Abstracts

From Neuroscience to the Classroom

5-6 April, 2017

Swedish Collegium for Advanced Study (SCAS), Uppsala
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CHRISTOPHER F. CHABRIS, Geisinger Health System, Danville, PA, and Union College, New York

On the Prevalence and Persistence of "Neuromyths"

Abstract:
Nothing infuriates neuroscientists and psychologists more than a movie or advertisement that is based on the claim that "we only use 10% of our brainpower." This is just one of several common "neuromyths," which are beliefs about the mind and brain that are widely circulated but not backed by any scientific consensus. In this talk I will present data from two surveys (weighted to be representative of the United States population demographics; total N = 2820) about the prevalence and correlates of beliefs in neuromyths, and I will discuss some possible reasons why neuromyths are so persistent. In addition to the "10% myth," I will address the myth that people are either left-brained or right-brained, as well as misbeliefs about attention, perception, memory, learning, intuition, and intelligence.

About:
Christopher Chabris is Professor at Geisinger Health System in Pennsylvania, Associate Professor of Psychology at Union College in New York, and Visiting Fellow at the Institute for Advanced Study in Toulouse, France. He received his Ph.D. in psychology and A.B. in computer science from Harvard University. His research focuses on attention, intelligence (individual, collective, and social), behavior genetics, and decision-making. His work has been published in leading journals including *Science, Nature, PNAS, Psychological Science, Perception,* and *Cognitive Science*. Chris is also co-author of the book *The Invisible Gorilla: How Our Intuitions Deceive Us*, which has been published in 19 languages.

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ROI COHEN KADOSH, University of Oxford

Using the Brain when Learning: How Neuroscience Can Improve Cognitive Learning

Abstract:
The field of neuroscience enriched our understanding of cognitive learning in typically developing individuals and in those who suffer from neurodevelopmental disorders, as well as improve our prediction of learning outcomes. However, neuroscientific findings open new opportunities to improve learning by modulating human biology. One of the most promising methods is transcranial electrical stimulation (tES). tES allows to deliver a low and painless current non-invasively through the individual's scalp. The current penetrates the skull and affects brain regions underneath the electrodes and connected brain regions. Basic research has shown the capability of tES to influence changes in the brain that occurred during learning. I will focus on research coming from my lab showing the combination between cognitive training and a recently introduced stimulation method when the current is varied randomly, and appears as if its main effects on cortical functioning are excitatory. I will present results that combine tES with cognitive training of arithmetic and executive functions and will discuss some of the potential mechanisms, and future directions.

About:
Roi Cohen Kadosh is a Professor of Cognitive Neuroscience at the University of Oxford. His main research focuses on the psychological and biological factors that shape learning and cognitive achievements with focus on mathematical cognition and executive functions. Depending on the research question, the techniques used can vary from cognitive assessment, mental chronometry, and diffusion models to neuroimaging methods that allow to examine neurochemicals and brain structures and functions. In addition, he pioneers the use of brain stimulation to modulate neuroplasticity during cognitive training to improve learning and cognitive achievement.

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PETER HAGOORT, Max Planck Institute for Psycholinguistics, Nijmegen and Radboud University Nijmegen

Language and Reading: The Consequences of the Kantian Brain for the Classroom

Abstract:
The classroom is designed to teach children cultural inventions for which the brain is not evolutionary designed. Hence the classroom environment has to implement cultural reycling of neuronal maps. To do this effectively it has to recruit existing neural infrastructure. Therefore, teaching programmes have to be tailored to the possibilities and limitations of available neural architecture. An example in case is reading, a cultural invention of a few thousand years old. Orthographies and reading methods need to use visual cortex areas in the most optimal way. I will discuss how the characteristics of different orthographies are tailored to the possibilities of complex cells in visual cortex. In addition, different reading methods will be evaluated in the light of our understanding of human brain organization. I will argue that a systematic investigation of culture-brain relations is much needed for optimizing the optimal environment.

About:
Peter Hagoort is director of the Max Planck Institute for Psycholinguistics (since November 2006), and the founding director of the Donders Institute, Centre for Cognitive Neuroimaging (DCCN,1999), a cognitive neuroscience research centre at the Radboud University. In addition, he is professor in cognitive neuroscience at the Radboud University Nijmegen. His own research interests relate to the domain of the human language faculty and how it is instantiated in the brain. In his research he applies neuroimaging techniques such as ERP, MEG, PET and fMRI to investigate the language system and its impairments as in aphasia, dyslexia and autism.

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PAUL HOWARD-JONES, University of Bristol

Neuroscience in the Classroom – What's on the Menu?

Abstract:
Educational neuroscience aspires to undertake research relevant to improving educational practice. There are several processes that might be pursued in attempts to transfer scientific knowledge about learning to the classroom. These all lie at different points along a classic push-pull scale of design, with interventions "pushed" by new scientific insights at one end, and activities "pulled" by educational demand at the other. At the "push" end are the possibility of new interventions from scientific insights closest to application in the classroom, and these are briefly reviewed. At the "pull" end are the most pressing educational needs, one of which is to develop a language and understanding of those practices already known to be effective, so contributing to insightful communication and application of high quality teaching. This raises some interesting questions: To what extent should researchers in this area address and make themselves relevant to current educational perspectives, current issues, contexts, aims/motivations and opinions, and to what extent should they focus on the realization and application of fundamental scientific research? Is change more likely through developing new novel interventions or through seeking and promoting a scientific understanding of current effective teaching practices, so enabling better adaptation and implementation of these practices?

About:
Paul Howard-Jones is Professor of Neuroscience and Education at the Graduate School of Education, University of Bristol, where he leads the MSc (Education) pathway in Neuroscience and Education. Recent research has focused on games-based learning. Prior to his research career, he was a secondary school teacher, then a trainer of teachers and inspector of schools. He was a member of the UK's Royal Society 2011 working group on Neuroscience and Education and authored one of the first text books in this area (*Introducing Neuroeducational Research*). His new book *A Brief History of Your Learning Brain* will be published in 2017 by Routledge.

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MINNA HUOTILAINEN, SCAS, Uppsala and University of Helsinki

Neuroscientific Evidence of the Cognitive Benefits of Musical Hobbies for Learning

Abstract:
Recent research has revealed several changes in brains of musicians both in terms of structure of the gray and white matter as well as altered functionality in a number of brain areas. Similar structural and functional changes have also been confirmed in children and adults after starting a musical hobby. Such changes have been shown to lead to advanced performance in a range of tasks, including linguistic, memory- and attention-related, psycho-motor and general intelligence tasks - findings originally observed in group comparison studies but later largely confirmed also in intervention studies. In the talk it is proposed that these neural changes induced by musical hobbies provide a cognitive benefit for learning that should be available for all learners and could be an important learning enhancement strategy for teaching. Specific applications of music in education are outlined, ranging from experimental intervention studies in infants to supporting toddlers' native and second-language learning, attentive skills in school-aged children, reading and writing in dyslexic individuals, and general cognitive capacities in learners. Finally, the specificity of music for such benefits is discussed in comparison to other hobbies and activities.

About:
Minna Huotilainen is a neuroscientist and a docent of cognitive science at University of Helsinki and is currently Erik Allardt Fellow at Swedish Collegium for Advanced Study in Uppsala. Her work has demonstrated capabilities of the auditory system for perceptive, memory and attentive functions in infants, fetuses, children and adults. Her main findings include fetal memory traces for speech and music, neurocognitive benefits of musical hobbies, alterations of cognitive performance in stress and burn-out, and methodological advancements of neuroscientific measurements using natural sounds in real-life working and learning environments.

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TORKEL KLINGBERG, Karolinska Institutet, Stockholm

The Neuroscience of Development and Training of Mathematical Abilities during Childhood

Abstract:
(Torkel Klingberg, Federico Nemmi, and Margot Schel, Dept. Neuroscience, Karolinska Institutet, Sweden)
The adult brain contains a cortical area specialized for the analysis of numbers (the number form area, NFA). How and when the NFA establish specific connectivity to the rest of the brain during development is unknown.

In a study of resting state connectivity, we showed striking difference in the age at which specific functional connectivity emerged: the right intraparietal cortex (IPS) was connected to NFA at the earliest age tested (age 3.5) while the connectivity of the left IPS and the right dorsolateral prefrontal cortex was not established until 11.5 and 13.3 years, respectively. The latter was also associated with increase in mathematical ability. These results show a network of regions with specific connectivity to the NFA, some of which are established very early in life, and some of which only emerges through years of education and training.

The intraparietal cortex is consistently associated with mathematical performance, but also spatial attention and visuo-spatial working memory. This suggests that spatial coding of numbers, such as incorporated in the numberline representation, should be useful. We therefore investigated the effect of numerical training using a number-line (NLT), visuo-spatial WM training (WMT), or the combination of the two on a composite score of mathematical ability.

We randomly assigned 308, 6-year-old children to WMT, NLT, WMT+NLT or a control intervention. Overall, there was a significant effect of NLT but not WMT. The WMT+NLT was the only group that improved significantly more than the controls. Higher WM and maths performance predicted larger benefits for WMT and NLT, respectively. Neuroimaging at baseline also contributed significant information about training gain. Different individuals showed as much as a three-fold difference in their responses to the same intervention.

These results show that the impact of an intervention is highly dependent on individual characteristics of the child. If differences in responses could be used to optimize the intervention for each child, future interventions could be substantially more effective.

About:
Torkel Klingberg is Professor of Cognitive Neuroscience at the Karolinska Institute in Stockholm, Sweden. Klingberg's work on child brain development, education and cognitive training is at the international front line with publications including *Science, Nature Neuroscience, PNAS* and *Nature Reviews Neuroscience.* He led the original studies demonstrating that working memory can be improved by training, and leads several large Swedish project on child brain development and academic abilities. He is head of a non-profit organisation, CognitionMatters.org, and has written several books of popular science.

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SEBASTIÁN J. LIPINA, Unit of Applied Neurobiology (UNA, CEMIC-CONICET), Buenos Aires; National University of San Martin (UNSAM); and National Council of Scientific and Technological Research (CONICET)

Where We Are and Where We Should Go in the Study of Childhood Poverty and Cognitive Development

Abstract:
Several studies in the realm of developmental science have identified associations between childhood poverty and cognitive development, all of which are related to a complex constellation of individual and social determinants at different levels of analysis (i.e., individual, family and social contexts). The evidence suggest that the impact of those biological, psychosocial, and sociocultural factors on cognitive development could vary according to the type, number and accumulation of risks related to poverty, the time in which these factors exert their influences, the co-occurrence of deprivations and the individual susceptibility to them. Complementarily, during the last decades several experimental and quasi-experimental interventions aimed at optimizing cognitive performance of children living in poverty have been designed, implemented and evaluated in different low- and middle-income countries. Results suggest that it is possible to optimize different aspects of cognitive performance, and that would be possible to transfer some aspects of these gains to other domains including the academic achievement. The variability in the effectiveness of some of these controlled interventions has been related to different aspects of program design (e.g., comprehensiveness, quality, intensity and directionality of interventions, and teachers and family involvement), and to a complex patterns of individual and environmental factors that modulate their implementation. Future directions in this field of research require iterative processes of experimentation based on a continuous dialogue between different disciplines in order to achieve a strategic integration of multiple sources of knowledge to feed the innovation in the design of experimental interventions and their eventual scaling at a community level.

About:
Sebastián J. Lipina, PhD (Buenos Aires, Argentina). Director of the Unit of Applied Neurobiology (UNA, CEMIC-CONICET), Professor of Social Vulnerability and Cognitive Development at the National University of San Martin (UNSAM), and Researcher of the National Council of Scientific and Technological Research (CONICET). Sebastian is a developmental psychologist working in the field of environmental impacts on cognitive and emotional development at different levels of analysis. The current research projects under his direction focuses on the analysis of poverty influences on cognitive development and the design of interventions aimed at optimizing children's cognitive performance through exercising and training in laboratory, school and community settings. As part of his work in the area of poverty and child development, he works as consultant for PAHO, UNDP, UNICEF and several Ministries of Health, Education and Social Development in different Latin American countries. He is member of his institutional IRB (CEMIC), the Committee of Interdisciplinary Studies of the SRCD and Volunteer Researcher of the American Association for the Advancement in Science (AAAS).

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MARTIN LÖVDÉN, Karolinska Institutet, Stockholm

Structural Brain Correlates of Human Learning

Abstract:
Skill and knowledge acquisition are associated with a complex pattern of regional growth and shrinkage of the human brain's grey and white matter that can be imaged with Magnetic Resonance Imaging (MRI). I will give an overview of this literature. Stimulated by our recent findings on the progression of changes in human gray matter structure during motor skill acquisition, I argue that growth of regional human grey matter is just an initial and transient phase of learning. This phase is followed by a phase of complete or partial return to baseline once optimal rewiring has occurred. Common requirements for forming complex but robust learnings systems have shaped different brain correlates of learning, such as macrostructural changes, cortical map dynamics, and synaptic plasticity to unfold in a similar expansion-renormalization way. The highly efficient Darwinian learning process may underlie this pattern. Learning is the production of diversity (i.e., replication with variation) followed by selection and stabilization. Growth is helpful for learning, but only selective maintenance is needed for memory. I will discuss the implications of this model for future research on the brain correlates of learning, for lifespan development in human brain structure, and for improving learning ability.

About:
Martin Lövdén is professor of cognitive neuroscience at Karolinska Institutet. He does research on the question of how experience shapes development of brain and cognition across the lifespan. The interactions among behavior, brain structure, brain function, and cognitive performance are studied by experimental (intervention) studies as well as with multivariate statistical modeling of naturally occurring between- and within-person variability and change. His recent work focus on the brain correlates, probed with Magnetic Resonance Imaging (MRI), of cognitive and motor skill acquisition in humans.

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LARS NYBERG, Umeå University

Encoding-retrieval Interactions in Long-term Memory: Importance for Durable Learning

Abstract:
A classic observation is that repeated learning/encoding serves to strengthen memory representations. Accumulating evidence also point to a critical role for repeated testing in strengthening memory representations, and in particular to support retention over longer intervals. In this presentation I will focus on this so-called "testing-effect". Findings from experimental and more applied settings will be reviewed, including discussion of the role of feedback/reward for the effect. Data from brain-imaging studies will also be discussed. Such data contribute to our understanding of the neurobiological basis of the testing effect. It will be concluded that testing has a vital role in educational settings to foster durable learning.

About:
Lars Nyberg serves as Professor of Psychology and Neurosciences at Umeå University, Sweden. He has been active in the field of functional neuroimaging of memory for more than two decades. He is the director of Umeå Center for Functional Brain Imaging (UFBI), and a principal investigator of the Betula longitudinal project on aging, memory and dementia. Since 2008 he is a member of the Royal Swedish Academy of Sciences. Nyberg's research is currently focused on the identification of genetic, brain, and life-style predictors of heterogeneity in cognitive-aging profiles.

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ANDREAS OLSSON, Karolinska Institutet, Stockholm
Emotion and Social Learning

Abstract:
In rapidly changing environments, humans and other animals often glean information about the value of objects and behaviors through social learning. In humans, for example, observing others' behaviors and their consequences, enables the transmission of a wide range of value-based information, from what stimuli should be avoided or approached to the appropriateness of specific social behaviors. In contrast to learning from direct, personal, experiences, little is known about the mechanisms underlying these forms of social learning. I will discuss studies using behavioral, imaging, and pharmacological techniques examining both the sender and receiver during various forms of social learning. Consistent with research across species, our results show that social learning (especially of threat and safety) draws on processes partially shared with direct conditioning, and extinction learning. Importantly, the outcome of social learning is distinguished by its dependence on social cognition.

About:
Dr. Andreas Olsson received his PhD in experimental psychology from New York University (2006). Until 2008 he was a post-doctoral research fellow at Columbia University. He then moved to Karolinska Institutet, where he was appointed an Associate professor and a research group leader in 2011. He is the founder and director of the Emotion Lab (www.emotionlab.se). The broad aim of Dr. Olsson's research is to describe and model the psychological and neural foundations of emotional learning and regulation in social situations. Dr. Olsson has >50 publications in peer-reviewed, scientific journals, including *Science, Nature Neuroscience, Nature Communication, Psychological Science*, and *Trends in Cognitive Science*. Dr. Olsson has obtained several national and international scientific awards and grants, including an individual Starting Grant from the European Research Council (ERC). In 2015, he was named a Wallenberg Academy Fellow.

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MEGAN A. SMITH, Rhode Island College, Providence

Retrieval-Based Learning Strategies from the Laboratory to the Classroom

Abstract:
Practicing retrieval, or bringing information to mind by taking a test or quiz, or some other retrieval-based activity, improves learning. Further, retrieval practice does not just improve rote memorization of facts, but improves meaningful learning. The learning benefits of retrieval practice have been established across a number of different researchers, in both the laboratory and live classroom settings, and with a wide range of students from college age to students in elementary school. However, the utilization of retrieval-based learning activities is not as widespread as it could be, and a recent report of teacher-training textbooks (Pomerance, Greenberg, & Walsh, 2016) indicates teachers are not likely learning about the benefits of retrieval during training. During the lecture, Dr. Megan Smith will present experimental evidence demonstrating the power of utilizing retrieval practice to improve meaningful learning. She will then discuss ways that she and her colleagues have worked to help bridge the gap between the research on effective learning strategies and practice through The Learning Scientists. Through this project, they have created free materials for teachers and students about retrieval practice and other effective learning strategies.

About:
Megan Smith is an Assistant Professor at Rhode Island College. She received her Master's in Experimental Psychology at Washington University in St. Louis and her PhD in Cognitive Psychology from Purdue University. Megan studies human learning and memory, specifically applying the science of learning in educational contexts. Megan is passionate about bridging the gap between research and practice in education. In an effort to promote more conversations between researchers and practitioners, she co-founded The Learning Scientists (www.learningscientists.org). Her research program focuses on retrieval-based learning strategies, and the way activities promoting retrieval can improve meaningful learning in the classroom.

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MARIA GRAZIA TOSTO, SOAS University of London and Tomsk State University

Insights from Genetic Research Into the Association Between Reading and Mathematics

Abstract:
Findings from quantitative genetic research on reading and mathematics suggest that variation in both abilities is driven by environments and by many genes of small effect. Genetic effects on reading and mathematics are moderate to strong, are relatively stable over development and are responsible for most of the observed co-variation between the two abilities. Environments mainly contribute to developmental changes and discrepancies in both abilities. The aetiology of normal, low and high ability in reading and mathematics is largely the same, suggesting mainly the same genetic and/or environmental factors operating in the whole range of ability. Recent research suggests that the observed association of reading and mathematics with measures of environments and non cognitive traits, such as motivation, subject interest and personality are also influenced by common genetic factors. Molecular genetic studies including polygenic scoring, support what reported by quantitative genetics. More importantly they are facilitating the discovery of genetic variances associated with those traits. Understanding genes function will help to understand the path from genes, to brain function, to patterns of behaviour. Ultimately, this research will bringing us closer to understanding the origins of individual differences and to apply this knowledge to new studies as well as in educational practice.

About:
I have been lecturing in psychology across different branches of the University of London, in the United Kingdom. I am currently lecturing at the School of Oriental and African Studies, University of London (SOAS) and I am an associate professor at Tomsk State University where I lecture in psychology. I am also course convenor for the MSc programme in developmental disorders. My research focuses mainly on mathematics, reading, cognitive and non-cognitive abilities associated with learning.