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The Royal Society of Canada
The Academies of Arts, Humanities and Sciences of Canada

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La Société royale du Canada
Les Académies des arts, des lettres et des sciences du Canada

PROGRAMME

Canada-Israel Symposium:

Brain Plasticity, Learning, and Education

Western University
London, Ontario, Canada
June 14 - 16, 2013

We would like to thank the following organizations for their support.

Western
The Brain and Mind Institute

CIFAR
CANADIAN INSTITUTE FOR ADVANCED RESEARCH

Yolande Grisé

Dear Colleagues,

On behalf of the fellowship of the Royal Society of Canada, I would like to welcome you to this wonderful occasion, the origins of which stretch back many years.

The RSC: The Academies of Arts, Humanities and Sciences of Canada is grateful to His Excellency the Right Honourable David Johnston, Governor General of Canada, and to the President of Israel, Shimon Peres, who, together, played an instrumental role in linking the two senior learned societies of our two countries. We know that, as the Honorary Patron of the Royal Society of Canada, His Excellency has been an enthusiastic supporter – indeed, he is a champion – of Canadian scholars, at home and around the world. In a similar fashion, President Peres is a remarkable champion of the culture of knowledge and innovation so present in Israel and in its institutions of higher learning. Together, they oversaw the signing of the Memorandum of Understanding between the RSC and the Israeli Academy of Sciences and Humanities (IASH).

To this expression of gratitude, I would like to add two additional "thank yous." The first is to Ruth Arnon, President of the Israeli Academy of Sciences and Humanities. President Arnon has been a remarkable source of leadership and counsel as our two learned societies developed the contours of our Memorandum of Understanding (MoU).

Secondly, may I thank the two Foreign Secretaries of our respective institutions, Professor Jeremy McNeil of the RSC and Professor Howard Cedar of the Israeli Academy. It is due to their commitment to give life to the MoU that this event is occurring.

I expect that this unique scholarly occasion will be resplendent in discovery and possibility, and I delight in the bright future of cooperation between the RSC and the IASH.

Sincerely,

Yolande Grisé

Yolande Grisé, FRSC
President, the Royal Society of Canada

Chers collègues,
Chères collègues,

Au nom de la Société royale du Canada, j'aimerais vous souhaiter la bienvenue à l'occasion de cette réunion exceptionnelle, dont l'idée initiale remonte à quelques années.

La SRC: Les Académies des arts, des lettres et des sciences du Canada est reconnaissante envers Son Excellence le très honorable David Johnston, Gouverneur général du Canada, et Monsieur Shimon Peres, Président de l'État d'Israël, qui, ensemble, ont joué un rôle déterminant dans la collaboration des deux plus anciennes sociétés savantes de nos deux pays. Nous savons qu'en tant que Président d'honneur de la Société royale du Canada, Son Excellence est reconnue pour être un partisan enthousiaste - en fait, le champion - de la recherche et de l'innovation canadiennes, au pays et partout dans le monde. De son côté, le président Peres a la réputation d'être un ardent défenseur de la culture du savoir et de l'innovation sur toutes les tribunes en Israël et dans les établissements d'enseignement supérieur de son pays. Tous deux ont présidé ensemble à la signature de l'accord conclu entre la SRC et l'Académie israélienne des sciences et des lettres (AIHS).

À ce témoignage de gratitude, je souhaiterais ajouter deux autres « mercis. » Le premier s'adresse à Madame Ruth Arnon, Présidente de l'Académie israélienne des sciences et des lettres. Le leadership et les conseils de Madame la Présidente Arnon ont été d'un admirable appui dans l'élaboration du protocole d'entente par nos deux sociétés savantes.

En second lieu, je voudrais remercier les deux Secrétaires aux affaires internationales de nos instituions respectives : Monsieur le professeur Jeremy McNeil, membre de la SRC, et Monsieur le professeur Howard Cedar, membre de l'Académie israélienne. Nous devons à leur engagement et à leur détermination la réalisation de cette entente mémorable à l'origine de l'événement d'aujourd'hui.

Je me réjouis à l'idée que cette rencontre inaugurale puisse ouvrir de nouvelles perspectives et possibilités à la recherche et qu'elle soit un formidable coup d'envoi pour l'avenir de la coopération entre la SRC et l'AIHS.

Cordialement,

Yolande Grisé

Yolande Grisé, MSRC
Présidente, la Société royale du Canada

Ruth Arnon

Dear workshop participants,

It is a privilege for me to greet participants in this first Canada-Israel bi-national workshop; I only regret that I am unable to be with you in person to launch what promises to be a significant factor in strengthening the ties between the scientists and researchers of our countries. When I assumed the Presidency of the Israel Academy, nearly three years ago, I resolved that one of my top priorities would be to further develop and expand the scientific cooperation of the Academy with sister institutions. The Royal Society of Canada was high on the list because of Canada's world renowned scientific achievements and its exemplary record in defending academic freedom. Thanks to the fortuitous presence of a number of Academy members at the Gairdner Prize Ceremony in 2011 and their meeting with RSC officials, the door was opened for a "fast-track" to an agreement. Dr. Yolande Grisé and I decided that a main feature of future cooperation between our sister institutions would be annual small, well-focused workshops alternating between the two countries. This is the first such meeting since the formal signing of the Agreement last year in Ottawa in the presence of Israel's President and Canada's Governor General.

It is no coincidence that the first symposium is devoted to *Brain Plasticity, Learning and Education,* considering the high level of research in brain sciences carried out in both countries. What makes this meeting especially noteworthy is the range of issues that will be addressed -- from animal models right through to research on the development of cognitive abilities in the human brain. Hopefully, one of the outcomes of the meeting, which is also supported by the Canadian Institute for Advanced Research, will be collaborative bi-national research. We are already looking forward to the second annual meeting, this one dedicated to the humanities to take place in Jerusalem in 2014.

I wish you all a scientifically rewarding and personally gratifying meeting.

Yours sincerely,

Ruth Arnon
President, the Israeli Academy of Sciences and Hunamities

Chers participants,

C'est un privilège pour moi d'accueillir les participants à ce premier atelier binational Canada/Israël. Je regrette seulement de ne pas pouvoir être parmi vous pour lancer cet événement qui jouera un rôle considérable dans le renforcement des liens entre les scientifiques et chercheurs de nos pays. Lorsque j'ai assumé la présidence de l'Académie d'Israël, il y a près de 3 ans, j'ai compris que l'une de mes priorités serait de renforcer et d'élargir la coopération scientifique de l'Académie avec ses institutions sœurs. La Société royale du Canada était en tête de liste en raison des travaux scientifiques de renommée mondiale réalisés au Canada et de sa capacité exemplaire à défendre la liberté académique. Grâce à la présence fortuite d'un certain nombre de membres académiques à la Cérémonie de remise du prix Gairdner en 2011 et à leur réunion avec les dirigeants de la SRC, nous avons pu rapidement parvenir à un accord. Mme Yolande Grisé et moi-même avons décidé que l'une des activités principales de la future coopération entre nos institutions jumelles serait l'organisation de petits ateliers annuels spécialisés, en alternance entre les deux pays. Il s'agit de la première réunion du genre depuis la signature officielle de l'accord l'année dernière à Ottawa en présence du président israélien et du Gouverneur général du Canada.

Ce n'est pas un hasard si le premier colloque est consacré au thème *Plasticité cérébrale, apprentissage et éducation,* étant donné le haut niveau des recherches en science du cerveau menées dans les deux pays. Ce qui rend cette réunion particulièrement remarquable, c'est la pluralité de questions qui seront abordées, des modèles animaux à la recherche sur le développement des capacités cognitives du cerveau humain. Nous espérons que la réunion permettra d'entamer des recherches conjointées entre les deux pays, comme le soutient également l'Institut canadien des recherches avancées. Il nous tarde déjà de vous accueillir pour la seconde réunion annuelle, qui sera consacrée aux lettres et aux sciences humaines et qui aura lieu à Jérusalem en 2014.

Je vous souhaite une réunion gratifiante tant sur le plan personnel que scientifique.

Salutations,

Ruth Arnon
Présidente, the Israeli Academy of Sciences and Hunamities

Marie D'Iorio

Dear colleagues,

As President of the Academy of Science, I am honored and delighted to welcome distinguished scholars from the Academy of Sciences and Humanities of Israel. In addition, I am grateful for the enthusiastic participation of eight Fellows of the Royal Society of Canada (RSC), who have travelled from Lethbridge, Toronto, Hamilton, Montreal and Vancouver in order to participate in this important Symposium.

This joint Symposium is noteworthy for a number of reasons: (1) it underlines the eagerness and capacity of National Academies to actively collaborate on issues of mutual importance; (2) it advances key scientific issues that inform our respective country's research agendas—Canadian Brain Research Centers like the Brain and Mind Institute in London, Ontario, are keen to understand how Israel has created such world renowned excellence throughout its university network; and (3) it unites disciplines—indeed the Symposium addresses not only the science of brain plasticity, learning and development but the implications of brain development on social policy, in particular with respect to early childhood development.

For these reasons, I am delighted to welcome and thank our distinguished Israeli guests for their participation in this Symposium. Our National Academies thrive due to the willingness of our scholars to serve in the name of advancing multidisciplinary research, to the benefit of us all.

Sincerely,

Marie D'Iorio
President
The Academy of Science

Chers collègues,
Chères collègues,

En tant que présidente de l'Académie des sciences, j'ai l'honneur et le plaisir d'accueillir les éminents érudits de l'Académie israélienne des sciences et lettres. De plus, je suis très reconnaissante de l'enthousiasme de huit membres de la Société royale du Canada (SRC), qui ont voyagé depuis Lethbridge, Toronto, Hamilton, Montréal et Vancouver pour participer à ce colloque d'importance.

Ce colloque conjoint se démarque pour plusieurs raisons : (1) il met l'accent sur l'engouement et la capacité des académies nationales à collaborer activement sur des questions d'importance commune; (2) il met en avant des questions scientifiques clés qui alimentent les programmes de recherche de nos pays respectifs. Les centres de recherche cérébrale canadiens comme le Brain and Mind Institute à London, en Ontario, sont désireux de comprendre comment Israël a réussi à créer un réseau universitaire d'excellence d'une telle renommée mondiale; (3) il réunit les disciplines. En effet, le colloque traite non seulement de la plasticité cérébrale, de l'apprentissage et du développement, mais également des implications du développement cérébral dans la politique sociale, en particulier en ce qui a trait au développement des jeunes enfants.

Pour ces raisons, je suis heureuse d'accueillir et de remercier nos éminents invités israéliens pour leur participation au colloque. Si nos académies nationales fonctionnent aussi bien, c'est grâce à la volonté de nos érudits à agir pour promouvoir la recherche pluridisciplinaire au profit de tous.

Cordialement,

Marie D'Iorio
Présidente
L'Académie des sciences

Alan Bernstein

Dear colleagues,

On behalf of the Canadian Institute for Advanced Research (CIFAR), I would like to welcome you to the Canada-Israel Symposium on *Brain Plasticity, Learning, and Education.* CIFAR is pleased to be a presenting sponsor for this event.

Research is at the very core of understanding the world in which we live and is essential for improving the quality of life for people everywhere. To continue our advances in knowledge creation, we need to find new ways to collaborate across disciplines and geographic boundaries.

This symposium establishes an important platform that will lead to exciting new conversations between experts in Canada and Israel, all who are contributing new thinking about the cognitive abilities of the human brain. We're pleased that representatives from CIFAR'S *Child & Brain Development* program will share their latest insights on how experience affects our genes, brain function and even how infants perceive speech.

CIFAR's unique research model was founded on the belief that when you bring together top scholars and scientists from any part of the world to form multidisciplinary research networks, you can create new ways to address issues of importance to the world that were not otherwise possible.

I look forward to the interdisciplinary exchange that will prevail at this symposium and to working together in the future to build a better understanding of the human brain.

Alan Bernstein, O.C., PhD, FRSC
President & Chief Executive Officer
Canadian Institute for Advanced Research (CIFAR)

Chers collègues,
Chères collègues,

Au nom de l'Institut canadien de recherches avancées (ICRA), j'aimerais vous souhaiter la bienvenue au Symposium Canada-Israël sur la plasticité cérébrale, l'apprentissage et l'éducation. L'ICRA est heureux d'être un commanditaire principal de cet événement.

La recherche est essentielle pour comprendre le monde qui nous entoure et améliorer la qualité de vie de tous les êtres humains. Pour poursuivre nos percées en matière de création de connaissances, nous devons trouver de nouvelles façons de collaborer entre disciplines et régions géographiques.

Ce symposium constitue une importante tribune qui permet de nouvelles conversations emballantes entre experts du Canada et d'Israël où chacun propose une nouvelle approche à l'étude des habiletés cognitives du cerveau humain. Nous sommes ravis de la participation de membres du programme *Développement du cerveau et de l'enfant* de l'ICRA qui partageront leurs tout derniers résultats sur la façon dont l'expérience influence les gènes, la fonction cérébrale et même la perception de la parole par les nourrissons.

Le modèle de recherche exceptionnel de l'ICRA repose sur la conviction que quand on réunit les plus grands chercheurs et scientifiques du monde entier pour créer des réseaux de recherche multidisciplinaires, il peut en découler de nouvelles façons d'aborder les grands défis du monde qui n'auraient pu voir le jour autrement.

J'attends avec intérêt les échanges interdisciplinaires qui règneront à ce symposium et je suis emballé à l'idée de travailler avec vous à l'avenir pour améliorer notre compréhension du cerveau humain.

Alan Bernstein, O.C., Ph. D., MSRC
Président et chef de la direction
Institut canadien de recherches avancées (ICRA)

Schedule

FRIDAY, JUNE 14, 2013		
7:00pm - 10:00pm	**Social Evening at the Graduate Student Pub**	Middlesex College
SATURDAY, JUNE 15, 2013		
7:30am - 8:30am	**Registration and Continental Breakfast**	Western Science Centre (outside Room 55)
8:30am - 9:00am	**Opening Ceremonies**	Western Science Centre Room 55
9:00am - 10:30am	**A Call for a Multidisciplinary Approach to Teaching with the Neurosciences and Cognitive Sciences in the Lead** *Sidney Strauss, Tel Aviv University*	Western Science Centre Room 55
	How Our Genes Listen to the Environment *Marla Sokolowski, FRSC, CIFAR, University of Toronto*	
10:30am - 11:00am	**Break**	Physics and Astronomy Atrium
11:00am - 12:30pm	**Brain Plasticity from the Perspective of Single Neurons** *Adi Mizrahi, The Hebrew University of Jerusalem*	Western Science Centre Room 55
	Understanding the Effects of Experience on Speech Perception in Infancy *Janet Werker, FRSC, CIFAR, The University of British Columbia*	
12:30pm - 2:00pm	**Networking Lunch**	Physics and Astronomy Atrium
2:00pm - 3:30pm	**Predispositions and Plasticity in Auditory Learning: Neural Correlates and Implications** *Robert Zatorre, McGill University*	Western Science Centre Room 55
	Adaptive Cortical Plasticity in the Developing Brain Following Sensory Loss *Stephen Lomber, Western University*	
3:30pm - 4:00pm	**Break**	Physics and Astronomy Atrium
4:00pm - 5:30pm	**Learning with Negative Reinforcement: The Good, the Bad, and Neural Mechanisms** *Rony Paz, Weizmann Institute*	Western Science Centre Room 55
	From Perceptual Learning to Cognitive Training *Merav Ahissar, The Hebrew University of Jerusalem*	
5:30pm - 6:45pm	**Poster Session**	Physics and Astronomy Atrium
7:00pm - 10:00pm	**Banquet**	Great Hall - Somerville House

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SUNDAY, JUNE 16, 2013		
8:00am - 9:00am	**Continental Breakfast**	Western Science Centre (outside Room 55)
9:00am - 10:30am	**Experience and the Developing Prefrontal Cortex** *Bryan Kolb, FRSC, CIFAR, University of Lethbridge*	Western Science Centre Room 55
	Enhancing Cognitive Function Via Memory Consolidation *Kobi Rosenblum, University of Haifa*	
10:30am - 11:00am	**Break**	Western Science Centre (outside Room 55)
11:00am - 12:30pm	**The Proactive Brain: Predictions in Visual Cognition** *Moshe Bar, Bar-Ilan University*	Western Science Centre Room 55
	Coping with Frustration at Preschool Age - Neural Correlates of Inhibitory Control while Experiencing Frustration, and Maternal Biological vs. Environmental Influences *Andrea Berger, Ben-Gurion University of the Negev*	
12:30pm - 2:00pm	**Networking Lunch**	Physics and Astronomy Atrium
2:00pm - 3:00pm	**Discussion on Current Issues in "Brain Plasticity, Learning, and Education"** *Moderator: Daniel Ansari, Western University* *Participants: Avishai Henik, Linda Siegel, Sidney Strauss and Adi Mizrahi*	Western Science Centre Room 55
3:00pm - 3:45pm	**Critical Periods Re-examined: Evidence from Children Treated for Dense Cataracts** *Daphne Maurer, FRSC, McMaster University*	
3:45pm - 4:15pm	**Break**	Western Science Centre (outside Room 55)
4:15pm - 5:45pm	**Paths to Orienting of Attention** *Avishai Henik, Ben-Gurion University of the Negev*	Western Science Centre Room 55
	Early Identification and Intervention to Foster Literacy Development and Prevent Reading Problems *Linda Siegel, The University of British Columbia*	
5:45pm - 6:00pm	**Closing Remarks**	Western Science Centre Room 55

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Speakers *(arranged alphabetically)*

Merav Ahissar, The Hebrew University of Jerusalem

Professor Ahissar received her MSc in Physiology and PhD in Neurobiology, from the Hebrew University of Jerusalem, and completed her postdoctoral research at UCSF and the Weizmann Institute. Her main interests are perceptual and cognitive learning in the general population and in individuals with learning disabilities. The relations between psychological phenomena and their underlying physiological mechanisms have always fascinated her. She began her scientific career with single unit electrophysiology in behaving monkeys, and continued with psychophysics, studying perceptual learning in adult humans. In the past few years she has focused on even higher level skills, and is now studying the relations between perception and cognition.

From Perceptual Learning to Cognitive Training

Traditionally perception was viewed as an early module of brain processing whose plasticity is limited. Our lab's studies of visual and auditory perceptual learning in adults revealed substantial plasticity, whose characteristics are surprisingly similar to those of cognitive learning. In both, improvement begins with grasping the relevant information for solving the required task. In both, acquiring expertise is contingent upon detecting the relevant regularities in the input. Training then leads to scheme formation that promotes automatic performance, which is based on lower-level brain representations. Thus, behaviour is first based on high-level representations and is gradually based on more stimulus-specific lower-level ones (in a reverse hierarchy manner). Individuals with difficulties in detecting these regularities will have difficulties in acquiring automatic behaviour. Such is the case with dyslexics, whose difficulties in detecting regularities in oral language and in written scripts impede reading acquisition. This common framework for perceptual and cognitive learning implies that lessons from perceptual training can serve as guidelines for improving cognitive training programs.

Moshe Bar, Bar-Ilan University

Professor Bar is the Director of The Gonda Multidisciplinary Brain Research Center at Bar-Ilan University and an Associate Professor in Neuroscience, Psychiatry and Radiology at Harvard Medical School and the Massachusetts General Hospital. His work focuses on exploring how the brain extracts and uses contextual information to generate predictions and guide cognition efficiently, as well as characterization of the links between cognitive processing, mood and depression. Prof. Bar uses neuroimaging (fMRI, MEG), psychophysical, cognitive and computational methods in his research.

The Proactive Brain: Predictions in Visual Cognition

Understanding our visual environment is crucial for our existence. In spite of the considerable complexity of achieving this goal, we are all extremely effective visual creatures. Research in my lab indicates that one of the main sources of this efficiency is the generation and use of predictions. Our proactive minds and brains continuously activate memories of previous experience to interpret the present and anticipate the future. These predictions are based on characteristic object appearances, on typical spatial relations, and on statistical regularities of other recurring patterns. They are associative in nature, and are triggered rapidly based on rudimentary, gist information. This principle of predictions covers an exceptional range of mental operations: from object to scene recognition, from person self-impressions to shaping our opinions and preferences, and from the brain's 'default mode' to mood and mental disorder. The talk is planned to describe the theoretical foundations of this framework and the empirical evidence to support it.

Andrea Berger, Ben-Gurion University of the Negev

Andrea Berger is an Associate Professor in the Department of Psychology at Ben-Gurion University of the Negev. She received a PhD in Cognitive Psychology and following her postdoctoral training at the University of Oregon, her research increasingly adopted a developmental perspective. Her field of expertise, Developmental Cognitive Neuroscience, reflects Dr. Berger's interest in the relation between the brain and behaviour during normal and abnormal development. The main topic investigated in her ERP lab is the development of the executive aspects of attention and control, such as inhibitory control, monitoring, and error-detection, and their implications for self-regulation. The second topic of research is early numerical cognition. In both lines of research, Dr. Berger studies typical and atypical development, combining behavioural and electrophysiological methods.

Coping with Frustration at Preschool Age – Neural correlates of Inhibitory Control while experiencing frustration, and maternal biological vs. environmental influences

Children's inhibitory control (IC), the ability to inhibit a prepotent response in favour of a situationally required one, undergoes significant development during a child's kindergarten years. Negative emotions, such as frustration and anxiety, impose challenges on executive functioning and may specifically affect IC. Whether a kindergarten-age child can cope with such a challenge is partially dictated by his/her temperamental effortful control (EC). EC can determine whether a child will be able to resist the internal distraction created by the frustration and, instead, productively exploit the induced motivational energy. Our study indicates that the child's IC in a frustrating situation is also related to maternal factors, such as the mother's EC and her parenting practices. Further, these relations can be seen at the behavioural level, as well as at the neural level, for example, at one of specific ERP components relevant to IC.

Avishai Henik, Ben-Gurion University of the Negev

Professor Henik received his PhD from the Hebrew University Israel and did his post doc at the University of Oregon. His laboratory studies the neural and cognitive basis of numerical processing, attention and cognitive control, emotion, and synesthesia. In all of these areas they investigate the brain-behaviour relationship, both in normal and deficient populations. Part of their research effort is devoted to understanding typical and atypical development. Recently, they have started to conduct research on fish in an effort to study numerical sense and attention in an evolutionarily older system.

Paths to orienting of attention

Orienting of visual attention to a point of interest is commonly accompanied by overt movements of the head, eyes, or body. However, orienting can be achieved covertly, without eye movement. Moreover, attending may originate at will, or it may originate reflexively without intention—termed exogenous attention. Exogenous shifts of attention are commonly initiated by non-predictive peripheral luminance change (i.e., a cue). Right after the appearance of the cue there is a facilitation of responding to targets at cued locations, which is superseded by relative slowdown of responding to such targets—inhibition of return (IOR). IOR has attracted attention of both cognitive and neuroscientists. Research has indicated that IOR is generated by the mid-brain superior colliculus but may require involvement of cortical structures. It has been suggested that IOR is designed to favor search in new locations, and functions as a foraging facilitator. We discuss the evolution of IOR, the neural tissue involved, and its functional significance.

Bryan Kolb, FRSC, CIFAR, University of Lethbridge

Bryan Kolb is a native of Calgary, Canada and is currently a Professor in the Department Neuroscience at the University of Lethbridge, where he has been since 1976. He received his PhD from Pennsylvania State University in 1973 and did postdoctoral work at the U of Western Ontario and the Montreal Neurological Institute. His recent work has focused on the development of the prefrontal cortex and how neurons of the cerebral cortex change in response to various developmental factors including hormones, experience, stress, drugs, neurotrophins, and injury, and how these changes are related to behaviour. Bryan Kolb has published 5 books, including two textbooks with Ian Whishaw *(Fundamentals of Human Neuropsychology, Sixth Edition; Introduction to Brain and Behavior, Fourth Edition),* and over 350 articles and chapters. Kolb is a Fellow of the Royal Society of Canada and a Killam Fellow of the Canada Council. He is currently a member of the Canadian Institute for Advanced Research program in the Experience-Based Brain Development program.

Experience and the developing prefrontal cortex

The prefrontal cortex (PFC) receives input from all other cortical regions and functions to plan and direct motor, cognitive, affective, and social behaviour across time. It has a prolonged development, which allows the acquisition of complex cognitive abilities through experience but makes it susceptible to factors that can lead to abnormal functioning, which is often manifested in neuropsychiatric disorders. When the PFC is exposed to different environmental events during development, such as sensory stimuli, stress, drugs, hormones, and social experiences (including both parental and peer interactions), the developing PFC may develop in different ways. The goal of the current review is to illustrate how the circuitry of the developing PFC can be sculpted by a wide range of pre- and postnatal factors. I will begin with an overview of prefrontal plasticity and development, before considering the implications for learning and education.

Stephen Lomber, Western University

Dr. Stephen G. Lomber is a Professor of Physiology and Psychology at Western University, where he is also an investigator in the Brain and Mind Institute and National Centre for Audiology. Dr. Lomber examines cortical plasticity utilizing animal models of human hearing, deafness, and the restoration of hearing with cochlear implants. His work is supported by CIHR, NSERC, CFI, and the Hearing Foundation of Canada. Dr. Lomber has received numerous research and teaching awards, including the 2012 Dean's Award for Research Achievement from the Schulich School of Medicine and Dentistry. He has authored over 80 original research publications and two books—*Reprogramming the Cerebral Cortex* and *Virtual Lesions.*

Adaptive Cortical Plasticity in the Developing Brain Following Sensory Loss

Studies of deaf or blind subjects often report enhanced perceptual abilities in the remaining senses. Compared to hearing subjects, psychophysical studies have revealed specific superior visual abilities in the early-deaf as well as enhanced auditory functions in the early-blind. The neural substrate for these superior sensory abilities has been hypothesized to reside in the deprived cerebral cortices that have been reorganized by the remaining sensory modalities through crossmodal plasticity. In this context, it has been proposed that auditory cortex of the deaf may be recruited to perform visual functions. However, a causal link between supranormal visual performance and the visual activity in the reorganized auditory cortex has never been demonstrated. Furthermore, if auditory cortex does mediate the enhanced visual abilities of the deaf, it is unknown if these functions are distributed uniformly across deaf auditory cortex, or if specific functions can be differentially localized to distinct portions of the affected cortices. These fundamental questions are of significant clinical importance now that restoration of hearing in prelingual deaf children is possible through cochlear prosthetics. Psychophysical, neuroanatomical, electrophysiological, and functional imaging studies will be described that demonstrate crossmodal plasticity in auditory cortex underlies the enhanced visual abilities of the early deaf. Finally, we will examine how short periods of acoustic exposure early in life can dramatically influence the developmental trajectory of auditory cortex.

Daphne Maurer, FRSC, McMaster University

Daphne Maurer is a Distinguished Professor at McMaster University, where she has studied the normal development of visual perception and its alteration by a period of deprivation caused by cataracts. She is a member of the Royal Society of Canada and the current President of the International Society for Infant Studies. Her book, *The World of the Newborn,* written with her husband, Charles Maurer, won the APA Book Prize and has been translated into five languages.

Critical Periods Re-examined: Evidence from children treated for dense cataracts

We have been taking advantage of a natural experiment: children treated for dense cataracts that blocked all patterned vision to the retina until the cataracts were removed surgically and the eyes fit with compensatory contact lenses. I will describe the general principles that have emerged from comparing the effects of bilateral and unilateral cataracts and from studying the consequences of deprivation that began at different ages. Together, the results suggest different critical periods for damaging different aspects of vision and different principles for low level (e.g., acuity) and higher level vision (e.g., global motion). Nevertheless, some potential for rehabilitation remains even in adulthood.

Adi Mizrahi, The Hebrew University of Jerusalem

Professor Adi Mizrahi completed his PhD at Ben Gurion University of the Negev under the supervision of Prof. Frederic Libersat where he studied identified neurons of invertebrates. Then, he continued to postdoctoral training with Prof. Lawrence Katz, at Duke University Medical Center. In the Katz's lab he studied the mammalian brain by employing expertise in live imaging techniques. In 2005 he established his lab as an independent researcher at The Hebrew University of Jerusalem where he is now an associate professor. His lab focuses on questions of long term plasticity in the adult mammalian brain with emphasis on two sensory systems, olfaction and audition.

Brain Plasticity from the Perspective of Single Neurons

The mammalian brain is dauntingly complex. Even local neural circuits are normally composed of highly heterogeneous groups of cells. Moreover, neurons are inherently dynamic making the study of brain function and plasticity highly challenging. I will describe new methods to study brain plasticity at the single cell level in mice. Specifically, I will describe novel technologies in high resolution imaging techniques and genetic manipulations that allows us to study single neurons and local populations of cells over long time scales. These methods open a window of opportunity get a mechanistic understanding of brain plasticity at single cell resolution.

Rony Paz, Weizmann Institute

Completed his BSc and BA in Mathematics and Philosophy *(cum laude)* from the Hebrew University in Jerusalem, then received his PhD *cum laude* at the center for neural computation (ICNC) at the Hebrew University and Hadassah medical school, exploring the neural mechanisms of motor learning, and then performed post-doctoral work with Prof. Denis Pare at Rutgers University, focusing on computational electrophysiology of emotional learning. He is now an assistant professor, Alon and Marie-Curie fellow, incumbent of the Beracha career development chair at the Department of Neurobiology at the Weizmann Institute of Science. His lab focuses on electrophysiology in non-human primates and psychophysics and imaging work in humans, to explore the mechanisms that underlie emotional and reinforcement learning.

Learning with Negative Reinforcement: The good, the bad, and the neural mechanisms

Learning with negative reinforcers is a primary goal of living organisms, as it can crucially affect survival. I will focus on two aspects of such learning: extinction of aversive memories, and generalization from examples. Extinction is a form of emotional modulation, where a previously aversive stimulus becomes safe. In abnormal conditions, failure to extinguish might result in post-trauma (PTSD) and anxiety-disorders; however, under normal conditions (e.g. education), it is beneficial to have memories that are resistant to extinction. I will use probabilistic reinforcement as a model to examine the effect on extinction rates and the underlying neural mechanisms. Generalization, where the response transfers to similar, but not identical stimuli, is a fundamental element of learning. Whereas normal learning (in education) requires some extent of generalization, over(wide)-generalization might result in anxiety-disorders. I will explore how primary and secondary reinforcers affect the extent of generalization, and point to the underlying neural architecture, as revealed by imaging and electrophysiological studies.

Kobi Rosenblum, University of Haifa

Professor Kobi Rosenblum received his PhD in 1997 from the Weizmann Institute of Science. He is now Associate Professor of Neurobiology, Director Gene Manipulation in the brain research center, Chair and founder of the Sagol Dept of Neurobiology, University of Haifa. Professor Rosenblum's research is focused on molecular and cellular mechanisms underlying learning and memory with a specific attention to the taste system and the insular cortex. Recently his laboratory identified basic mechanisms underlying memory consolidation and new cognitive enhancers. His research utilized different techniques ranging from MRI in human, behaviour, electrophysiology, imaging, pharmacology, biochemistry and molecular biology.

Enhancing Cognitive Function Via Memory Consolidation

We are interested in understanding how memories are encoded and retained in the brain and use different methods to uncover the basic molecular and cellular mechanisms underlying learning. Following accumulation of basic science research and data, we recently try to find new ways to enhance memory. Very little is known about drugs which can enhance the consolidation phase of memories in the cortex, the brain structure considered to store at least partially, long term memories. We tested the hypothesis that pharmacological and genetic manipulation of translation machinery (which decode proteins from mRNA), known to be involved in the molecular consolidation phase, enhances positive or negative forms of cortical dependent memories. We found that modification of a translation factor named, eIF2α, specifically in the cortex is both correlated and necessary for normal memory consolidation. Moreover, we tested the involvement of eIF2α pathway in mice models of aging and sporadic Alzheimer disease and found strong link between the two.

Linda Siegel, The University of British Columbia

Linda Siegel is the Dorothy C. Lam Chair in Special Education and a Professor in the Department of Educational and Counselling Psychology and Special Education at the University of British Columbia, Vancouver, Canada. She had conducted research on dyslexia, reading and language development, mathematical concept learning, mathematical learning disabilities, and children learning English as a second language. She has been the President of the Division of Learning Disabilities of the Council on Exceptional Children. In 2010, she was awarded the Gold Medal for Excellence in Psychological Research from the Canadian Psychological Association. In 2012 she was awarded the Eminent Researcher Award from the Learning Difficulties Association of Australia.

Early Identification and Intervention to Foster Literacy Development and Prevent Reading Problems

This study was designed to develop a system for identifying children at risk for reading difficulties and to test a classroom based intervention program. The participants in this study were children from a school district in Vancouver, Canada. The screening battery consisted of measures of phonological awareness, letter identification, and syntactic awareness. The district used a phonological awareness program, called Firm Foundations. In kindergarten, 25% of the children English as a first language were at significant risk for reading difficulties and 48% of the children of English as a second language were at risk for reading difficulties. At the end of grade 7, 1.9 % of the children who had English as a first language and 2.3 % of the children who had English as a second language were showing dyslexia. Early intervention identification for potential reading difficulties and can be successful, efficient and cost-effective.

Marla Sokolowski, FRSC, CIFAR, University of Toronto

University Professor Marla B. Sokolowski PhD, FRSC, has trail-blazed the development of a branch of Behaviour Genetics that addresses the genetic, molecular environmental underpinnings of natural individual differences in behaviour and is best known for her discovery of the gene. Her innovative work is esteemed worldwide as a clear, integrative mechanistic paragon of the manner in which genes interact with the environment and impact behaviour. Prof. Sokolowski is a Canada Research Chair, Co-director of the Child and Brain Development Program at the Canadian Institute for Advanced Research and the Academic Director of the Fraser Mustard Institute for Human Development at the University of Toronto where her home is in the Department of Ecology and Evolutionary Biology.

How our genes listen to the environment

I will discuss the relationships between genes, environment and behaviour and why the nature vs. nurture dichotomy is no longer a relevant concept. New science has shown us that our genes are listening to our environment and that they respond to it. The early years are the most critical time in this listening process. It is during this time that developmental paths for health, learning and functioning within society are established. I will use animal models and humans to discuss how the areas of gene-environment interactions and epigenetics have informed us about the importance of the early years and how individual differences in behaviour grow and develop.

Sidney Strauss, Tel Aviv University

Professor Sidney Strauss claims that teaching is a natural cognitive ability on the part of humans (Strauss, 2005; Strauss & Ziv, 2002). Areas harnessed to bolster that claim are: cognitive developmental psychology (children age 3 teach), anthropology (teaching is universal among humans), comparative psychology (teaching among humans and non-humans is different). Other domains this claim draws on are: phylogeny, cultural evolution, cognitive archeology, and brain sciences. He recently made a call for a multi-disciplinary approach to teaching (Strauss and Ziv, 2012) for the purpose of creating a modern, scientific understanding of teaching which could lead to a paradigm shift regarding teaching.

A Call for a Multidisciplinary Approach to Teaching with the Neurosciences and Cognitive Sciences in the Lead

Teaching is one of the most remarkable of human achievements. It allows cumulative human culture and, as a result, history. Despite its deep importance, teaching has hardly been addressed in the neurosciences and cognitive sciences. Learning has captured the interests of scientists in the neurosciences and cognitive sciences. In contrast, teaching, whose intentional acts are aimed at causing learning in others, has received little attention. I claim that teaching is a natural cognitive ability in humans. Among the many reasons for this claim is cognitive developmental in nature: it is complex, children are not taught how to teach, yet they teach at an early age. Teaching is also species typical (universal) in humans and species-unique. With the advent of fMRI technology, part of the neurosciences dealt with real estate (location, location, location) within individuals' brains. Today there are growing efforts to study individuals' brains as they communicate with each other. One form of communication is teaching.

Janet Werker, FRSC, CIFAR, The University of British Columbia

Janet Werker, Professor and Canada Research Chair, is known for her work investigating the effects of experience on language acquisition. Current research focuses on the multisensory biases infants have at birth for perceiving speech, how broad initial sensitivities are tuned to become language-specific, and how developing speech perception supports language acquisition. Using a variety of behavioural and functional neuroimaging tools, she focuses on infants growing up in different monolingual and bilingual language environments, complemented by research with infants with, or at risk for, developmental disabilities.

Understanding the effects of experience on speech perception in infancy

The process of language acquisition begins in perceptual development long before infants produce their first words. In this talk, I will review the rapid changes in auditory, visual, and multimodal speech perception that occur in the first months of life as infants establish a foundation for language acquisition. I will then present evidence that, while under typical circumstances the timing of perceptual attunement seems to be constrained by maturation, there are identifiable variations in experiences that can accelerate or slow down this developmental trajectory. Finally, I will introduce new questions about whether or not studies to date on the timing of plasticity have considered all the relevant input systems. The implications of these findings for better understanding language development, and for optimal maternal and child well being, will be discussed.

Robert Zatorre, McGill University

Robert Zatorre is a cognitive neuroscientist whose research explores the functional and structural organization of the human brain, with special emphasis on two complex and characteristically human abilities: speech and music. He and his collaborators have published over 200 scientific papers on topics including pitch perception, musical imagery, music and emotion, and brain plasticity. He holds a James McGill chair in Neuroscience since 2005. In 2006 he became the founding co-director of the international laboratory for Brain, Music, and Sound research (BRAMS). In 2011 he was awarded the IPSEN foundation prize in neuronal plasticity and in 2013 he won the Knowles prize in hearing research.

Predispositions and Plasticity in Auditory Learning: Neural Correlates and Implications

It is now well established that training and learning induce specific plastic changes in both the functional and structural properties of the brain. It is less clear how initial brain states may influence the nature or degree of plasticity. In this lecture I will review neuroimaging findings from our lab regarding the relationship between pre-existing anatomical and functional features of human auditory cortex and the functions it subserves. Our recent studies have explored how these anatomical and functional features may be modified as a function of long-term musical training, or after sensory deprivation, and whether they may also prove to be predictive of performance on perceptual and learning tasks involving speech and musical stimuli. The findings overall indicate a consistent relationship between individual differences in cortical anatomy or function, and learning outcome in both the speech and the music domain. I discuss how these effects may be understood in the context of plasticity and of predispositions, and the possible implications of the work for models of neurocognitive functions and perhaps even pedagogy.

Posters *(Saturday, 5:30pm - 6:45pm, Physics and Astronomy Atrium)*

Abstract #	Authors	Abstract Title
1	Ethridge, P., Duke, D. & , Köhler,S.	Fear-specific familiarity enhancement in high anxiety individuals.
2	Kwok, E., Archibald, L., Brown, H., Joanisse, M., Smyth, R., Stothers, M. & Cardy, J.	Auditory temporal integration in children with Specific Language Impairment (SLI) compared to same age controls.
3	Duke, D., Bowles, B., Gilboa, A., Rosenbaum, S., McRae, K. & Köhler, S.	Abnormal semantic memory structure in a case of developmental amnesia.
4	Cusak, R., Wild, C., Arichi, T., Gelman, N. & Linke, A.	Designing stimulation protocols to maximize sensitivity in neonatal fMRI.
5	Bugden, S., Archibald, L. & Ansari, D.	The effect of symbolic and non-symbolic priming on magnitude processing in children with developmental dyscalculia.
6	Maor, I. & Mizrahi, A.	Single neuron responses in the mouse primary auditory cortex following perceptual learning.
7	Watson, M., Akins, K., Chromy, J. & Enns, J.	How learning guides the development of synaesthesia: Cross-linguistic comparisons.
8	Gao, D., Wang, J., Desroches, A., Li, X., & Liu, L.	Dynamic top-down modulation of bottom-up information during speech perception.
9	Kimura, N., Workman, A., Charvet, C. & Finlay, B.	Predictable and deviant patterns of brain development across and within species.
10	Whitwell, R., Tang, R. & Goodale, M.	Anticipatory knowledge of visual feedback and cognitive supervision affect grasping with the left but not the right hand.
11	Nichols, E. & Joannise, M.	Neural correlates of second language acquisition: Proficiency and age of acquisition in Mandarin-English bilinguals.
12	Coros, A., Strother, L. & Vilis, T.	Neural representation of fixated words in visual cortex.
13	Pauls, L.J.	Language and working memory: Domain specificity in intervention.
14	Lopata, J., Nowicki, E. & Joanisse, M.	Transient hypofrontality and creative fluency: A review of the literature.
15	Cabral, L., Stojanoski, B., Wild, C. & Cusack, R.	In search of babies: Using Mechanical Turk to evaluate infant stimulus preferences.
16	O'Neil, K. & Desroches, A.	ERP Indices of orthographic intrusion during the time course of spoken word processing.
17	Matejko, A., Price, G., Mazzocco, M. & Ansari, D.	Individual differences in left parietal white matter predict performance on the Preliminary Scholastic Aptitude Test (PSAT).
18	Major, A., Wood, D., Chouinard, P. & Goodale, M.	Localization of brain areas responsible for wrist posture selection in ambiguous situations
19	Battista, C., Morton, J.B. & Ansari, D.	Neural correlates of arithmetic learning: Evidence from customized arithmetic training.

Abstract #	Authors	Abstract Title
20	Wild, C. & Cusack, R.	Rock-a-bye baby: Using slice-by-slice motion estimation and correction to improve the sensitivity of neonatal fMRI.
21	Vogel, S., Goffin, C. & Ansari, D.	Developmental changes in the cortical representation underlying the semantic processing of numerical symbols.
22	Martin, C., McLean, A., O'Neil, E. & Köhler,S.	Distinct familiarity-based recognition responses for faces and buildings in perirhinal and parahippocampal cortex.
23	O'Neil, E., Hutchison, R. McLean, A. & Köhler,S.	Evaluation of resting-state fMRI data reveals behaviorally-relevant connectivity between the face-selective perirhinal cortex and the fusiform face area.
24	Malins, J. & Joanisse, M.	Processing tonal categories in Mandarin Chinese: An fMRI investigation using short-interval habituation.
25	Moreno, S., Lee, Y., Janus, M. & Bialystok, E.	Short-term second language and music training induces lasting functional brain changes in early childhood.
26	Stöttinger, E., Rafesteder, E., Anderson, B. & Danckert, J.	Right hemisphere involvement in updating and theory of mind.
27	Lackner, C., Santesso, D., Marshall, W. & Segalowitz, S.	Self-regulation in adolescence: Some new electrophysiological measures.
28	Snow, J., Rangel, A. & Culham, J.	Bringing the real world into the fMRI scanner: real objects amplify signals in the vmPFC valuation system.
29	Podrebarac, S., Goodale, M. & Snow, J.	Are visual texture-selective areas recruited during haptic texture discrimination?
30	Sheikh, H., Joanisse, M., Mackrell, S., Kryski, K. Smith, H., Singh, S. & Hayden, E.	Hypothalamic-Pituitary-Adrenal axis stress reactivity is associated with differences in white matter integrity in young girls.
31	Charvet, C., Cahalane, D. & Finlay, B.	Systematic variation in neuron numbers per unit of cortical surface area in rodents and primates arises from gradients in neurogenesis timing.
32	Shiell, M., Champoux, F. & Zatorre, R.	Early-deaf people have enhanced visual motion detection thresholds.
33	Anello, M., Milne, J., Thaler, L. & Goodale, M.	Does a blind human expert echolocator show size constancy?
34	Brown, T. & Lomber, S.	Cross-modal hemodynamic activity in non-primary areas of deaf cat auditory cortex.
35	Jared, D., Cormier, P., Levy, B.A. & Wade-Woolley, L.	Orthographic learning in biliterate children.
36	Leow, L.A., de Rugy, A.& Hammond, G.	Motor cortex anodal tDCS increases anterograde interference only with movement repetition.
37	Wammes, J., Fernandes, M. & Hsiao, J.	Language experience shapes cognition: Comparing memory for Chinese and English words.
38	Chouinard, P., Landry, O. & Goodale, M.	Visual and semantic FMRI-adaptation in Autism using a normal range analogue.
39	Leibovich, T. & Henik, A.	Comparing performance in discrete and continuous comparison tasks.
40	Chabot, N., Kok, M. & Lomber, S.	Amplifed cortical, but not thalamic, somatosensory and visual projections to the anterior auditory field following early – or late – onset deafness
41	DeBenedictis, B., Daley, M. & Morton, J.B.	Dynamic changes in cognitive control network connectivity and its development.

Abstract #	Authors	Abstract Title
42	Biduła, S. & Króliczak, G.	Insular asymmetries and the laterality of functions in a healthy brain.
43	Kuo, M.C. & Leung, L.S.	Modulation of hippocampal long-term potentiation by a naturally occurring theta rhythm during REM sleep.
44	Wood, D., Chapman, C., Gallivan, J., Milne, J., Culham, J. & Goodale, M.	A linear decay of visual salience in a compelled reaching task.
45	Thibault, F. & Potvin, P.	Study of the role of inhibition in the evolution of undergraduate engineering students' force-related conceptions.
46	Brault Foisy, L.M., Masson, S., Potvin, P. & Riopel, M.	Using fMRI to compare cerebral activations between novices and experts in science during a task in mechanics involving a common misconception.
47	Allaire-Duquette, G., Bélanger, M. & Masson, S.	Proposing a research design to explore the neural correlates underlying conceptual difficulties of high school students in science.
48	Huyck, J., Smith, R., Hawkins, S. & Johnsrude, I.	Does perceptual learning of degraded speech generalize to a novel voice and accent?
49	Lafay, A., St-Pierre, M.C. & Macoir, J.	Specific numerical implementation in developmental dyscalculia: Number sense deficit and/or deficit of access to numerical representations

Summer 2012: *Royal Society of Canada President Yolande Grisé and Israeli Academy of Sciences and Humanities President Ruth Arnon sign a Memorandum of Understanding between the two national academies, accompanied by David Johnston, Governor General of Canada, and Shimon Peres, President of Israel.*