Culture, Brain, Learning
Wallenberg Network Initiative

LUND UNIVERSITY, NOV 19-21, 2014

Conference information

Conference chairs

Sven Strömqvist, Lund University
H. Craig Heller, Stanford University
Marianne Gullberg, Lund University
Hans Wibom, the Peter Wallenberg Foundation

Local committee

Marianne Gullberg (chair), Lund University
Mikael Johansson, Lund University
Magnus Lindgren, Lund University
Maja Petersson, Lund University

Moderator

Mo Costandi

Volunteers

Peer Christensen
Mette Clausen Bruun
Sandra Debreslioska
Heinrich Sebastian Dohm-Hansen
Anna Karlsson
Tove Madsen
Frida Mårtensson
Anders Persson
Paula Widén

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Culture, Brain, Learning, Lund, Sweden, 2014

We are very pleased to welcome you to Lund University and the symposium Culture, Brain, Learning.

This is the third in a series of interdisciplinary symposia organised by the Wallenberg Network Initiative. It targets a key question at the intersection between the humanities and science: How can knowledge of the mind and brain contribute to our understanding of human culture and social behaviour, and how can we use the products of culture and the nature of social interaction to understand how the mind and brain develop, learn, remember, and create? We gather some 60 scholars from the humanities,social sciences, neuroscience, and education to discuss this central issue from different perspectives. We are grateful to all who have come from afar to share their recent work with us. In addition to talks and posters, we are also excited by the prospect of engaging in a broad discussion of the core topics guided by neuroscientist and science writer Mo Costandi.

We have a few days ahead of wonderful opportunities to learn new things, to broaden our horizons, to deepen and extend existing collaborations, and hopefully also to pave the way for some new ones.

We wish to express our sincere thanks to the Wallenberg Foundations (the Knut & Alice Wallberg Foundation, and the Peter Wallenberg Foundation) for supporting the Wallenberg Network Initiative and this event. We also thank the many volunteers who have contributed to its practical realisation.

We sincerely hope you will enjoy your stay in Lund.

Marianne Gullberg, Sven Strömqvist, H. Craig Heller
Mikael Johansson, Magnus Lindgren, Maja Petersson

LUND UNIVERSITY

Programme

November 18, Tuesday	
18.00	Welcome mingle at the *Pufendorf Institute for Advanced Studies*
November 19, Wednesday	**Grand Hotel**
11.30	Registration
12:00	Lunch
13:00	Opening words by Sven Strömqvist
13.10	Keynote: Asaf Gilboa "Prior knowledge and its influence on new learning and memory: a cognitive neuroscience perspective"
14.00	Anthony Wagner "Virtual reality, event replay, and memory-guided behavior "
14.30	H. Craig Heller, Damien Colas, Bayarsaikhan Chuluun, & Fiona Mulvey "Curing the learning disability of individuals with Down Syndrome"
15.00	Coffee
15.30	Jonathan Berger "Measuring listeners' engagement with music" (via conference link)
16.00	Alex Schlegel "The artist emerges: tracking neural changes in visual art students"
16.30	Andreas Olsson "Emotional learning in social interaction"
17.00	Daniel Schwartz "Learning technologies to improve and understand the human mind (brain)"
19.00	Dinner at *Hypoteksvåningen*
November 20, Thursday	**Grand Hotel**
9.00	Keynote: David W Green "Adaptive changes in the multilingual brain: causes and correlates"
10.00	Coffee
10.30	Brian Wandell "Reading circuitry in the human brain"

Programme

11.00	Niclas Burenhult "Diversity and the language/culture interface: the case of landscape"
11.30	Bencie Woll "Deaf culture, sign language and the brain, iconicity, phonology and sign language poetry"
12.00	Lunch
13.00	Poster session
14.00	Keynote: Judith Hudson "Stories of the past and future: Constructing an autobiographical self through time"
15.00	Coffee
15.30	Natalie Phillips "Literary neuroscience and disciplinary learning: patterns of attention and memory in reading Jane Austen" (via conference link)
16.00	Patrik Svensson "The emerging humanities"
16.30	Short walk to the *Humanities Lab*
16.50	The Humanities Lab: tour and demo
18.00	Dinner at *Biskopshuset*
November 21, Friday	**Turning Torso, Malmö**
8.30	Transportation to Malmö by bus from Lund Central Station, Västra station (West station)
9.00	Coffee
9.30	Panel discussion led by Mo Costandi
10.30	Break
10.45	Panel discussion continued
11.30	Marianne Gullberg, Patrik Svensson,H. Craigh Heller "Research in an interdisciplinary network"
12.00	Lunch
13.30	Transportation by bus to Malmö central station, and to Lund

Keynotes

Asaf Gilboa

University of Toronto, Rotman Research Institute at Baycrest

Specialises on memory disorders and on the cognitive neuroscience of autobiographical memory.

Prior knowledge and its influence on new learning and memory: A cognitive neuroscience perspective

Common wisdom as well as cognitive and educational psychology have long identified the influential role of prior knowledge on encoding and retrieval of new knowledge. Two forms of such knowledge have traditionally been the focus of cognitive psychology research: conceptual knowledge and schemas. Cognitive neuroscience has primarily investigated the neural substrates of conceptual knowledge and its influence on new learning. More recently schemas have also generated interest in both the animal and human cognitive neuroscience literature.

Being highly complex knowledge structures, schemas have always posed significant theoretical and experimental challenges to cognitive scientists. Bartlett (1932) was the first to introduce the concept of schema into the memory domain, after it had been used for a couple of decades in the domains of sensory perception and developmental psychology. Curiously, even Bartlett expressed significant reservations about the use of the term, proclaiming it poorly captured key characteristics of memory schemas as he viewed them, most notably their adaptability and dynamic nature. Thus, while the influence of prior knowledge on the constructive and reconstructive nature of memory has never been doubted, reservations were expressed about the utility and precise meaning of schema itself as a psychological and neurobiological construct. Over the past century schemas have intermittently appeared in cognitive psychology, only to later fall out of favor, arguably due to poor theoretical constraints of the term.

In the present lecture I will review some of the recent and exciting findings on the neurobiology of schema in the memory domain, arising from animal, lesion and neuroimaging investigations. Importantly the presentation will be geared towards elucidating the use of the term schema and delineating its relationship to other related terms- most notably concepts, but also scripts, gist, extracted probabilities and so forth. The discussion will focus on essential properties of schema includ-

ing interconnectivity, nested structures, extracted commonalities, adaptability and chronology. Their cognitive and neurobiological functions including scaffolding of information assimilation, directing attentional resources, enabling inferential elaboration, facilitating orderly memory searches, editing and summarizing of new information and supporting reconstruction of missing information from memory will be discussed. Data from patients with neurological damage (confabulation and amnesia), and neuroimaging (fMRI and ERP's) will be presented. Neuroanatomically, I will suggest that the same principle of representational hubs that bind together isolated neural modules into multi-modal ensembles operate for different mnemonic reconstructions. The medial temporal lobe (MTL) and hippocampus is a hub for episodic memories, the anterior temporal lobe (ATL) is a hub for conceptual knowledge end the ventromedial prefrontal cortex (vmPFC) is a hub for schemas. Facilitation of encoding of new information by prior schemas can be mediated by vmPFC interaction with the hippocampus and posterior neocortex, but the possibility of hippocampal-independent learning under certain conditions will also be explored.

David W Green

Department of Cognitive, Perceptual & Brain Sciences, Institute of Cognitive Neuroscience, University College London

Specialises on bilingual processing in mind and brain, executive control, modelling the control processes in bilingual speech production.

Adaptive changes in the multilingual brain: causes and correlates

How does the brain adapt to learning and using multiple languages? Changes might be expected in the neural regions mediating the representation of language and its control and reflect the interactional context of language use. Communities differ in their use of languages: some code-switch within a conversational turn, others do not. Different patterns of use induce different habits of language control to mediate effective turn-taking. In this paper I will consider what we know so far about these adaptive changes and what we might expect to find as we explore further.

Judith Hudson

Dept of Psychology, Rutgers University

Specialises on memory development and narrative construction.

Stories of the past and future: Constructing an autobiographical self through time

Recent research has highlighted the commonalities between remembering the past and thinking about the future. Both involve construction mental representations of events from our past and our imagined future. Both involve the projection of oneself into a past or future experience. I will discuss the similarities and differences involved in remembering the past and imagining the future from a cognitive-developmental and socio-cultural perspective. I am particularly interested in how viewing autobiographical memory from a narrative perspective can inform our thinking about how people envision their future. When we share memories of our past with others, we are telling stories about ourselves. To what degree is future thinking a process of future self-construction and how do we learn to construct stories about our future selves? What kinds of cultural practices promote future thinking? When do children and adolescents envision the future as part of their evolving life story? These are some of the issues I will be discussing in considering the development of past and future thinking across the life span.

Talks

Anthony Wagner, *Department of Psychology and Neurosciences Program, Stanford University*

Specialises on the cognitive neuroscience of memory and cognitive/executive control in young and older adults.

Virtual reality, event replay, and memory-guided behavior

Memory for the past can inform current perception, categorization, decision-making, and action. Episodic memory supports the conscious remembrance of the details (features) of life's events. Episodic memories depend, in part, on the establishment of cortical representations of event features during encoding, and the binding of these features within the hippocampus. At retrieval, cues trigger hippocampal-dependent replay of the cortical representations that were present during encoding. In this talk, I will first discuss how advances in functional neuroimaging and multivariate analyses provide leverage on each of these critical components of episodic memory. Initial evidence indicates that trial-level quantitative measures of cortical and hippocampal activity predict memory-guided behavior, including subjective reports of memory precision, retrieval accuracy, and memory.

H. C. Heller, D. Colas, B. Chuluun, *Stanford University* **& F. Mulvey,** *Lund University*

Specialise on the neurobiology of sleep, circadian rhythms, learning disabilities and cognitive disabilities in Down Syndrome.

Curing the learning disability of individuals with Down Syndrome

Down Syndrome is a leading cause of intellectual disability with a current incidence of about 1 in 700 births. Previous opinion was that the brain impairment of these individuals was permanent and they were doomed to a life of cognitive impairment. We have shown that is not true. Working on the hypothesis that the cause of the learning disability in DS was due to elevated activity of the major inhibitory system in the brain, we showed in mouse models of DS that the learning ability could be rescued with drugs that reduce this inhibition. Remarkably, a short-term treatment resulted in a very long-term normalization of learning and memory. Two crucial questions followed: 1. what was the mechanism whereby these drugs were effecting long-term changes in the brain's ability to learn and remember, and 2 would this therapy work in humans with DS? To answer the first question, we initiated studies on basic mechanisms of learning and memory

and the role of sleep and circadian rhythms in those processes. To answer the second question we worked with the company Balance Therapeutics to initiate a clinical trial. In this presentation we will explain: 1. that learning ability can be restored with GABAergic antagonists, 2. that the drug actions involve both the circadian and sleep systems, and 3. that the over-inhibition depends directly or indirectly on the activity of the circadian clock, the suprachiasmatic nucleus. We will also discuss the status of the ongoing clinical trial and our efforts to develop more efficient clinical assessment tools to facilitate the next clinical trials required for US FDA approval.

Jonathan Berger, *Center for Computer Research in Music and Acoustics, Stanford University*

Specialises on audio processing, audio restoration, music and the brain, music cognition, music composition, music theory, neural net modeling, signal processing and sonification.

Measuring listeners' engagement with music

Listening to music - whether passively or actively - comprises constantly shifting levels of arousal and attention. In this presentation, inter-subject correlations (ISCs) of brain responses are demonstrated to provide a measure of engagement, with a focus on the relationship between the structural coherence of a musical stream and the listener's degree of engagement with it.
EEG was recorded while subjects listened to naturalistic music (popular Hindi songs) presented in original versions and in temporally disrupted, phase-scrambled conditions. ISCs were computed from the EEG data using Reliable Components Analysis. Original versions of songs yielded significantly higher ISCs than phase-scrambled versions, and were also rated as more pleasant, well ordered, and interesting by subjects. The most reliable spatial component extracted from responses to the original songs concurs with past EEG findings involving naturalistic music. The time course of the ISCs is resolved at a musically relevant time scale. The sum of our findings suggests that ISCs show promise toward finding time-critical measures of engagement and attention in typically noisy EEG signals, and, specifically, as a means to find correlations between structural features of music and brain responses in listeners. We discuss possible links between heightened ISCs and regions of musical interest, and implications for future research.

Alex Schlegel, *Department of Psychological and Brain Sciences, Dartmouth college*

Specialises on creative cognition, perception, and perception-to-action.

The artist emerges: tracking neural changes in visual art students

How does the brain mediate visual artistic creativity? To approach this question, we investigated how the brains of visual art students changed as they studied drawing and painting. We focused on three aspects of cognition vital to many visual artists: creative cognition, perception, and perception-to-action. We found that the art students became more creative via the reorganization of prefrontal white matter but did not find any significant changes in perceptual ability or related neural activity in the art students relative to a control group. Moreover, the art students improved in their ability to sketch human figures from observation, and multivariate patterns of cortical and cerebellar activity evoked by this drawing task became increasingly separable between art students and controls. Our findings suggest that the emergence of visual artistic skills is supported by neural plasticity in pathways that enable creative cognition and mediate perceptuomotor integration. More generally, longitudinal studies of learning could potentially provide insights into the neural basis of a range of complex human behaviors.

Andreas Olsson, *Dept. of Clinical Neuroscience, Division of Psychology, Karolinska Institutet*

Specialises in the neural mechanisms underlying emotional learning and regulation in social situations.

Emotional learning in social interaction

The biological basis of learning to associate objects, and our own behavior, with emotional outcomes through direct, personal, experiences (classical and instrumental conditioning) is well studied. Yet, little is known about the mechanisms underlying learning through indirect, social, means. Social learning lies at the heart of human cultural evolution, and it may be more representative of our learning in every-day situations. For example, many of our learned fears and aversions are acquired from our social environment through observation and verbal communication. In addition, many of our learned fears and aversions are about other individuals. I will present research addressing these social forms of learning by bringing together two hitherto unconnected lines of research; the biology of emotional learning and social cognition. More specifically, I will present work using behavior, psychophysiology and neuroimaging (fMRI) methods to examine

emotional learning (1) from others through observation, and its dependence on stimulus bound (e.g. expressiveness) and conceptual (e.g. attributed experiences) features of the individuals we learn from, and (2) about others and its dependence on stimulus bound (e.g. ethnic group belonging) and conceptual (e.g. attributed intentions) features of the individuals we learn about. Taken together, this work suggests that (i) classical and instrumental conditioning can serve as appropriate basic models to study human emotional learning and memory in a broader social context, and that (ii) these models should incorporate the influence of social cognition, such as social group perception and mental state attribution.

Daniel Schwartz, *Graduate School of Education, Stanford*

Specialises on the ways that technology can facilitate learning working at the intersection of cognitive science, computer science, and education, examining cognition and instruction in individual, cross-cultural, and technological settings.

Learning technologies to improve and understand the human mind (brain)

We develop computer games that teach disciplinary ways of thinking in science and mathematics. For instance, with Teachable Agents, the games teach causal, hierarchical, and hypothetico-deductive reasoning in science. The learning technologies build upon and extend contemporary theories of learning. In this presentation, we will describe several novel learning technologies developed in our laboratory and in Sweden. We present empirical evidence on whether they contribute to student learning as well as theories of learning. We consider the prospect of using computer games to make a more educationally relevant neuroscience.

Brian A Wandell, *Psychology Department and Neuroscience Institute Stanford University*

Specialises on vision science, spanning topics from visual disorders, reading development in children, to digital imaging devices and algorithms for both magnetic resonance imaging and digital imaging.

Reading circuitry in the human brain

I will review magnetic resonance imaging (MRI) findings that identify an essential portion of the neural circuitry used by good readers to rapidly and efficiently identify word forms. Quantitative MRI of the tissue properties in specific axon bundles within this circuitry predicts the acquisition of reading skills in individual children.

I will introduce a speculative hypothesis about why the development of these axons influences a child's ability to efficiently recognize words. The MRI techniques that enable us to identify the cortical and white matter reading circuits, quantify several aspects of their tissue properties, and model their functional responses have advanced significantly over the past few years. Used in combination, these methods may offer a valuable summary of the neural networks that mediate human cognitive abilities.

Niclas Burenhult, *Max Planck Institute for Psycholinguistics, Humanities Lab, Lund University*

Specialises in the relationship between language, culture and cognition, language documentation, and linguistic prehistory.

Diversity and the language/culture interface: the case of landscape

The language and cognitive sciences currently undergo major transformations. For example, the preoccupation of past decades with the 'common denominators' of human language and thought (e.g. language universals, universal concepts and grammar) is being gradually replaced by an appreciation that focus on variation and diversity provides a more promising way forward in exploring what is distinctly human (Evans and Levinson 2009). This shift is taking place against a backdrop of extreme urgency, since linguistic diversity is on a rapid and irreversible retreat. It is estimated that half of the world's 6,000 or so languages will have become extinct a hundred years from now, along with the unique and typically non-literately transmitted knowledge systems that they harbor. Countless forms of human experience are lost on a daily basis. In this talk I will illustrate some intellectual and practical rewards to be gained by studying linguistic and cultural diversity, with a focus on the domain of landscape, which until recently was largely unexplored by the language sciences (Burenhult 2008; Mark et al. 2011).

Bencie Woll, *Department of Human Communication Science, University College London*

Specialises on sign language, the neurocognition and neurological underpinnings of sign language.

Deaf culture, sign language and the brain: iconicity, phonology and sign language poetry

The sign languages of Deaf communities are natural human languages, arising wherever Deaf people establish communities. Like spoken languages, sign langu-

ages exhibit a complex hierarchical underlying structure, with contrastive sublexical elements (phonology) combining to form words/signs. However, unlike spoken languages, sign languages make extensive use of iconicity (visual motivation) within their lexicons.
One of the manifestations of culture within Deaf communities is poetry. Sign language poetry - like spoken language poetry – often exploits linguistic structure for poetic effect. This presentation starts with a brief description of poems in BSL and how they exploit features of BSL phonology and visual metaphor. In the second section, functional imaging studies which compare the neurological correlates of processing sign language phonology, spoken language phonology, and visual images are discussed. These reveal – despite the surface differences – strong similarities in the networks underlying phonological representations in spoken and signed languages.

The presentation concludes with reflections on the relationships between modality – the sensory percepts and articulatory channels in which language is instantiated – language, and culture.

Natalie Phillips, *Dept. of English, Michigan State University*

Specialises on18th-century literature, the history of mind, and cognitive approaches to narrative.

Literary neuroscience and disciplinary learning: patterns of attention and memory in reading Jane Austen

Patrik Svensson, *Humanities and information technology, Umeå University*

Specialises on information technology and learning, research infrastructure, screen cultures and the digital humanities as an emerging field.

The Emerging Humanities

Posters

A. Andersson, S. Sayehli & M. Gullberg, *Lund University*

First language background affects word order processing in a second language online but not offline

Different languages organize information differently, for example in different word orders. A large body of work shows that learning to use word order in a new, second language (L2) is difficult. An example is the production of verb-second (V2) word order, which requires the finite verb in main clauses to appear in second position even when the sentence does not start with a subject. V2 difficulties are ubiquitous and only partially modulated by patterns in thefirst language (L1; e.g., Ganuza, 2008 for an overview). Despite the body of work on L2 production, we know surprisingly little about how word order is processed behaviorally and neurocognitively, and how production relates to comprehension. This study therefore examined how advanced German (n=14) and English (n=14) adult learners, matched for proficiency and age of acquisition, process word order in Swedish compared to native speakers (n=20) depending on L1 background (i.e., ±similar word order in the L1; German [+V2] vs. English [-V2]), sentence-initial adverb frequency (frequent idag 'today' vs. infrequent hemma 'at home' (1)), and length of the sentence-initial constituent (short vs. long prefield; (2)).

(1) Idag/Hemma läste hon tidningen. vs. *Idag/Hemma hon läste tidningen.
Today/At home read she paper.def vs. *Today/At home she read paper.def

(2) Idag/Hemma hos Maria läste hon tidningen. vs. *Idag/Hemma hos Maria hon läste tidningen.
Today/At home at Maria's read she paper.def vs. *Today/At home at Maria's she read paper.def.

We probed the production of word order in a sentence completion task and examined responses to word order (violations) in a timed acceptability judgment task during which participants were presented with sentences word by word while event-related potentials (ERPs) were recorded. At the end of the sentence participants judged the sentence acceptability.

Overall, the results indicated that the two learner groups behaved similarly on behavioral measures of comprehension and production, but crucially differed in online processing. All groups, including learners, showed sensitivity to V2-violations in the ERPs. Swedish native speakers were also sensitive to length of prefield showing the typical biphasic ERP response only to violations with long prefields allowing build up of expectations. Importantly, the learners, who did not differ behaviorally, showed different responses. The German learners [+V2] showed similar ERP patterns to native Swedish speakers, whereas the English learners [-V2] showed more variation in their ERP responses. We discuss these findings in terms of theories of crosslinguistic influence and theories of native-like syntacticprocessing.

K. Borgström, J. v. K. Torkildsen, M. Lindgren, *Lund University*

Visual ERP repetition effects to novel objects predict word fast-mapping ability in 20-month-olds

Vocabulary development between 18 and 24 months shows enormous individual variability (Fenson et al., 1994). Although the causes of individual differences are many and complex, one factor that has been found to predict productive vocabulary at this age is the ability to receptively fast map a novel word to a novel object (Torkildsen et al.,2009; Torkildsen et al., 2008). In other words, productive vocabulary is dependent on effective receptive processing of novel words and their referents. Previous research has demonstrated this link using ERP measures of word processing during learning, and later mismatch responses (N400) to incongruous word and object pairings. We wanted to investigate if efficiency of visual object processing could also be predictive of subsequent measures of successful fast mapping.

A sample of 20 months old children (n = 38) contributed data in an ERP experiment showing pictures of fantasy objects paired with auditory presentations of pseudowords. Familiar words and objects were also included as a control. The experiment contained 30 items of each stimulus type, divided into 10 independent presentation blocks. During a learning phase each picture was presented five times together with the same label, always with other interleaving pictures/words, and the picture was presented 1000 ms before onset of the word stimulus. In a test phase directly following the learning phase, the same pictures were presented with a label that was incorrect but equally familiar. The semantic incongruity effect as measured by N400 amplitude was used as an index of successful fast mapping, and this was related to a negative central (Nc) response to the picture stimuli, modulated by repetition.

EEG data was recorded with Electrical Geodesic's (EGI) HydroCel Geodesic Sensor Nets(HCGSN) with 128 channels. To test the relationship between ERP responses and vocabulary, the children were divided into two groups based on productive vocabulary size. Repeatedmeasures ANOVAs were carried out to test the statistical effects of differences in ERP waveforms, and productive vocabulary group was entered as a between-subjects factor. The relation between ERP effects was tested with a linear regression model.

The sample as a whole did not produce a significant N400 incongruity effect to newly learned pseudowords, regardless of vocabulary size, although the effect was present in the real word condition. However, the size of the Nc repetition effect to fantasy object pictures was found to predict the size of the N400 amplitude difference between congruous and incongruous pseudoword presentations, $r = 0.462$, $p = 0.004$, and in fact, when grouped according to their repetition difference scores, a group of 11 children with the biggest amplitude difference due to repetition showed a significant N400 incongruity effect to the pseudowords, $F(1,10) = 5.69$, $p = 0.038$. The results suggest that the ability to successfully fast map novel words to novel objects is not only related to efficient word processing

but also dependent on efficient processing of the visual object information.

I. Bramão & M. Johansson, *Lund University*

The encoding–retrieval match principle and the diagnostic value of the retrieval cue: an event-related potential (ERP) study

The present study investigated conditions yielding beneficial effects of context on episodic memory retrieval. An influential idea in the memory literature states that memory performance is higher when a retrieval cue matches contextual features of the originally encoded episode. However, recent studies have shown that a match between the encoding and retrieval contexts not always facilitates retrieval, and that it can even have detrimental effects on memory performance. Such effects typically occur when the contextual cue also matches other retrieval candidates, competitors. Accordingly, memory performance should improve with the presence of diagnostic features in the retrieval context that help to discriminate the correct target from the incorrect competitors. To test this prediction, we constructed a novel paradigm where the diagnostic value of the context and the encoding-retrieval match were manipulated in an associative recognition memory task. During study, participants were asked to memorize pairs of words presented together with a unique or a non-unique background photograph of outdoor scenes (diagnostic versus non-diagnostic context photographs). After a distractor task, participants were asked to recognize the word pairs in the presence and in the absence of the previously encoded contexts. Behavioral data showed that memory performance was better in the presence of the original context, but importantly, only when the contextual cues were diagnostic for the target memory trace. The electrophysiological data mirrored this finding and showed an encoding-retrieval match effect in ERPs associated with diagnostic contextual cues, but not in the ERPs associated with non-diagnostic contextual cues. Taken together, the present results underscore the importance of the diagnostic value of the retrieval cue, and further suggest that the typically observed beneficial effects of an encoding-retrieval match may be impeded due to interference from competing memories.

P. Davidson, I. Carlsson, P. Jönsson & M. Johansson, *Lund University*

Pattern separation is a prerequisite for differentiated fear conditioning.

The capacity to discriminate cues in our environment that are associated with danger from cues that are not represents an important survival function. In this study, we investigated the influence of Pattern Separation (PS) on acquiring differentiated fear responses. PS is the ability to form distinct memories for events that are highly similar and share overlapping features. We hypothesized that PS

is crucial for acquiring differentiated fear responses and for displaying fear responses that gradually increase as a function of similarity to the danger signaling stimulus; the CS+.
We tested this by using a fear conditioning paradigm with a small and a big circle as the CS+ and the CS -. Fear responses were measured by Skin Conductance Responses. At the re-test, participants were again exposed to the CS+ and the CS-, as well as 8 novel circles that varied in size between the CS+ and the CS-. We expected higher PS ability to result in more differentiated fear responses, as well as a better ability to predict a stimulus' fear relevance based on its similarity to the original CS+.
Based on their scores on the PS task, participants were split into a high or a low PS group. Results revealed a significant interaction effect of GROUP (high/low PS) and CS (CS+/CS-), where only the high PS group showed greater fear responses to the CS+ compared to the CS-. Entering all circles into an ANOVA also revealed a significant interaction effect; the fear responses in the high PS group increased gradually as a function of increased similarity to the CS+, while no such effect was evident in the low PS group.
This suggests that PS is a prerequisite for acquiring differentiated fear responses, and for the ability to use similarity to an originally dangerous stimulus as a predictor of fear relevance.

M. Haake, E. Anderberg, M. Malmberg & A. Gulz, *Lund University*

Demo of the educational computer game Magical garden

R. Hellerstedt, *Lund University,* **M. C. Anderson,** *University of Cambridge,* **& M. Johansson,** *Lund University*

Electrophysiological correlates of memory intrusions

Involuntary retrieval of unwanted episodic memories is a core symptom of post-traumatic stress disorder. Previous neuroimaging studies of intrusions have focused on the cognitive control of memory retrieval rather than on the neural underpinnings of the intrusions per se. With an aim to investigate the neurocognitive mechanisms underlying intrusions, we recorded electrophysiological measures of brain activity while the participants engaged in a think/no-think task. In the first phase, the participants learned word pairs (e.g. radio - snow). In the subsequent think/no-think phase, the stimulus word (the left hand word, e.g. radio) was either presented in green or in red. The participants were instructed to retrieve the response word (the right hand word, e.g. snow) when a stimulus word was presented in green and to avoid thinking of the response word when a stimulus word was presented in red. The participants rated after each trial the extent to which they thought about the response word. The event-related poten-

tial (ERP) results revealed that intrusions were related to a central negative slow wave 600-750 ms after the presentation of the stimulus word. Similar negativities have previously been related to working memory maintenance, so this effect may reflect the activation of the response word in working memory. Supporting this interpretation, this effect was also present in the think condition involving voluntary retrieval. The duration of the effect was shorter for intrusions compared to voluntary retrieval, suggesting that the participants managed to purge the intruding response word out of working memory in the intrusion condition. Besides the negative slow waves, voluntary retrieval was also related to a left parietal positivity that previously has been related to recollection. This effect was absent in the intrusion condition, indicating that this ERP component reflects processes that are specifically involved in voluntary memory retrieval.

L. Hall, P. Pärnamets, P. Johansson, et al, *Lund University*

Investigating the Educational Implications of Confabulatory Narratives

R. Johansson & M. Johansson, *Lund University*

How gaze behavior influences selective memory retrieval

Episodic memory allows people to mentally travel back in time and to reconstruct previous events in a first person perspective. An accumulating body of research suggests that such reconstructions partly rely on re-instating sensorimotor processes that were active during the original event formation. For instance, it has been shown that people who recall a scene from memory, while looking at "nothing" on a blank screen, execute spontaneous eye movements which to a large degree correspond with the original scene viewing. Furthermore, we have in a recent study demonstrated that such episodic remembering is not only accompanied by eye movements that mirror those associated with the retrieved content but also that gaze positions showing a compatibility between encoding and retrieval increases the likelihood of successful remembering (Johansson & Johansson, 2014. Psychological Science). While the underlying neurocognitive mechanisms of this fascinating interplay remain to be specified a prominent explanation is that gaze re-instatements can assist in cue specification and limit the interference from competing memory traces during selective retrieval.

The present study was designed to address this fundamental issue by imposing different eye movements on participants who engaged in a competitive retrieval experiment. Participants first studied a set of events on a computer screen, which each consisted of a face in the center and four concrete words located in the quadrants of the screen. Following study, a retrieval-practice phase required participants to recall a part-set of those words in a cued-recall (face + word stem) procedure. In a final test, they then recalled the entire set of words. By manipu-

lating gaze towards locations that overlapped with either target or competitor word locations, we were able to elucidate the influence of specific gaze positions on selective memory retrieval characterized by differing demands for interference control.

F. Mulvey, *Lund University,* **C. Bayarsaikhan, H.C. Heller,** *Stanford University*

Measuring cognition in Down Syndrome: an eye-movements based approach

List of participants

Annika Andersson, Humanities Lab, Lund University

Jonathan Berger, Center for Computer Research in Music and Acoustics (CCRMA), Stanford

Emma Bergman, Lund

Susanna Bernstrup, Dept of Psychology, Lund University

Arthur Bienenstock, Dept. of Applied Physics, Stanford Special Assistant to the President for Federal Research Policy

Kristina Borgström, Dept. of Psychology, Lund University

Ines Bramao, Dept. of Psychology, Lund University

Niclas Burenhult, Max Planck Institute for Psycholinguistics, Humanities Lab, Lund University

Mo Costandi, London

Per Davidsson, Dept of Psychology, Lund University

Richard Dewhurst, Dept of Psychology, Lund University

Joakim Ekstrand, Affective Centre, Malmö University hospital, Psychiatric Neuromodulation Unit, Lund University

Sture Forsén, Pufendorf Institute for Advanced Studies, Lund University

Kerstin Gidlöf, Dept. of Philosophy, Lund University

Asaf Gilboa, Dept. of Psychology, Toronto

David W. Green, Department of Cognitive, Perceptual & Brain Sciences, Institute of Cognitive Neuroscience, University College London

Marianne Gullberg, Centre for Languages and Literature, Humanities Lab, Lund University

Agneta Gulz, Cognitive Science, Lund University

Peter Gärdenfors, Cognitive Science, Lund University

Magnus Haake, Cognitive Science, Lund University

Pehr Hedenqvist, Foundation Administration Management Sweden, Stockholm

H. Craig Heller, School of Medicine, Stanford

Robin Hellerstedt, Dept of Psychology, Lund University

Merle Horne, Centre for Languages and Literature, Lund University

Judith Hudson, Dept of Psychology, Rutgers University

Peter Indefrey, Dept. of Linguistics, Heinrich Heine University Düsseldorf & Donders Centre for Cognitive Neuroimaging, Radboud Universiteit Nijmegen

Barbro B. Johansson, Wallenberg Neuroscience Center, Lund University

Mikael Johansson, Dept of Psychology, Lund University

Roger Johansson, Dept of Psychology, Lund University

Cecilia Lindhé, HUMlab, Umeå

Magnus Lindgren, Dept. of Psychology, Lund University

Britt-Marie Malmkvist, Foundation Administration Management Sweden, Stockholm

Fiona Mulvey, Humanities Lab, Lund University

Johan Mårtensson, Dept. of Psychology, Lund University

Hannele Niemi, Faculty of Behavioural Sciences, University of Helsinki

Thomas Nygren, Dept of History, Stanford, HUMlab, Umeå

Andreas Olsson, Dept. of Clinical Neuroscience, Division of Psychology, Karolinska Institutet, Stockholm

Maja Petersson, Humanities Lab, Lund University

Natalie Phillips, Dept of English, Michigan State University

Ingmar Rosén, Clinical Sciences, Lund University

Birgitta Sahlén, Department of Logopedics, Phoniatrics, and Audiology, Clinical Sciences Lund University

Göran Sandberg, Peter Wallenberg Foundation

Alex Schlegel, Department of Psychological and Brain Sciences, Dartmouth college

Dan Schwartz, Graduate School of Education, Stanford

Mandana Seyfeddinipur, Dept of Lingustics, School of Oriental and Asian Studies and Hans Rausing Endangered Languages Documentation Programme, University of London

Yury Shtyrov, Dept of Clinical Medicine, Aarhus

Bob Smith, Stanford University

Georg Stenberg, Kristianstad

Sven Strömqvist, Lund University

Freddy Ståhlberg, MR Physics, Lund Bio Imaging Centre, Lund

Ingrid Sundström, Foundation Administration Management Sweden, Stockholm

Patrik Svensson, HUMlab, Umeå

Anders Tingström, Psychiatric Neuromodulation Unit, Clinical Sciences, Lund University

Anthony Wagner, Dept. of Psychology, Stanford

Peter Wallenberg Jr, Peter Wallenberg Foundation

Brian Wandell, Dept of Psychology and Neuroscience Institute, Stanford

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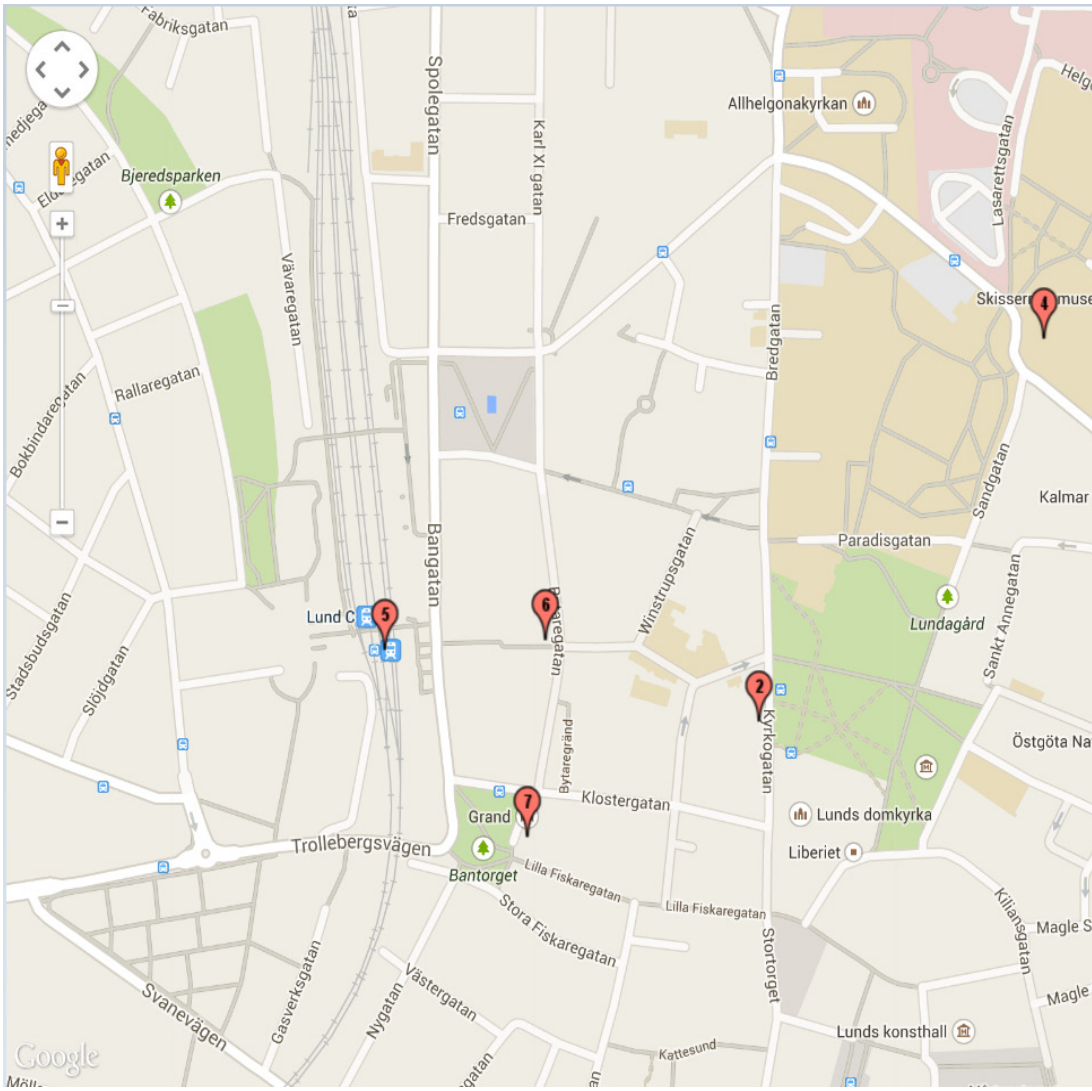
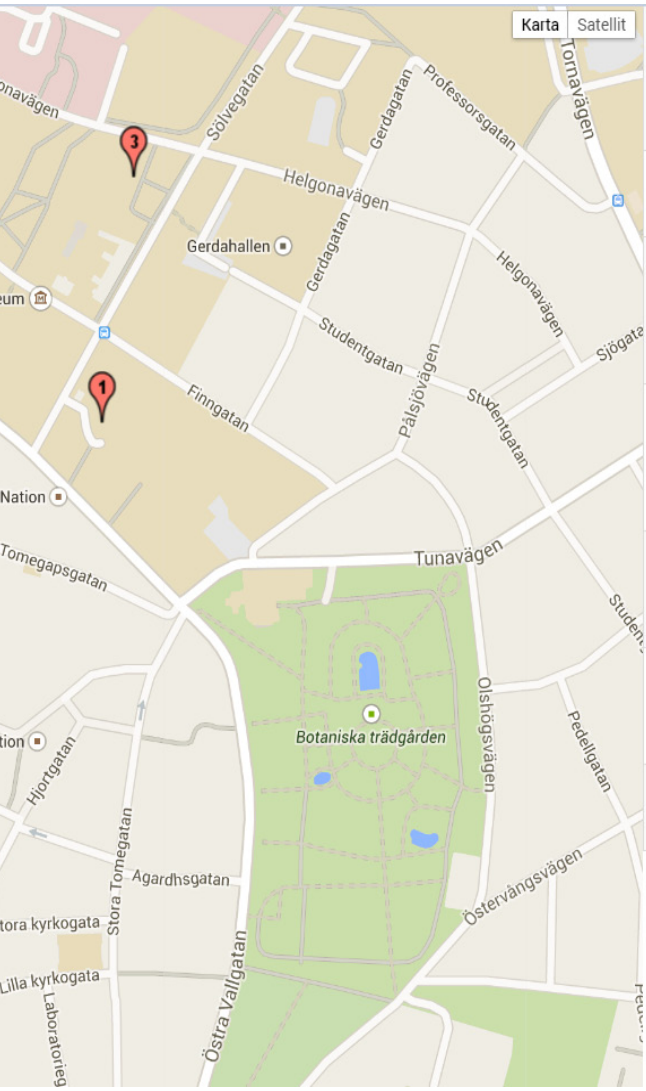
Stefan Östersjö, Malmö Academy of Music, Malmö

Conference Venues in Lund





1	Pufendorfinstitutet	Lunds universitet Biskopsgatan 3 Lund
2	Hypoteksvåningen	Kyrkogatan 13 Lund
3	Humanities Lab	Lunds universitet Helgonabacken 12 Lund
4	Biskopshuset	Lunds universitet Biskopsgatan 1 Lund
5	Central Station	Lund Centralstation Lund
6	Hotel Lundia	Knut Den Stores Torg 2 Lund
7	Grand Hotel	Bantorget 1 Lund

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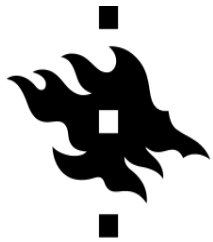

Ekon. dr Peter Wallenbergs
Stiftelse för Ekonomi och Teknik

LUND UNIVERSITY

Box 117
SE-221 00 Lund
Sweden
Phone +46 46-222 00 00
www.lu.se