Brenda Milner

Dorothy J. Killam Professor of Psychology in the Montreal Neurological Institute and Professor in the Department of Neurology and Neurosurgery, McGill University

2009 Balzan Prize for Cognitive Neurosciences
For her pioneering studies of the role of the hippocampus in the formation of memory and her identification of different kinds of memory system.

Institution Administering Research Funds:
Montreal Neurological Institute (MNI) at McGill University

Adviser for the Balzan General Prize Committee: John Krebs

Hemispheric Interaction in Cognitive Processes

Brenda Milner has set aside the second part of the 2009 Balzan Prize for Cognitive Neurosciences to recruit two post-doctoral fellows from well-established neuroimaging labs. One of these young researchers is now working under Dr. Milner's supervision at the Montreal Neurological Institute at McGill University, using functional imaging to explore the issue of hemispheric interaction in cognitive processes; the second research fellow will join her here in the fall. A recent study from Marcus Raichle's lab (Johnston J.M. *et al*., *Loss of resting interhemispheric functional connectivity after complete section of the corpus callosum*, "Journal of Cognitive Neuroscience", 28:6453–645, 2008), Washington University in St. Louis, School of Medicine, uses functional magnetic resonance imaging to explore changes in resting interhemispheric connectivity after complete section of the corpus callosum in a 6-year old child, thus suggesting a powerful methodological approach. Subsequently, functional imaging studies have shown, for example: increasing bilaterality of involvement in normal healthy subjects as they grow older and increasing involvement of the right hemisphere, as verbal tasks become more demanding. The aim of the research project funded with the second part of her Balzan Prize is to gain a better understanding of the significance of such "recruitment". In this connection, a recent study from Marcus Raichle's lab at Washington University, using functional magnetic resonance imaging to explore changes in resting interhemispheric con-

nectivity after complete section of the corpus callosum in a 6-year old child, suggests a potential methodological approach to this issue.

Two workshops have been held at the Montreal Neurological Institute (MNI) to explore how best to proceed with the project and to develop appropriate experimental paradigms. The first took place on 12th April 2010. It was attended by Joelle Crane (MNI), Simon Eickhoff (Universitätsklinikum Aachen, Germany), Alan Evans (MNI), Denise Klein (MNI), Stefan Köhler (University of Western Ontario), Hesheng Liu (Massachusetts General Hospital and Harvard Medical School), Brenda Milner (MNI), Morris Moscovitch (University of Toronto), Kate Watkins (Oxford University) and Robert Zatorre (MNI). Following from this first brainstorming session, a second workshop was held on 22nd February 2011, devoted to fleshing out the specifics of the experiments proposed. The meeting was attended by Randy Buckner (Massachusetts General Hospital, Harvard Medical School and Howard Hughes Medical Institute), Joelle Crane (MNI), Alan Evans (MNI), Denise Klein (MNI), Stefan Köhler (University of Western Ontario), Hesheng Liu (Massachusetts General Hospital and Harvard Medical School) and Brenda Milner (MNI). At this second workshop, a McGill-Harvard collaboration was instituted, planning to combine the expertise of the neuropsychology team at the MNI with the expertise in Magnetic Resounance Imagining (MRI) paradigms of the Harvard Group.

During these meetings, it was decided that the question of hemispheric interaction could best be addressed by combining fine-grained behavioural paradigms with conventional functional MRI experiments and also with newly emerging tools in MRI, such as resting-state fMRI paradigms. More specifically, the study involves testing 100 neurologically normal right-handed volunteers, using both behavioural tests and neuroimaging techniques. Participants will undergo structural magnetic resonance imaging and diffusion tensor imaging (DTI) scans for precise anatomical localization. They will also have a functional-imaging session that will involve a blocked-design activation study, a continuous-task scan (using resting-state parameters) and a more conventional resting-state scan. The activation tasks will be chosen based on a survey of the extensive databases derived from the neuroimaging literature, specifically looking for a task that reliably activates medial temporal regions unilaterally and another that activates them bilaterally. The continuous-task protocol will involve two six-minute scans, during which subjects will view a long series of dually encodable objects, making a “living” versus “non-living” judgment for each. Recognition for these objects will be tested once the entire scanning session is finished, so that activity during

encoding can be examined with a subsequent memory paradigm. The continuous-task scans will also be contrasted with the resting-state scans, in order to examine how co-occurring activation patterns differ in the resting versus the engaged brain. Dr. Buckner has kindly agreed to pilot this procedure at Harvard to assess its feasibility. Finally, a three-hour battery of neuropsychological tests will be administered, from which individual behavioural measures can then be extracted and correlated with the neuroimaging results.

Researchers:
Two Post-doctoral fellowships
Ami Tsuchida, Ph.D. McGill University 2012
Meera Paleja, Ph.D. Ryerson University, Toronto 2012

15 Volunteers