogonally. To capture storage mechanisms of WM, data was analysed using small volume correction including Brodmann area 5, 7 and 40 of the parietal lobe.

**Results** Preliminary results based on 7 DES and 6 HNS showed a significant main effect of load in right superior parietal lobe (rSPL). Neither group showed any main effect of visual resolution but DES showed a significant interaction between load and visual resolution in the left inferior parietal lobe (lIPL).

**Conclusions** The expected effect of WM load on parietal storage mechanisms was found in both groups. The interaction found for DES suggests that visual resolution modulates the effect of load in language processing regions when signs are meaningful, possibly relating to cross-modal plasticity in auditory cortex in DES (cf Cardin et al., 2017).

This work is supported by grant number 2015-00929 to Mary Rudner from the Swedish Research Council.

2. Open feasibility study: NAVIGATOR ACT for parents to children of Autism Spectrum Disorders (ASD) and/or other disabilities

**BERG, B.; HOLMBERG BERGMAN, T.; REHNHORN, E.; HIRVIKOSKI, T., Karolinska Institutet (KIND)**

**Introduction** Parents of children with disabilities report high amounts of psychological distress, e.g., depression, anxiety and parenting stress. However, there are only a few evidence based interventions. An Acceptance- and Commitment Therapy (ACT)- based,
manualized group intervention was developed at Habilitation & Health, the disability services in Stockholm, Sweden. The aim of this study is to evaluate the feasibility of the 5-session Navigator ACT.

**Method** 94 parents were allocated to treatment. The criteria for good feasibility was defined as 75% of the parents participating in at least 4/5 sessions. Parent satisfaction was measured by session evaluations. Pre, post and 3-month follow-up was conducted to collect distress-related measures.

**Results** 80% of the parents attended at least 4/5 sessions. Treatment satisfaction was good and stable over the five sessions. The preliminary efficacy measures showed statistically significant increases in psychological/behavioral flexibility and mindfulness skills as well.

**Conclusions** The Navigator ACT is a feasible intervention in the outpatient disability services context. Promising results regarding preliminary efficacy were observed. We are currently conducting a pragmatic multi-center randomized controlled trial including several disability services clinics in Sweden.

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3. Internet-based rehabilitation for persons with mild acquired cognitive impairment

**Inga-Lill BOMAN, Azra RAMOVIC; Pia Linde RUNESKOG; Caroline DALFORS; Anders ELDH; Aniko BARTFAI, Department of Clinical Sciences, Division of Rehabilitation Medicine, Karolinska Institutet, Stockholm, Sweden / Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden**

**Introduction** Internet-based rehabilitation allows an increased flexibility, possibilities to integrate it with everyday life and work, and less time devoted for transport. Studies have showed that internet-based interventions with therapist support are effective for a range of symptoms and require less therapist time. Internet-based rehabilitation is lacking for persons with acquired cognitive impairment in Sweden. The aim of this project was to develop an internet-based rehabilitation programme for patients with mild acquired cognitive impairment to support them to develop self-management skills to manage problems in everyday life.

**Method** The internet-based rehabilitation programme was based on evidenced-based cognitive rehabilitation methodology. The programme was developed in an iterative process by neuropsychologists, occupational therapists, speech and language therapist, physiotherapist and input from patients with mild acquired cognitive impairment.

**Results** A 10-week programme entitled eRehab was developed. eRehab included the following 10 modules: brain and mild cognitive impairment, attention, memory 1, memory 2, executive function, mental fatigue, stress and sleep, emotions, communication and summary. Modules contained information, tools and strategies, homework tasks and questionnaires. There were also video clips demonstrating basic body awareness techniques and persons with cognitive impairment reporting of its consequences in everyday life and
chat. Homework tasks were developed to help patients to recognize problems, which might occur in connection with mild acquired cognitive impairment, and to identify and practice strategies that can support them to function more effectively. In addition patients receive weekly-personalized feedback about completed homework tasks. To access to eRehab patients and therapists log in with electronic ID via www.1177.se.

Conclusions A feasibility study with 10 patients with acquired cognitive impairment is in progress.

Grant support Innovationsfonden, Stiftelsen Back2Life, and VINNOVA supported the project.

4. Self-reported memory on attention/working memory predicts objective memory performance in healthy elderly: A HUNT study

Ole BOSNES1; Ove ALMKVIST2-3; Ingunn BOSNES1-4; Eystein STORDAL1,

1Namsos Hospital, Nord-Trøndelag Hospital Trust, Norway; 2Department of Neurobiology Care Sciences and Society, Karolinska Institutet, Stockholm, Sweden; 3Department of Psychology, Stockholm University, Stockholm, Sweden 4Department of Psychology, Norwegian University of Science and Technology (NTNU), Trondheim, Norway; 5Department of Mental Health, Norwegian University of Science and Technology (NTNU), Trondheim, Norway

Introduction A previous study showed that the Meta Memory Questionnaire (MMQ), an instrument to measure subjective memory included in the HUNT3 Survey, consists of one component related to long term memory (component I) and the other related to attention and working memory (component II). However, the ability of the MMQ to predict objective memory is unknown.

Method A sample of participants in HUNT3 aged 55-89 (n=106), who had all answered the MMQ, completed the WAIS-III and the WMS-III. Performance on three subtests of objective memory were compared to total and component scores on the MMQ.

The study was approved by the Regional Ethics Committee.

Results Linear regression analyses revealed that component II of the MMQ was a significant predictor of objective memory. Single items linked to component II (For example item 9:“Do you have problems remembering what happened a few minutes ago”, and item 3:”Do you have problems keeping track of a conversation?”) were significantly associated with Vocabulary and Letter-Number Sequencing performance, respectively. In contrast, no item linked to component I (for example item 1:”Do you have problems with your memory”, and item 2:”Do you have problems remembering names of other people?”) was significantly associated with objective memory performance.

Conclusions In healthy elderly individuals component II of MMQ predicted objective memory performance, while component I and total score on MMQ did not. Consequently MMQ total and component I scores should not be trusted as valid indicators of objective memory.
5. A comparative study of simple and interference reaction times in men and women

Martin BRANDBERG, University of Gothenburg, Department of Psychology; Elisabeth Kenne SARENMALM, Research and Development Centre Skaraborgs Hospital; Hans SAMUELSSON, University of Gothenburg, Department of Psychology; Stefan WINBLAD, University of Gothenburg, Department of Psychology

Introduction Studies on reaction time (RT) indicate faster reactions for men than women. However, when comparing samples across decades, this difference seems to decrease. The aim of this study was to explore reaction times in a large contemporary sample of adult males and females (age range = 15-82).

Methods Simple reaction time and interference reaction time (a go/no go reaction task) were measured with the Vienna Reaction Apparatus (Wiener Reaktionstest, Schuhfried), RT, version S1 and S2 for simple reaction time and version S3 and S4 for interference reaction time.

Results Men responded faster on the interference reaction task, S3 (M=441.57, SD=80.86) than women (M=461.53, SD=91.53). This difference was significant, t(3.7) = p<0.001 and represent a small sized effect, d=.21. There were no significant differences regarding simple reaction time (S1 and S2) or on the other interference task (S4). In regards to intraindividual variability there was a significant difference, t(3.1), p=.002, d=.21, with less variability in males (M=65.99) as compared to females (M=70.45) on S3.

Conclusions When comparing groups, men performed slightly faster on one of the interference tasks. However, there were no significant differences on the other measures. This result is consistent with previous studies indicating a decrease in differences on reaction times, comparing men and women.

Grant support Skaraborg Research and Development Council, Research Fund at Skaraborg Hospital and The Swedish Stroke Association.

6. The reactivity as well as activity of the hpa-axis in children towards exercise interventions

Henning BUDDE, Faculty of Human Sciences, Medical School Hamburg, Hamburg, Germany

Introduction The stress-buffering hypothesis suggests that physically trained adults show lower cortisol (C) responses to physiological exercise stressors. Effects may be found for cortisol responses to acute stressors (HPA axis reactivity) as well as to chronic effects (HPA axis activity). The present research examined cortisol awakening response (CAR) and HPA axis reactivity in adolescents and children.

Methods To investigate C reactivity primary (n=53, mean age 9.8) and high school students (n=121, mean age 14.6) were randomly assigned to a physical stress or control task. Participants’ physical activity status (PAS) was assessed before intervention using a questionnaire.
To investigate physical fitness effects on C activity, a 10-week exercise program (3 x 45 min a
week) with children (9-10 years) was performed. Participants were assigned to a
cardiovascular exercise (CE, n=27), motor exercise (ME, n=23), or control group (n=21,
home work sessions).

Salivary C concentration (reactivity) and CAR (activity) were measured prior and after the
interventions.

Results Cortisol reactivity to physical exercise stress is not dependent on age or PAS in these
young age groups. We could not confirm the stress-buffering hypothesis for children and
adolescents.

Participants in CE who enhanced their cardiovascular fitness after intervention showed an
increased cortisol activity ($B=0.213$), whereas children in ME who gained in motor fitness
exhibited a decreased CAR ($B=-0.188$).

Conclusions The findings suggest age-dependent cortisol patterns with reduced endocrine
stress activity and reaction in children and young adolescents. This may be attributed to a
yet developing HPA axis in childhood.

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7. On the Relation between Dimensions of Fatigue and Depression in Adolescents and
Young Adults with Acquired Brain Injury

DORNONVILLE DE LA COUR Frederik Lehman; FORCHHAMMER Hysse Birgitte; NORUP Anne,
National study of young brain injury survivors, Department of Neurology, Rigshospitalet,
Copenhagen University Hospital, Denmark / Brain Injury Centre BOMI, Denmark / The Unit
for Cognitive Neuroscience (UCN), Department of Psychology, University of Copenhagen,
Denmark; MOGENSEN Jesper, The Unit for Cognitive Neuroscience (UCN), Department of
Psychology, University of Copenhagen, Denmark

Introduction Complaints of fatigue following acquired brain injury (ABI) are often associated
with depression. However, the nature of this relationship is unclear. Furthermore, research
among young patients with ABI is limited. The objectives of this cross-sectional study were
(1) to investigate levels of fatigue and depression in young outpatients with ABI (15-30 year
old) and (2) to determine how different dimensions of fatigue relate to symptoms of
depression.

Method Fatigue was assessed in five dimensions with the Multidimensional Fatigue
Inventory (MFI-20): General Fatigue (GF), Physical Fatigue (PF), Mental Fatigue (MF),
Reduced Motivation (RM), and Reduced Activity (RA). Symptoms of depression were
assessed with the Major Depression Inventory (MDI). Mann-Whitney U-tests and multiple
regression analyses were conducted.

Results The patient group (n=105), on average 23.7 year old (SD=4.2) and 31 months post-
injury (SD=61), had elevated levels of fatigue and depression compared to a convenience
sample of 160 healthy controls (all $p’s<.001$). Controlling for shared variance in multivariate
analyses, the predominantly mental dimensions of fatigue, GF, MF, and RM, were independently associated with MDI (all $p's<.01$), while the physical dimensions, PF and RA, were not.

**Conclusions** Fatigue and depression are common and related symptoms in young patients with ABI. However, distinctions within the concept of fatigue (mental/physical fatigue) may be important in relation to depression, and future research could benefit from adopting a multidimensional approach in the development of more targeted and effective treatments of fatigue and depression following ABI.

**Grant Support** The work was supported by the Danish Ministry of Health.

8. Changes in cognitive abilities in patients with bacterial meningitis

*Margus ENNOK, Department of Neurology and Neurosurgery, University of Tartu; Margit LILL, Neurology Clinic of Tartu University Hospital; Pille TABA, Department of Neurology and Neurosurgery, University of Tartu*

**Introduction** Bacterial meningitis (BM) is a rare and severe disorder with a high mortality rate. Previous studies have described a lowered ability levels in survivors of BM in various cognitive domains. In children these impairments can persist into adolescence and adult life. The aim of our study is to observe changes in cognitive abilities in a group of adult BM patients in a post-acute state and about 1-2 years later.

**Method** Sample includes 9 BM patients (5 women, 4 men) with mean age of 59.2 years (range 25-78 years) and mean education of 11.3 school years (range 4-16 years). The mean intertest interval was 500.6 days (range 388-847 days). All patients were administered a battery of tests assessing attention (Stroop test, Trail Making test, Bourdon-Wiersma test), memory (Digit Span, Auditory Verbal Learning test, Rey-Osterrieth Complex Figure), visuospatial (Money Road Map test, Judgment of Line Orientation test) and executive abilities (Wisconsin Card Sorting Test, verbal fluency, 5-point test).

**Results** Performance in most of the tests was rather stable. In the attention domain the performance of Stroop test became faster (part 2: $Z=-2.43$, $p<.015$; part 3: $Z=-2.07$, $p<.038$) but in Trail Making test part B it became slower ($Z=-2.37$, $p<.018$). Some improvements were also observed in Auditory Verbal Learning test (sum score: $Z=-2.08$, $p<.037$; delayed recall: $Z=-2.06$, $p<.04$), Judgment of Line orientation ($Z=-2.25$, $p<.024$) and verbal fluency ($Z=-2.20$, $p<.028$).

**Conclusions** In adult survivors of BM the ability level in various cognitive domains remains rather stable in comparison of post-acute state and short-term outcome. Differences in cognitive skills over time are more individual in nature.
9. Motor imagery in relation to movement planning in 6-year-old children with autism spectrum disorder

JOHANSSON, Anna-Maria, Department of Psychology, Umeå University; BÄCKSTRÖM, Anna, Department of Psychology, Umeå University; RÖNNQVIST, Louise, Department of Psychology, Umeå University; ROSANDER, Kerstin, Department of Psychology, Uppsala University; VON HOFSTEN, Claes, Department of Psychology, Uppsala University, DOMELLÖF, Erik, Department of Psychology, Umeå University

Introduction The ability to engage in motor imagery (MI) has been shown to be deviant in children with autism spectrum disorder (ASD). Less is known about how MI ability relate to goal-directed action planning in these children.

Method Twenty-four 6-year-old children (N_{ASD}=12, M_{Age}=6.6) participated. MI was investigated using a computerized hand laterality judgement (HLJ) task utilizing back-of-hand images oriented at 6 rotational angles (0-300˚). The task was to judge if a left or right hand was presented. Response durations (RDs) on the HLJ-task were compared with movement initiation latency times (MILs) derived from a peg rotation (PR) task consisting of fitting a semicircular peg into a semicircular target oriented at 4 rotational angles (0-270˚) with differing biomechanical constraints.

Results Five children in the ASD-group and 10 controls performed above chance on the HLJ-task (i.e. showing MI ability). For these, RDs were longer in the ASD-group (M=5966ms) than controls (M=4093ms), and longer for larger than smaller angle increments. In the PR-task, the ASD-group displayed longer MILs than controls for all rotational angles. Children with ASD who failed the HLJ-task had longer MILs (M=804ms) than those performing above chance level (M_{ASD}=404ms, M_{Controls}=349ms). The difference was evident for all angles compared with controls, and for the largest angle increments within the ASD-group.

Conclusions The slower RDs and the angular increment effect on the HLJ-task suggest inefficient but functional MI in ASD. For children with ASD failing the HLJ-task, MILs in the PR-task were longer and with a biomechanical effect indicating mental movement simulation. For children with ASD who showed MI ability, the PR-task appeared less demanding for action pre-planning as shorter MILs and lack of rotational increment effect (i.e. no biomechanical effect) were observed. Better MI ability may thus relate to improved online motor control and functional performance.

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10. Reliability of neuropsychological testing by videoconferencing

KAAE, Henriette H. (Neuroenhed Nord, Regionshospital Nordjylland, Danmark); GULDBORG, Cilla (Neurologisk afdeling, Aalborg Universitets Hospital); SØRENSEN, Stine T., Riis, Jens Ø.

Introduction The use of videoconferencing in neuropsychology are more common, as it can reduce costs, and help provide better treatment and rehabilitation to rural populations. Generally, there is a lack of empirical studies in this field and most existing studies have primarily focus on patients with dementia. This study was conducted to determine the
reliability of neuropsychological tests administered over videoconference to patients with acquired brain injury.

Method  20 patients recruited from an inpatient neurorehabilitation centre. All completed The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and Block Design from Rigshospitalet in two conditions: face-to-face and videoconferencing. Afterwards the patients rated the experience on a questionnaire. The scores in the two conditions were compared using Intraclass Correlations (ICC) and limits of agreement (95%).

Results  All ICC were between moderate to excellent (.73-.94) and all significant. The tests requiring a motor response had the best ICC (.87-.94). Verbally mediated tests had an agreement between moderate to excellent ICC (.73-.94) and visually mediated tests a good agreement ICC (.76-.83). Patients were generally satisfied with the test form and felt overall comfortable. 40 % of the patients reported to have never tried videoconferencing of any kind before.

Conclusions  Results on tests that required motor responses suggest good to excellent agreement between the two conditions. Results on verbally and visually mediated tests were more sensitive to learning effect and random error, which may have affected the results. Overall, the findings support that video-based psychological testing is a reliable alternative to face-to-face testing in patients with acquired brain injury.

Grant Support  None.

11. Childhood ADHD symptoms and executive functioning at 40 years in a cohort with perinatal risks

KORHONEN Nella, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki; VIRTA Maarit, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki; LEPPÄMÄKI Sami, Helsinki University Central Hospital; LAUNES Jyrki, Faculty of Medicine, University of Helsinki; JÄRVINEN Ilkka, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki; IMMONEN Satu, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki; MICHELSSON Katarina, Children’s Hospital, University of Helsinki; HOKKANEN Laura, Faculty of Medicine, Department of Psychology and Logopedics, University of Helsinki; Introduction  Deficits in executive functions (EF) are considered central in adult ADHD and seem to persist from childhood to adulthood. The present study examines adulthood performance in EF tasks in a perinatal risk cohort with different levels of childhood ADHD symptoms.

Method  The participants (n = 376) belong to a longitudinally studied cohort with perinatal risks assessed at 40 years of age. The cohort was divided into three groups according to ADHD symptom level in childhood: high-ADHD, medium-ADHD and low-ADHD. A control group followed from birth was also studied (n = 70). EF was assessed with Trail Making Test B (TMT-B), Stroop Test and Verbal Fluency Test.

Results  The groups differed in verbal fluency total score \[H(3) = 14.06, p = .003, d = .31\]}, and completion times for TMT-B \[H(3) = 10.03, p = .018, d = .25\] and Stroop interference task \[H(3) = 8.01, p = .046, d = .21\]. The high-ADHD (Mdn= 41, p = .009) and medium-ADHD (Mdn= 44, p = .015) groups scored lower than controls (Mdn= 48) on verbal fluency. The high-
ADHD group (Mdn = 63.5) had longer completion times than controls (Mdn = 55) on TMT-B (p = .024).

**Conclusions** As anticipated, childhood ADHD symptoms were associated with deficits in EF tasks in midlife. No differences were found between controls and participants with low childhood ADHD symptoms suggesting perinatal risks per se are not associated with EF in midlife.

**Grant Support** The research was supported by grants from the Finnish Cultural Foundation and Alfred Kordelin Foundation.

### 12. Face recognition when children learn to read

Christina D. KÜHN, University of Southern Denmark; Inge L. WILMS, University of Copenhagen; Christian GERLACH, University of Southern Denmark; Randi STARRFELT, University of Copenhagen

**Introduction** Face and word recognition are generally assumed to rely on highly specialized and relatively independent areas in the adult brain lateralized to the right and the left hemisphere, respectively. Recently it has been proposed that the development of these cognitive processes might not be as independent as previously assumed, and that learning to read may drive the lateralization of the face processing system to the right hemisphere. One behavioral question remaining is whether learning to read affects face recognition ability. We hypothesize that learning to read could reduce face recognition ability during the initial learning phase while the brain reorganizes to meet the challenges of learning a new skill and obtaining a greater efficiency in the long run.

**Method** 82 children, 5 to 6 years old, from two Danish schools were included in this study. They were tested twice approximately 8 months apart, in the beginning and in the end of first grade (Danish grade 0). At both sessions they were given a new test for immediate face recognition and tasks for visual letter and word recognition.

**Results** The children improved their letter and word recognition during their first year of school as expected, but overall their face recognition ability also improved during this period. Reliability of the face test is discussed.

**Conclusions** We found no overall negative behavioral effect of reading acquisition on face recognition ability during first grade. This may be because a negative effect occurs earlier or later during reading acquisition.

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13. Longitudinal associations between cognitive functioning and distress among community-based elderly in Hong Kong

LEUNG Chantel Joanne, Laboratory of Neuropsychology, The University of Hong Kong, Hong Kong/ Institute of Clinical Neuropsychology, The University of Hong Kong, Hong Kong/ Institute of Psychiatry, Psychology and Neuroscience, King’s College London, United Kingdom; CHENG Lewis, Laboratory of Neuropsychology, The University of Hong Kong, Hong Kong/ Institute of Clinical Neuropsychology, The University of Hong Kong, Hong Kong; YU Junhong, Laboratory of Neuropsychology, The University of Hong Kong, Hong Kong/ Institute of Clinical Neuropsychology, The University of Hong Kong, Hong Kong; YIEND Jenny, Institute of Psychiatry, Psychology and Neuroscience, King’s College London, United Kingdom; LEE Tatia M. C., Laboratory of Neuropsychology, The University of Hong Kong, Hong Kong/ Institute of Clinical Neuropsychology, The University of Hong Kong, Hong Kong/ The State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, Hong Kong

Introduction The cross-sectional relationship between cognitive impairment and psychological distress has been extensively studied. But findings related to their longitudinal associations remain to be mixed. The current study investigates the longitudinal and bidirectional associations between cognitive functioning and psychological distress across six months among community-dwelling elderly in Hong Kong.

Method Objective and subjective measures of cognitive functioning, as well as self-reported distress ratings were administered to 162 older adults (40 males; $M_{age} = 69.8$ years, $SD = 6.4$), at two time points. The cross-lagged relationships between cognitive functioning and distress were examined using structural equation modeling.

Results Our cross-lagged model demonstrated that baseline cognitive functioning significantly predicted subsequent psychological distress but not vice versa. In addition, the objective and subjective measures of cognitive functioning were not significantly correlated.

Conclusions The results suggested that psychological distress appears to manifest as a consequence of poorer cognitive functioning. The lack of correlation between objective and subjective cognitive measures implied participants’ inadequate insight into their cognitive abilities, which may be related to their subsequent distress. Our findings underscore the need for mental health professionals to enhance older adults’ sense of self-efficacy and insight into their cognitive functioning.

14. Towards a bidirectional relationship between executive functions and academic learning

Daniela MARQUES, University el Bosque, Colombia; Ramon CLADELLAS, Autonomous University of Barcelona, Spain; Gonçalo JACINTO, University of Evora, Portugal; Antoni CASTELLÓ, Autonomous University of Barcelona, Spain; Yeraldin CUARTAS, University el Bosque, Colombia; Juan Peña, University el Bosque, Colombia

Introduction Weiland and Yoshikawa (2013), have shown that the intervention in academic skills are related with better outcomes in executive functions. It is known that executive functions impact the learning process. This suggests that exists a bidirectional relationship
between executive functions and academic achievement. This research contributes to the establishment of the indicators for a possible bidirectional relationship between executive functions and academic learning.

**Method** The research examined the performance of 138 subjects from public and private schools in Bogotá, Colombia. We applied the following instruments: Raven’s Progressive Matrices, Child Neuropsychological Assessment (ENI), Porteus Maze, ENFEN – anillas and senderos, Stroop and Rey-Osterriet Complex Figure.

**Results** We use simple and partial correlations and determine possible directions for the bidirectional relationship between executive functions and academic achievement. Our results show high significant correlations between inhibition, attention, cognitive flexibility and academic achievement. This could be a strong indicator that the aforementioned skills could impact and be impacted by the learning process.

**Conclusions** We establish directions towards a bidirectional relationship between executive functions and academic achievement. This possible relationship could allow curriculum adaptations that could involve activities for intervening in executive functions, e.g. by doing targeted tasks related with math, reading and writing. Our initial validation of the bidirectional relationship between the executive functions and the learning process could benefit the educational field in the development of academic skills.

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15. Predictive factors for cognitive rehabilitation and trajectories of functional improvement after acquired brain injury

**Gabriela Markovic,** Institution of clinical sciences, KIDS; **Aniko Bartfai,** Institution of clinical sciences, KIDS; **Mattias Elg,** Department of Management and Engineering, IEI, Linköping University, Linköping, Sweden

**Introduction** A more detailed inspection concerning predictive factors and differential outcome in cognitive rehabilitation would have a positive influence on clinical decision making for rehabilitation effort and resource allocation. The present study examines the influence of premorbid factors, injury characteristics and postmorbid factors such as intervention and cognitive variables on the results.

**Methods** A series of 59 patients with mild to moderate ABI received 20 hours of attention training, either with Attention Process Training (APT) or activity-based training of attention within four months post injury. The primary outcome variable, the Paced Auditory Serial Addition Test (PASAT), was monitored at eight measurement points during intervention and analysed with statistical process control (SPC). To evaluate the relative contribution of potential predictive markers, general linear model (GLM) ANOVA was used. The dependent variable was the difference between the first and last PASAT performance and identified patterns of improvement based on process analysis.

**Results** Premorbid demographic factors including intellectual level, and injury and clinical characteristics have no correlation to patterns of improvement. Functional improvement post-intervention was correlated to marital status ($c^2 (1, N=59) =0.29; p=.037$). Results on neuropsychological tests of alternating attention and type of intervention are predictive for
patterns of improvement. Predictive factors were not identified for patients without functional improvement on PASAT.

**Conclusions** The results indicate that the extent of cognitive improvement after attention training can be estimated using neuropsychological assessment in statistical modelling and type of intervention. However, demographic, clinical and cognitive variables found to influence improvement in earlier studies seemed not to contribute to the model. This finding needs further statistical exploration. The results highlight the complexity of the recovery process after ABI and the interaction between types of rehabilitation provided.

16. Neurocognitive profile of children with persistent congenital hyperinsulinism

**MUUKKONEN Liisa, Coronaria Tietotaito; MÄNNISTÖ Jonna, Department of Pediatrics, Kuopio University Hospital / University of Eastern Finland; HANNONEN Riitta, Department of Psychology, Carea – Kymenlaakso Social and Health Services; HUOPIO Hanna, Department of Pediatrics, Kuopio University Hospital; JÄÄSKELÄinen Jarmo, Department of Pediatrics, Kuopio University Hospital / University of Eastern Finland**

**Introduction** Persistent congenital hyperinsulinism (P-CHI) is a rare, monogenic disease leading to persistent hypoglycemia in infants. It is characterized by inappropriate insulin secretion from pancreatic beta cells. P-CHI predisposes to neurodevelopmental impairment, and earlier studies have shown 8-15% prevalence of intellectual disability. However, treatment strategies of the disease have developed. It is not known whether this has improved the neurodevelopmental outcome. This study examined neurocognitive outcome in patients with P-CHI born in the 21st century.

**Method** Participants were 24 Finnish children with P-CHI (5 to 16 years) drawn from a nationwide CHI registry (participation rate 67%). Children with other risk factors for developmental deficits than hypoglycemia were excluded from the study. Cognitive functioning of the P-CHI children was assessed with the WISC-IV and the NEPSY-II and compared to the standardization samples of the tests.

**Results** Full Scale IQ of the P-CHI group settled in normal variance (mean=98.79, SD=14.74). When compared to the standardization samples of the tests, children with P-CHI performed significantly worse on the WISC-IV subtest of Digit Span (p=.031) and on the NEPSY-II subtests of Inhibition/Naming (p<.001), Memory for Designs (p=.036), Visuomotor Precision (p<.001) and Design Copying (p=.011).

**Conclusions** Nowadays P-CHI leads to less severe neurocognitive impairment than in the 20th century. However, children with P-CHI still have a risk for specific neurocognitive difficulties in attention, memory, visual and sensorimotor functions. Therefore, adequate follow-up and developmental support are needed for these children.

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17. Self-rated fatigue and cognitive fatigability: associations with saccade performance and attention after mild traumatic brain injury

MÖLLER, Marika C, Department of Clinical Sciences, Division of Rehabilitation Medicine, Karolinska Institutet, Stockholm, Sweden / Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden; MATUSEVICIENE, Giedre; Department of Clinical Sciences, Division of Rehabilitation Medicine, Karolinska Institutet, Stockholm, Sweden / Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden; JOHANSSON, Jan, Department of Clinical Neuroscience, Eye and vision, Karolinska Institutet, Stockholm, Sweden; PANSELL, Tony, Department of Clinical Neuroscience, Eye and vision, Karolinska Institutet, Stockholm, Sweden; NYGREN DEBOUSSARD, Catharina, Department of Clinical Sciences, Division of Rehabilitation Medicine, Karolinska Institutet, Stockholm, Sweden / Department of Rehabilitation Medicine, Danderyd University Hospital, Stockholm, Sweden

Introduction The aim was to examine the presence of fatigue and its relation to visual saccade and attention functions in patients in a subacute phase after a mild traumatic brain injury (mTBI).

Method Fifteen consecutive patients with mTBI and 15 patients with minor orthopedic injury (OC) were assessed within a week from presenting to the emergency department. Also, a non-injured control group was included. All participants were aged 18-40 years. Acquired fatigue (AF) was measured with the question on fatigue in Rivermead Post-concussion Symptoms Questionnaire (RPQ), trait fatigue (TF) with Fatigue Severity Scale (FSS) and cognitive fatigability (CF) with WAIS-III Digit Symbol Substitution Test. Attention functions were measured with Ruff 2&7 and WAIS-III Digit Span. Hospital anxiety and depression scale was used to control for depression and anxiety.

Results There was a significant difference between the three groups for AF ($p=0.001$) and TF ($p=0.033$). The mTBI group scored significantly higher AF ($p=0.023$), and showed more CF ($p=0.039$) compared to the OC.

There were no significant group differences regarding the saccade measurements when all three groups were included in the analyses. However, between mTBI group and OC, there was a significant difference regarding the standard deviation of Pro Saccade Latency (PSLD) ($p=0.024$) and the mean of the Anti-Saccade Latency (ASLM) ($p=0.031$).

For the mTBI patients, AF correlated with pro-saccade latency ($r_{mTBI}=0.692$, $p=0.035$) and CF ($r_{mTBI}=-0.527$, $p=0.043$) - the higher self-rated AF the more fatigability, while TF correlated with anxiety ($r_{mTBI}=0.716$, $p=0.006$). CF correlated with errors in Ruff 2&7controlled attention ($r_{mTBI}=0.585$, $p=0.022$). These correlations did not emerge for the controls.

Conclusions Acquired fatigue after an mTBI was related to fatigability and pro-saccade functions while trait fatigue was related to anxiety. The choice of instruments is crucial when we study fatigue, as different aspects of fatigue were associated with different mechanisms. This study needs validation in larger studies.
18. Behavioral executive function at home and at school in 11-year-old very preterm born children

NYMAN Anna, Department of Psychology, University of Turku, Turku, Finland/, Department of Pediatrics, University of Turku and Turku University Hospital, Turku, Finland; MUNCK Petriina, Department of Psychology, University of Turku, Turku, Finland; HAGELSTAM Camilla, Department of Psychology, University of Turku, Turku, Finland; KORHONEN Tapio, Department of Psychology, University of Turku, Turku, Finland; LEHTONEN Liisa, Department of Pediatrics, University of Turku and Turku University Hospital, Turku, Finland; HAATAJA Leena, Children’s Hospital, Pediatric Research Center, University of Helsinki/, and Helsinki University Hospital, Helsinki, Finland

Introduction Behavioral executive function (EF) problems of the very preterm (VPT) born children may present differently at school compared to the home environment. Parental and teacher rated behavioral EF profiles of the 11-year-old VPT born and control children, and associated risk factors were evaluated.

Method A total of 125 VPT born children (birth weight ≤ 1500 grams and/or < 32 gestational weeks) and 132 full-term born controls were assessed for behavioral EF using Behavior Rating Inventory of Executive Function including eight subscales forming Behavioral Regulation (BRI), and Metacognition (MI) indexes. For VPT born children, full-scale IQ was assessed using WISC-IV. Neonatal data were collected systematically. Brain MRI was performed at term age.

Results VPT born children had significantly more problems at home in several subdomains of behavioral regulation and metacognition compared to the controls. Most affected subscale was BRI. In addition, they had significantly more problems at school in metacognition compared to the controls. Most affected area was Working Memory. School environment offered additional information especially about Inhibit, Shift, Initiate, and Working Memory. Lower gestational age and lower paternal education were the only risk factors for behavioral EF. Major brain pathologies did not associate with behavioral EF.

Conclusions Behavioral EF problems of the VPT born children manifest both in metacognition and behavioral regulation. Behavioral regulation problems are most evident at home, and metacognition problems at school. Screening EF problems in both environments is recommended.

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19. The criterion validity of the Questionnaire of learning and mental health problems (QLMP)

PARKKILA Minna, Rehabilitation Foundation, Finland; PELTONEN Kati, Rehabilitation Foundation, Finland; POUTIAINEN Erja, Rehabilitation Foundation, Finland

Introduction Learning difficulties can be hard to identify, particularly in adults. Without adequate support, these difficulties can have a negative impact on person’s employment
prospects and inclusion in society. The aim of this study is to examine criterion validity of the learning subdomains of the Questionnaire of Learning and Mental health Problems (QLMP).

**Method** 86 unemployed young adults between the age of 16 – 28 completed the QLMP and a comprehensive neuropsychological examination. The QLMP is comprised of four learning subdomains: Reading and verbal skills (RV), Attention and executive functioning (AE), Mathematical skills (MA) and Visual perception and eye-hand co-operation (VE). For validity analyses three neuropsychological measures for each cognitive function were used.

**Results** A higher number of self-reported difficulties in the RV subdomain was related to poorer performance on WMS Logical memory test, reading comprehension and reading pseudo word-list (Pearson r,  \( p < .05 \)). In the AE subdomain, higher number of difficulties was related to more reported problems in two clinically used ADHD/ADD symptom checklists (\( p < .01 \)). Difficulties in the MA subdomain, were related to poorer performance in Reading and writing large numbers task and RMAT test score (\( p < .01 \)). In the VE subdomain, higher number of difficulties was related to lower scores on WAIS-IV Block Design test, WAIS-IV Processing Speed Index and copying a Greek Cross task (\( p < .01 \)).

**Conclusions** The QLMP was found a valid screening tool for preliminary recognition of learning disabilities, especially for young adults who may need support with learning difficulties or more in-depth clinical assessment.

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20. Previous Support and Reported Mental Health Problems of Adults with Learning Disabilities

**PELTonen Kati, MA Psych, ParkKila Minna, MA Psych, Poutiainen Erja, PhD**

**Introduction** Learning disability (LD) is defined as a heterogeneous group of developmental disorders consisting difficulties in academic skills. Studies have reported that individuals with LD have more mental health problems than population in general. The aim of this study was to examine whether the LD group with wider problems (LDW, borderline mental disability) differed from the LD group with specific problems (LDS) in early recognition of problems, support in school and in current self-reported mental health problems.

**Method** A study group consisted of 84 subjects aged 16-28. All subjects had neuropsychologically verified learning disability. The subjects were divided into two groups: a group with specific learning disability (N=55) and a group with wider range of learning problems (N=29). The differences in previous recognition of LD, previous support and current symptoms of mental health between the groups were studied (Chi\(^2\)).

**Results** The previous recognition and support for LD was more frequent in subjects with LDW when compared with the LDS group. However, over 50% of the LD problems were unnoticed, even in the LDW group. The LDS group reported more current problems in mental health than the LDW group (\( p < .001 \)).

**Conclusions** More effort on early recognition, support and targeted interventions on learning difficulties is needed. Specially individuals with specific learning disabilities tend to be at risk in not having appropriate support in schools and having an increased risk for mental health problems.
21. The Modified Cognitive Reserve Scale as a proxy for cognitive reserve

RELANDER, Kristiina, Clinical Neurosciences, Neuropsychology, University of Helsinki and Helsinki University Hospital, Helsinki, Finland; HIETANEN, Marja, Clinical Neurosciences, Neuropsychology, University of Helsinki and Helsinki University Hospital, Helsinki, Finland; SOINNE, Lauri, Clinical Neurosciences, Neurology, University of Helsinki and Helsinki University Hospital, Helsinki, Finland

Introduction Traditionally, cognitive reserve is measured by education and occupation, but also leisure activities have been shown to provide protection against cognitive changes following ageing or brain pathology. Earlier, the Cognitive Reserve Scale, a questionnaire for active lifestyle, was introduced in Spanish population (León et al., 2014). The aim of this study is to investigate the usability of the Modified Cognitive Reserve Scale (mCRS) in Finnish population.

Methods Thirty-eight healthy adults aged 55-78 (10 women, mean age 68) filled the mCRS and were neuropsychologically tested. Effects of gender, occupation and education on the mCRS were analyzed with 1-way ANOVAs. Relations between the mCRS, age and reasoning (Block Design and Similarities subtests of WAIS-IV), working memory (digit span forwards and backwards) and verbal memory (word list learning, delayed recall and recognition) were assessed with Pearson’s and partial correlations.

Results As expected, the mCRS was significantly related to other proxies for cognitive reserve, occupation and education (p<.01) but not age or gender. There were significant relationships between the mCRS and verbal reasoning (p<.03) and, when corrected for age, also visual reasoning (p<.02) and verbal learning (p<.03).

Conclusions The mCRS can be used as a proxy for cognitive reserve, including active lifestyle, in healthy Finnish adults. Next, we aim to study the usefulness of the mCRS in patient groups in order to get a more comprehensive view of cognitive reserve.

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Ro Julia ROBOTHAM, Department of Psychology, University of Copenhagen; Jens Oestergaard RIIS, Aalborg University Hospital, Aalborg, Nele Demeyere, Cognitive Neuropsychology Centre, University of Oxford; Randi STARRFELT, Department of Psychology, University of Copenhagen

Introduction Every year, approximately 15’000 people have a stroke in Denmark. Cognitive deficits following stroke are common and have negative consequences on quality of life, return to work and likelihood of developing depressive symptoms. Cognitive deficits must be identified in order to provide appropriate interventions and care. There is no international golden standard for screening cognitive deficits following stroke so dementia screening tools are often used. The Oxford Cognitive Screen (OCS) has been developed specifically to identify clinically important cognitive deficits following stroke. It consists of 10 sub-tests that
are structured around five cognitive domains: Attention and Executive function, Language, Memory, Number processing, and Praxis, and only takes 15 minutes to administer. The aim of the study was to translate OCS into Danish and standardize the OCS on a sample of healthy Danish participants.

**Method** The OCS was translated from English to Danish and culturally adapted for a Danish context. After piloting on five patients, data from approximately 100 healthy participants stratified for age and education was collected. Participants were screened for dementia with the Montreal Cognitive Assessment.

**Results** We present the Danish version of the OCS as well as reference material based on the data collected. Influence of age and education on OCS performance are discussed.

**Conclusions** The Oxford Cognitive Screen is a screening tool that is specifically designed for stroke patients. It is quick to administer and is designed to maximise patient inclusion. The Danish translation and reference material provided will enable its use in a Danish context.

23. Cognitive recovery from pediatric mild traumatic brain injury

Mari SAARINEN, The Mannerheim League for Child Welfare, The foundation for the Rehabilitation of Children and Young People; University of Turku; Nina ERKINJUNTTI, Turku University hospital, University of Turku; Nea ISAKSSON, Turku University hospital; Saana VIRTANEN, University of Turku; Leena HIMANEN, University of Turku; Olli TENOVUO, Turku University hospital, University of Turku; Tuire LÄHDESMAKI, Turku University hospital, University of Turku

**Introduction** According to recent statistics, overall incidence of TBI in pediatric population is increasing. Seventy to ninety percent of all treated paediatric TBIs are mild. There is some consensus regarding the existence of acute physical, cognitive and behavioral symptoms following mild TBI. However, there is a continuing disagreement and lack of consensus in terms of long-term sequelae following mTBI.

The aim of this project is to retrospectively study children and adolescents with mTBI in terms of neuropsychological sequelae 1 to 3 months after injury.

**Method** Neuropsychological examinations of children and adolescents under 16 years of age treated in Turku University Hospital due to mTBI during the years 2010-2015, will be gathered retrospectively from the patient records, focusing on the domains of executive functioning, processing speed, working memory, naming, visuo-spatial perception and fatigue. Demographic information will be combined with neuropsychological data in order to examine the possible correlations between them.

**Results** Descriptive statistics from the retrospective data as well as some preliminary findings will be presented in the congress.

**Conclusions** According to the previous literature, pediatric rates of TBI in Finland are high, compared to respective western countries. A childhood TBI results in substantial healthcare and societal costs, even if the initial injury was mild. This study should provide valuable information concerning the existing treatment guidelines for pediatric mTBI in terms of...
recognizing the children at risk for prolonged symptoms and use of limited rehabilitation resources.

24. Grooved Pegboard Test and fingertapping speed: Updated norms for children aged 6 to 16 years

Annette Holth SKOGAN, Vestre Viken HF

Introduction Neuropsychologists in the Nordic countries report The Grooved Pegboard Test (GPT) and Fingertapping test to be two most used tests of motor function (Egeland et al., 2016). Addressing the lack of updated, normative data on GPT performance in children and adolescents, the present study report GPT data obtained in a large, population-based sample aged 6-16 years. GPT data was supplemented with a measure of finger tapping speed obtained in the same sample.

Method A total of 847 Norwegian schoolchildren (451 girls, 396 boys) completed the GPT together with a test of finger tapping speed administered by use of a smartphone application (Tap Count). Relations between fine motor functioning, and demographic variables (age, gender, handedness, time) were investigated both categorically and dimensionally.

Results Age proved to be the most important source of variance in both GPT and Tap Count scores. From age 14 years on, girls tend to perform better than same-aged boys on the GPT. No significant gender differences in Tap Count performance were found. Handedness was not significantly related to GPT performance (both hands), but proved to account for a significant amount of variance in finger tapping speed (nondominant hand) across age Groups.

Conclusions Norms for fine motor test performance in childhood and early adolescence should be age-stratified. Gender differences in motor function may differ according to task complexity, and may be evident only in certain periods during normative development. Gender separate norms should be used when assessing complex motor functions in adolescents.

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25. CERAD –NB subtests and progression rate in Alzheimer’s Disease

SOTANIEMI Mona, Helsinki University Central Hospital/University of Helsinki; HALLIKAINEN Ilona, University of Eastern Finland; SELANDER Tuomas, Kuopio University Hospital; HÄNNINEN Tuomo, Kuopio University Hospital; HOKKANEN Laura, University of Helsinki; KOIVISTO Anne, University Of Eastern Finland/ Kuopio University Hospital

Introduction The objective of this study was to determine the ability of the cognitive subtests included in CERAD test battery to predict progression of Alzheimer’s disease (AD). Recognition of the persons with AD in risk of fast disease progression would be particularly useful to be able to appropriately plan care and support services.
Method This study is part of the longitudinal ALSOVA study with 236 persons with AD. All the persons with AD had very mild or mild disease at baseline. CERAD-NB was carried out at baseline and annually for 3 years. AD progression was evaluated with CDR-sob (Clinical Dementia Rating, sum of boxes).

Results The disease progression was graded as slow (N=74), moderate (N=82) or fast (N=80) on the basis of CDR-sob change. There was a significant main effect between groups in three subtests at baseline: Wordlist learning, Constructional praxis and Clock drawing. Pairwise comparisons revealed differences (p<.01) between the slow and the fast progression groups in all these subtests. Constructional praxis performance (p<.01) differentiated between the moderate and the fast progression groups.

Conclusions Our results indicate that low baseline scores in CERAD’s Wordlist learning, Constructional praxis and Clock drawing subtests may be associated with more rapid AD aggravation. CERAD–nb carried out at the time of diagnosis may provide useful information for health care professionals to plan health care services for person with AD patient already at the very beginning of the disease process.

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26. Effect of load and visual resolution on working memory for signs

STENBÄCK Victoria, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University; ANDIN Josefine, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University; HOLMER Emil, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University; RUDNER Mary, Linnaeus Centre HEAD, Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University

Introduction For hearing non-signers (HNS) working memory for lexical signs is negatively affected by poor visual resolution and this effect is greater when load is higher. In the present study, we investigated whether these effects extend to deaf early signers (DES).

Method In this preliminary study, 7 DES and 7 HNS performed a sign-based n-back task with three different loads (n=1-3). Visual resolution was manipulated orthogonally at two levels. Button-press responses were given and d’ was calculated by adjusting hits for false alarms in accordance with signal detection theory.

Results A repeated measures 2x3x2 (noise x load x group) ANOVA showed the expected statistically significant main effects of load and resolution. However, the expected interaction between load and resolution was not significant. There was no main effect of group but a statistically significant interaction between load and group showed that the effect of load was smaller for DES than HNS.

Conclusions The main effect of resolution on working memory for signs extended previous results from HNS to DES. The lack of interaction between load and resolution may be partly
due to greater resilience to WM load in DES compared to HNS thanks to pre-existing semantic representation of the sign stimuli (cf. Rudner et al., 2016).

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27. The MapCogSpectra-test as a quick way to evaluate problems of attention: preliminary data

**WAXEGÄRD, Gustaf, Linnaeus University/R&D-unit, Region of Kronoberg**

**Introduction** The value of neuropsychological tests in the assessment phase of neurodevelopmental disorders (ND) is increasingly debated. Critics have questioned the added value to diagnostics, poor ability of tests to contribute at the level of the individual patient, whether the time spent on testing is worth the extra information it gives, the less than evidence-based status of several tests in use, and the poor convergence between the psychological constructs measured by the tests and the constructs supposed to be of importance for patients encountered in clinical practice. On the other hand, sole reliance on anamnestic interviewing along with rating scales presents scientifically well documented clinical problems of its own. In sum, the need for test development and research is urgent.

**Method** The new, brief, Ipad-based MapCogSpectra (MCS) test, designed to detect problems in intra-individual variation of attention, was administered to children and adolescents singled out for ND assessment (n=91), a non-clinical control group (n=158), and a clinical non-ND control group (n=37).

**Results** Receiver Operating Characteristics-analysis suggests that the MCS discriminates well between the clinical group and the non-clinical group (AUC=0.918, 95% confidence interval: 0.880-0.955, p<0.000). Results are similar but somewhat attenuated when the clinical group and the clinical non-ND group are combined and compared to healthy controls (AUC=0.895, 95% confidence interval: 0.859-0.932, p<0.000).

**Conclusions** The MCS may be useful as a quick test to assist clinicians in deciding whether children belong to a clinical group that should be further evaluated.

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28. The relation between test anxiety and cognitive task performance in the Finnish standardization sample of WAIS-IV

**VUORI Outi, Helsinki University Central Hospital, Neuropsychology, Finland / University of Helsinki, Finland; HAAVISTO Marja-Leena, Hogrefe Psykologien Kustannus, Helsinki, Finland; LIPSANEN Jari, University of Helsinki, Finland; HOKKANEN Laura, University of Helsinki, Finland**

**Introduction** Test anxiety is related to impaired performance in different cognitive tasks. Relation between test anxiety and performance has been found mainly in mathematical, visual and working memory tasks but also in overall performance in WAIS-III -version. This
study examines the relation between test anxiety and cognitive task performance in WAIS-IV.

**Method** The study was conducted during the national Finnish standardization of WAIS-IV. The full sample was 657 individuals. Test anxiety was estimated in 599 cases by the examiner (observer-evaluation) and in 611 cases by the examinee (self-evaluation) using a four-point scale. 262 subjects (44%) experienced minor, medium or large amount of anxiety in observer-evaluation. 299 subjects (49%) experienced minor, medium or large amount of anxiety in self-evaluation. Two highest categories were combined in analyses.

**Results** When those with no, minor, and significant test anxiety were compared, test anxiety in observer-evaluation was negatively related to subtests of working memory, perceptual reasoning and processing speed, and to all indices. Test anxiety in self-evaluation was related to working memory index and perceptual reasoning index. In both cases, test anxiety was related to both Full Scale IQ (FSIQ) and General Ability Index (GAI).

**Conclusions** Test anxiety appears to have a broad negative relation to cognitive test performance. Test anxiety may weaken individuals’ ability to demonstrate their best performance which may result in misinterpretation and underestimation of cognitive capacity in clinical work. Attention should be paid to alleviating test anxiety in neuropsychological assessments.

**Grant Support** None

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29. Psychometric investigation of the subtest Odd Item Out (OIO) from Reynolds Intellectual Screening Test (RIST) in a sample of Danish students.

ØRSKOV Per T., Department of Language and Communication, University of Southern Denmark; BEATTY Erin L., Department of Language and Communication, University of Southern Denmark

**Introduction** 1822 students completed the OIO, mean age 18.23 years (SD 2.43), girls 50%. OIO is a measure of nonverbal intelligence. We evaluated the psychometrics of the OIO under a modified administration. Additionally, we investigated the effect of a 10 minute time limit and if the stop criteria should be changed from three to four consecutive incorrect answers.

**Method** The OIO was administered online to students in the classroom. Students had 10 min to complete the 29 items. The scoring of the test was changed; 1 point were given for every correct answered item. Rasch modelling and data analysis was done in SPSS Statistics 24 and R package eRm.

**Results** The mean score was 16.95 (SD 3.01). The concordance of item difficulty and item order was not perfect. Some items had similar difficulty parameters: Item 15: 0.558, 95% CI [0.463, 0.652] and item 19: 0.542, 95% CI [0.447, 0.636]. 86% of the students finished within 10 minutes. A stop criteria of three incorrect answers left 38% of the students’ raw scores unchanged, whereas a stop criteria of four left 62% unchanged.
Conclusions OIO did well differentiating between ability on average as well as at more extreme levels of intelligence (± 2.5 SD). Some items were redundant, and the ordering of the items should be changed according to difficulty. Most students could finish the test in 10 minutes, so the time limit seemed reasonable. The stop criteria should be changed to four, to not distort the final scores.

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