

Neuroscience of Individual Differences Fellowship

Name of Institution: Montreal Neurological Institute

Type of Fellowship: Research/Clinical

Fellowship Program Director: Dr. Sherif Karama

Number of positions: 1

Length: 1 year

Mission Statement: While the last few years have witnessed an explosion of research on the neurobiological underpinnings of psychopathology, relatively little work has focused on the neurobiology of individual differences in healthy subjects. A better grasp of normal human variability is an important step that would likely improve our understanding of changes or predispositions associated with psychopathology. The “Neuroscience of Individual Differences” fellowship offers the fellow to work on the relationship between a given trait (e.g. general cognitive ability, circulating hormone levels) and brain structure using sophisticated brain imaging methods while developing an analytical and critical understanding of the complexity underlying apparently simple behavioral differences in healthy individuals.

1. Goals and Objectives of the Fellowship:

- a. Become acquainted with the various new methods of structural brain imaging including local cortical thickness, cortical surface area and cortical volume analyses as well as voxel-based morphometry, estimation of total volumes of subcortical structures, diffusion tensor imaging, as well as local and global network efficiency using small-world networks analyses.
- b. Familiarize oneself with the statistical approaches used in brain imaging including multiple comparison issues and random field theory
- c. Develop critical thinking skills regarding research attempting to bridge the gap between brain and behavior
- d. Learn neuroanatomy
- e. Write and publish at least 2 papers on a specific topic of interest for which extensive longitudinal data is already available (cognitive ability, working memory capacity, aggression, hormonal levels, puberty status...).
** Please note that funds will be made available to fellows to attend a conference to present their findings.

- ### **2. Names and Roles of the Teaching Faculty:**
- Dr. Sherif Karama will supervise the fellow in all aspects of his research. This supervision will be done in collaboration with Dr. Alan Evans, a world-renowned brain imaging expert based at the Montreal Neurological Institute. Dr. Evans will co-supervise the writing of the manuscripts and provide access to all the tools available at the MNI for brain imaging analysis. The fellow will also have the opportunity to benefit from the multiple on-going international collaborations that exist with

Dr. Karama's lab and that include collaborators from the National Institute of Mental Health and others from the United States, England, Scotland, Spain, and South Korea.

Names of other teaching faculty:

Dr. Alan Dagher is a neurologist specializing in movement disorders and brain imaging. His research aims at understanding the function of the basal ganglia, with a particular emphasis on appetitive behaviors. This involves studying how we learn about rewards and punishments, and become motivated to engage in reward seeking behaviors.

Dr. Lesley Fellows is a neurologist specializing in disorders of cognition. She has a particular interest in the functions of the frontal lobes. Her research program focuses on the brain basis of decision making in humans, using tools of cognitive neuroscience.

Dr. Theo Kolivakis is a psychiatrist and clinical psychopharmacologist with a particular interest in neurostimulation treatment such as vagal nerve stimulation, basal nerve stimulation, and deep brain stimulation for the treatment of psychiatric disorders including depression and obsessive compulsive disorders.

3. Academic Facilities

The McConnell Brain Imaging Center at the MNI is affiliated with McGill University and is a predominantly imaging research environment with a major commitment to the study of the brain. The program has the support of approximately 50 MNI Neuroscience laboratories for direct consultation on neuroanatomy and image processing. As an example of the Computing Infrastructure system, is a set of tools which have been assembled into a pipeline environment for batch-processing of large numbers (500+) of brains. For the last few years, the McConnell Brain Imaging Center was the coordinating center for a large longitudinal study of normal brain development including over 500 children aged between 1 week and 18 years and representative of the US population.

4. Fellow Duties and Responsibilities

- a. Use the large databases available to study, based on a priori hypotheses, the relationship between a variable of interest and brain structure
- b. Clinical duties as per department of psychiatry requirements. Opportunity to learn of to perform neuropsychiatric evaluations.

c. Participate in teaching activities

5. Curriculum

During his training, the fellow will benefit from individually-tailored training. While the fellows are expected to have a basic understanding of statistics, teaching in statistics including multiple and multivariate regression analyses will be provided. Opportunities for interaction with other groups and scientists at the MNI. Weekly seminars are offered. Overall, the fellow will be provided with an invaluable opportunity to develop research skills in the field of brain imaging.

6. Selected relevant publications from Dr. Karama's and Dr. Evans' labs

Shaw P, Greenstein, Lerch J, Clasen L, Lenroot R, Gogtay N, Evans A, Rapoport J, Giedd J. Intellectual ability and cortical development in children and adolescents *NATURE* 440(7084): 676—679, 2006.

Shaw P, Greenstein D, Lerch J, Sharp W, Clasen L, Evans A, Giedd J, Castellanos FX, Rapoport J Longitudinal mapping of cortical thickness and clinical outcome in children and adolescents with attention deficit/hyperactivity disorder *ARCH GEN PSYCH* 63:540-549, 2006.

Potvin S., Mancini-Marië A., Fahim C., Mensour B., Levesque J., Karama S., Beauregard M., and Stip E. Increased striatal gray matter densities in patients with schizophrenia and substance use disorder ; a voxel-based morphometry study. *PSYCHIATRY RESEARCH* vol. 154(3), 275-279, 2007.

Shaw P, Lerch J, Taylor K, Greenstein D, Clasen L, Evans AC, Rapoport J, Giedd JN Cortical morphology in children and adolescents with different apolipoprotein E gene polymorphisms: an observational study *LANCET NEUROL* 6: 494—500, 2007.

Lenroot RK, Gogtay N, Greenstein DK, Wells EM, Wallace GL, Clasen LS, Blumenthal JD, Lerch J, Zijdenbos AP, Evans AC, Thompson PM, Giedd J.(2007) Sexual dimorphism of brain developmental trajectories during childhood and adolescence *NEUROIMAGE* 36: 1065-1073, 2007.

Gogtay N, Greenstein D, Lenane M, Clasen L, Sharp W, Gochman P, Butler P, Evans A, Rapoport J Cortical brain development in nonpsychotic siblings of patients with childhood-onset schizophrenia *ARCH GEN PSYCH* 64(7):772-80, 2007.

Potvin S., Mancini-Marië A., Fahim C., Mensour B., Levesque J., Karama S., Beauregard M., and Stip E. Increased striatal gray matter densities in patients

with schizophrenia and substance use disorder ; a voxel-based morphometry study. *PSYCHIATRY RESEARCH* vol. 154(3), 275-279, 2007.

Karama S., Ad-Dab'bagh Y., Haier R., Deary I., and Evans A. and The Brain Development Cooperative Group. Association between cortical thickness and general cognitive ability on a representative US population of 6 to 18 year-olds. *INTELLIGENCE*, vol 37 (2), 145-155, 2009.

Lyttelton O., Karama S., Ad-Dab'bagh Y., Carbonell F., Worsley K., Evans A.C. Positional and Surface Area Asymmetry of the Human Cerebral Cortex explored through automated surface-based analysis. *NEUROIMAGE*, 46(4), 895-903, 2009.

Haier RJ, Karama S., Leyba L., Jung R. MRI Assessment of Cortical Thickness and Functional Activity Changes in Adolescent Girls Following Three Months of Practice on a Visual-spatial Task. *BMCResearch Notes*, 2(174), p. 1-7, 2009.

Karama S., Colom R., Johnson W., Deary I., Haier R., Ganjavi H., Evans A. and the Brain Development Cooperative Group. Attenuated brain correlates for specific cognitive ability after controlling for g: A cortical thickness approach. The Tenth Annual Conference of the International Society For Intelligence Research, Madrid, Spain, 2009.

Ganjavi H., Evans A., Lewis J., MacDonald P.A., Karama S. and the Brain Development Cooperative Group. Negative correlations between corpus callosum area and intelligence in a representative sample of healthy young males. The Tenth Annual Conference of the International Society For Intelligence Research, Madrid, Spain, 2009.

MacDonald P.A., Karama S., Ganjavi H., and Evans A. and the Brain Development Cooperative Group. Investigating the relation between basal ganglia volume and intelligence. The Tenth Annual Conference of the International Society For Intelligence Research, Madrid, Spain, 2009.

Ducharme S., Hudziak J.J., Botteron K., Lepage C., Ganjavi H., Karama S., Evans A.C., Brain Development Cooperative Group. Cortical and Subcortical MRI Correlates of Aggression Traits in Healthy Children. Human Brain Mapping Annual Meeting, Barcelona, Spain, 2010.