Maurice Ptito, MD, Ph.D.

Effects of Perinatal Hemispherectomy in Monkeys (Aethiops Sabeus)

In this series of studies, we used a monkey model of human hemispherectomy in order to characterize behavioral recovery and anatomical reorganization of the visual system. Monkeys were tested neurobehaviorally on a variety of tests every 6 months for a period of 30 months. Thereafter, the organization of the retinofugal pathways was studied by means of histological techniques. At the behavioral level, there was a striking recovery of sensory and motor functions that rendered lesioned baby monkeys undistinguishable from controls. Anatomically, hemidecordication in baby monkeys produced a transneuronal retrograde degeneration of the retinal ganglion cells (RGCs) that affected mainly the foveal rim. Although the density of RGCs in this region was drastically diminished, the soma sizes of the surviving cells remained normal. The lateral geniculate nucleus (dLGN) ipsilateral to the removed cortex was dramatically reduced in size, although it still showed normal layering. There was a marked reduction in the number of neurons in both the parvocellular and magnocellular layers and a heavy gliosis. By contrast, the superior colliculus ipsilateral to the lesion was remarkably well preserved: although slightly reduced in volume, it showed little gliosis and a metabolic activity, as revealed by cytochrome oxidase histochemistry, similar to the superior colliculus contralateral to the lesion. Behavioral perimetry indicated a partial sparing of vision up to 45 degrees in the 'blind' hemifield. We argue that the preservation of the retino-tectal pathway mediates most of the residual visual functions found in the 'blind field' of hemispherectomized human subjects.

BIOSKETCH

Dr. Ptito is a Harland Sanders Professor of Visual Science at Université de Montréal. His education includes Université de Montréal, Ph.D., M.Sc., B.Sc., B.A.; M.D., University of Aarhus (Denmark); and a postdoctoral fellowship in Neurophysiology at Stanford University (California). He has been an invited professor and visiting scholar at the following: DRCMR (2006–, Copenhagen University). PET center (1999–2000, Aarhus University). The University of Sydney, Australia, (Histology, 1996). Istituto di Fisiologia, Verona, Italy, (Neurophysiology, 1984–1985); Istituto di fisiologia e Biochimica, Pisa, Italy (Neurophysiology1988–1993); Neuroscience (MGH), Harvard University (Neuroanatomy,1993–1994); Department of Pharmacology, University of Maryland, USA (Neuroanatomy,1994–).

Honors and awards include Canadian Psychological Association (Fellow), Royal Society of Medicine (London, Fellow), Royal Society of Canada (Fellow), Sir John William Dawson Medal (Laureate), Harland Sanders Research Chair (Laureate), American Academy of Optometry Fellow, Henry and Karla Hensen prize.

Grants have been awarded from various national and international agencies: National and Engineering Research Council of Canada (NSERC); Medical Research Council of Canada (MRC); Formation de Chercheurs et Aide à la Recherche (FCAR); Fonds de la Recherche en Santé du Québec (FRSQ); Danish Medical Research Council.

Dr. Ptito has published four books and more than 125 scientific papers.

Jason Brandt, Ph.D.

Cognitive Neuropsychological Effects of Cerebral Hemispherectomy

This presentation will first briefly review the clinical neuropsychological literature on hemispherectomy and hemidecortication. Then, cognitive and functional outcomes of 71 children evaluated pre-operatively and an average of 5 years postoperatively will be described. Finally, some of the methodological and conceptual issues in research on this topic will be discussed.

BIOSKETCH

Dr. Brandt obtained his Ph.D. in experimental and physiological psychology from Boston University in 1982. Since that time, he has been on the faculty of the Johns Hopkins University, where he is currently Professor of Psychiatry and Behavioral Sciences, Professor of Neurology, and Director of the Division of Medical Psychology in the School of Medicine. He is also Director of the Cortical Function Laboratory at the Johns Hopkins Hospital and is Research Director at the Copper Ridge Institute.

Dr. Brandt's research focuses on memory and other cognitive disorders as they appear in Alzheimer's disease, Huntington's disease, and other degenerative brain disorders. He has developed several widely used neuropsychological tests, including the Hopkins Verbal Learning Test–Revised and The Telephone Interview for Cognitive Status. Dr. Brandt has also investigated the cognitive changes associated with epilepsy and its treatments, the psychological consequences of genetic testing for neuropsychiatric disorders, and improved methods for neuropsychological assessment. He has published over 270 articles and book chapters on these and related topics.

Dr. Brandt is a Fellow of both the American Psychological Association (APA) and the Association of Psychological Science (APS), and is board certified by the American Board of Clinical Neuropsychology. He has served on the governing boards of the International Neuropsychological Society, the American Academy of Clinical Neuropsychology, and numerous editorial and professional advisory boards. Dr. Brandt served as President of both the APA's Division of Clinical Neuropsychology (2000–2001) and the International Neuropsychological Society (2004–2005).

In 1996, Dr. Brandt received the Arthur Benton Award for mid-career achievement from the International Neuropsychological Society. He was named a "Hero of Medicine" by *TIME* magazine in 1997.

Alain Ptito, Ph.D.

Neural Substrates of Blindsight in Hemispherectomized Subjects

Blindsight is a visual phenomenon whereby hemianopic subjects are able to process visual information in their blind visual field without awareness. Previous research demonstrating the existence of blindsight in hemianopic subjects has been criticized for the nature of the paradigms used, for the presence of methodological artefacts as well as for the possibility that spared islands of visual cortex may have sustained the phenomenon since the subjects generally had small circumscribed lesions. In order to respond to these criticisms, we have been investigating for several years now, residual visual abilities in the blind field of hemispherectomized subjects in whom a whole cerebral hemisphere has been removed or disconnected from the rest of the brain. These subjects have offered a unique opportunity to establish the existence of blindsight and to investigate its underlying neuronal mechanisms since in these cases spared islands of visual cortex cannot be evoked to explain the presence of visual abilities in the blind field. In addition, we have been using precise behavioral paradigms, strict control for potential methodological artefacts such as light scatter, fixation, criterion effects and macular sparing and we have utilized new neuroimaging techniques such as Diffusion Tensor Imaging Tractography to enhance our understanding of the phenomenon. The following article is a review of our research on the involvement of the superior colliculi in blindsight in hemispherectomized subjects.

BIOSKETCH

Dr. Ptito is an Associate Professor of Neurology and Neurosurgery at McGill University and a Neuropsychologist at the Montreal Neurological Institute and Hospital. He has worked as a Neuropsychologist at the Montreal Neurological Institute and Hospital since 1983. Dr. Ptito's research program involves the investigation of the mechanisms involved in cerebral reorganization and plasticity in patient populations (hemispherectomy, callosotomy, Parkinson's Disease, stroke, and head injury), and his clinical work includes the neuropsychological assessment of these patients. His research is threefold: 1) He has hypothesized an organic basis for the emergence of post-concussive symptoms in head injured individuals as well as in concussed elite athletes and has been using fMRI, neuropsychological tests and cognitive evoked potentials to quantify cerebral function in these individuals; 2) another research interest involves vision particularly identification of the critical cerebral regions implicated in stereopsis as well as in the "blindsight" phenomenon following a rare procedure called hemispherectomy, the surgical removal or disconnection of a cerebral hemisphere; 3) he is also interested in studying the effects of practice on fMRI activation following stroke.

Harry Chugani, M.D.

Cerebral Hemispherectomy in Children: Clinical Considerations and Neuroimaging Perspectives

Cerebral hemispherectomy in infants and children is performed as a treatment for medically refractory epilepsy resulting from infantile hemiplegic cerebral palsy, unilateral brain malformations such as hemimegalencephaly or hemispheric cortical dysplasia, chronic focal encephalitis of Rasmussen, Sturge-Weber syndrome, and hemiplegia-hemiconvulsive syndrome. Surgical procedures vary across centers and include anatomical hemispherectomy, functional hemispherectomy and hemispherotomy. In all these procedures, the basal ganglia and thalamus of the affected side are left intact.

Children undergoing these large resections early in life show marked functional recovery. The hemiplegia is most pronounced in the forearm and hand, and shoulder strength can be normal. Ambulation is the rule, although with a hemiparetic gait. There is a hemianopsia contralateral to the side of surgery. Even complex cognitive and other skills such as language, visual processing, interfield visual discrimination, auditory-temporal processing, abstraction and reasoning can be served by a single hemisphere. These children provide unique opportunities for the study of functional brain reorganization and age-at-lesion effects.

We have used neuroimaging approaches to study these children and have reported a number of interesting observations. Using positron emission tomography (PET), we observed the initial loss of glucose metabolism in the ipsilateral basal ganglia and thalamus when scanned 3–6 months following hemispherectomy; however, when these children were rescanned 1–2 years later, glucose metabolism in the deafferented caudate nucleus had reappeared (Ann Neurol 1995; 36:794–7). In a more recent study, we used PET with alpha[11C]methyl-L-tryptophan (AMT) to evaluate serotonergic alterations in subcortical structures following cortical resection in children with intractable epilepsy. AMT uptake in the thalamus and lentiform nucleus was evaluated postoperatively (1–89 months following resection) in 19 children (mean age: 8.7 years) with a previous cortical resection. There was increased AMT uptake in the lentiform nucleus ipsilateral to the resection as compared to the contralateral side (mean asymmetry: 4.2 □ 3.0%), and the asymmetries were significantly higher than those measured in normal and epileptic control groups ($p \leq 0.001$). Post-resection asymmetry indices in the lentiform nucleus correlated inversely with postoperative time ($r= -0.67$; $p=0.002$), but not with age ($p=0.29$) or the extent of resection ($p=0.77$). In contrast, thalamic AMT uptake asymmetries were not different among the three groups ($p=0.63$). Thus, cortical resection results in a sustained increase of AMT uptake in the lentiform nucleus, suggesting increased serotonin synthesis (*Epilepsy Res* 2008;78:124-130). Increased serotonergic activity in the deafferented striatum may play a role in the functional reorganization of cortico-striatal projections in humans.

In the monkey, the caudate and putamen receive bilateral projections from motor cortex and, following bilateral frontal cortical lesions in neonatal monkeys, the caudate appears to assume functions (e.g., delayed response) mediated by dorsolateral prefrontal cortex. In both rat and cat, sparing of contralateral motor function following neonatal motor cortex ablation is markedly diminished if the caudate-putamen is also removed. Indeed, the South African neurosurgeon Krynauw, in his classical description of the first series of hemispherectomy in human subjects, stated that the hemiplegia contralateral to the side of surgery is worse if the basal ganglia are also removed, although actual data to this effect were not included in his manuscript.

BIOSKETCH

Dr. Harry Chugani is Professor and Chief of Pediatric Neurology at Children's Hospital of Michigan, Wayne State University School of Medicine. His education includes M.D. at Georgetown University, resident in Pediatrics at Northwestern University, resident in both Pediatrics and Neurology at Georgetown University, Fellow in Pediatric Neurology at Georgetown University, and Fellow in Nuclear Medicine at UCLA.

Between 1981 and 1993, Dr. Chugani has served as Assistant and then Associate Professor in the Departments of Neurology and Pediatrics at the UCLA School of Medicine. At the same time he served as a consultant in Pediatric Neurology at Olive View Medical Center, Los Angeles. From 1990–1992 he was an Instructor in the Division of Nuclear Medicine and Biophysics at the UCLA School of Medicine. Since 1993, Dr. Chugani has been a Professor in the Departments of Pediatrics, Neurology and Radiology and Director of Positron Emission Tomography Center at the Children's Hospital of Michigan, Wayne State University. He also has served as the Chief of the Division of Pediatric Neurology at the Children's Hospital of Michigan since 1999.

Some of Dr. Chugani's awards include Teacher Investigator Developmental Award (1984–1989); UCLA Pediatrics Faculty Scholar Award (1986–1987); Young Investigator Award, Association of Indian Neuroscientists (1986–1987); Niilo Hallman Award for Outstanding Research in Pediatrics. Helsinki, Finland (1997); and Sunny Days Award, Sesame Street Parents (1998).

In 1997 Dr. Chugani was invited as an expert to testify on research progress in child brain development, United States Senate Subcommittee, Washington, D.C. He was also invited to participate on the White House Committee on Developmental Medicine by President and Mrs. Clinton, Washington, D.C., that same year.

Faraneh Khadem, Ph.D.

Speech and Language in the Isolated Hemisphere

Margaret Kennard was the pioneer who provided the first experimental evidence of recovery of function in primates. Her profound influence has guided the basic principles of neurological treatment, neurorehabilitation, and most relevant for the theme of this meeting, neurosurgery for treatment of intractable epilepsy in children.

It has long been recognized that because of its abundant plasticity and reorganizational capacity, the immature human brain can rescue critical cognitive functions, notably speech and language. Although the degree of sparing of function is related to age at injury, other factors contribute to the course and extent of plasticity and recovery of function after unilateral damage, including the removal of an entire hemisphere.

This presentation will provide an overview of speech and language function after hemispherectomy. The profiles of groups of hemispherectomized patients and individual cases will reveal the extent and limits of reorganization available to the young brain.

BIOSKETCH

Professor Faraneh Vargha-Khadem completed her Ph.D. and postdoctoral studies at the University of Massachusetts in the United States and McGill University in Montreal, Canada. She moved to London in 1983 to take a position at the Institute of Child Health and Great Ormond Street Hospital for Children where she helped create the first academic Department of Developmental Cognitive Neuroscience in the United Kingdom, and its clinical counterpart, the Department of Clinical Neuropsychology.

Professor Vargha-Khadem conducts research on the effects of brain injury on cognitive and behavioral function in children. Her goal is to understand how brain systems develop and reorganize in the face of pathology. She has been investigating developmental amnesia, brain and motor speech abnormalities resulting from the mutation of the FOXP2 gene in children and adults, and brain plasticity in patients who have undergone neurosurgery for epilepsy. She holds a personal chair in Developmental Cognitive Neuroscience at University College London Institute of Child Health, and is also the head of her department. She was elected Fellow of the Academy of Medical Sciences in 2000, and has received a number of awards, including the 2006 Jean Louis Signoret Prize for her contributions to genetics of behavior.

Maryse Lassonde, Ph.D.

Tactile and Auditory Functions in Hemispherectomized Patients

Hemispherectomy provides a unique model of brain plasticity that has been studied mostly within the context of cognitive reorganization. Less is known, however, regarding sensory compensation following hemispherectomy. Here we present a review of investigations addressing behavioral or functional plasticity in sensory modalities that have either a strong contralateral representation (touch) or a bilateral one (pain and audition). In the tactile domain, behavioral studies have demonstrated that patients are able to detect the presence, but not the direction, of stimulations on the paretic side. fMRI studies suggest that this residual sensitivity is related to primary (S1) and secondary (S2) activations whereas PET and evoked response paradigms rather indicate that processing is carried out essentially in S2. In turn, painful stimulation applied on both sides activates S2, with the contralateral activation being paradoxically weaker in hemispherectomized patients than in neurologically-intact individuals. The latter finding has been interpreted in terms of transcallosal involvement in pain processing, an interpretation that can be challenged when studying split-brain individuals.

With regard to audition, hemispherectomized patients can localize moving and stationary sound sources presented binaurally albeit with lesser accuracy than controls, especially in the hemifield contralateral to the removed hemisphere. Under monaural listening conditions, hemispherectomized patients can detect the presence of an auditory stimulation and some show remarkable sound discrimination abilities. In parallel, functional imaging indicates substantial auditory reorganization after hemispherectomy, with the activity in the intact hemisphere being paradoxically decreased in response to contralateral stimulation while a concomitant increase in response is observed after ipsilateral stimulation. These results will be interpreted in relation to dichotic listening findings based on the use of both speech and non-speech stimuli.

Finally, whereas dichotic listening paradigms may be helpful in studying language reorganization in hemispherectomized patients, we introduce a novel functional approach to the study of language in epileptic children, namely that of near-infrared spectroscopy (optical imaging).

BIOSKETCH

Dr. Maryse Lassonde received a Ph.D. in Neuropsychology at Stanford University. She is a full Professor in the Department of Psychology at Université de Montréal, Director in the Laboratory of Electrophysiology and Optical Imaging, Sainte-Justine Hospital, and a Chairholder, Canada Research Chair in Developmental Neuropsychology. Development of visual system in children, neuropsychology of childhood epilepsy, development and integration of callosal system, cross-modal plasticity and reorganization, and long-term effects of concussions in children and adults are Dr. Lassonde's research interests.

Distinctions and awards include Adrien Pinard prize, SQRP (2008); Emeritus Member, ACFAS (2006); Noel Mailloux Prize, Quebec Order of Psychologists (2001); Knight (Chevalier), National Order of Quebec (1999); Marcel Vincent Prize, ACFAS (1998); Fellow of the Canadian Royal Society (1997); Woman of Distinction, Science, YWCA (1996); Fellow, Canadian Psychological Association (1994).

Joe Culver, Ph.D.

Mapping Human Brain Function with Light

We are developing diffuse optical tomography (DOT) methods for mapping brain function. DOT has many unique advantages including a wearable imaging cap and portable equipment that give it promise as an important imaging tool for subjects, such as ICU patients and children that are not amenable to fixed scanner geometries (e.g., MRI and PET). In addition, the ability to simultaneously image multiple hemodynamic contrasts allows the study of developing and diseased brains where the neurovascular coupling is unknown. However, successful DOT in humans is challenging due to the concurrent requirements of high-dynamic range, high channel counts, and sufficient temporal resolution. Hence, most optical imaging of human brain activity is performed using a topography approach with relatively sparse imaging arrays. As such, previous optical neuroimaging of the visual cortex has been limited to detecting contralateral activations. We have recently reported the development of a high-density DOT system optimized for human brain mapping (Zeff et. al PNAS 2007). Current studies are exploring the use of this system to retinotopically map the adult human visual. Our temporal resolution and high contrast-to-noise allow us to detect individual activations. Our spatial resolution enables us to map both eccentricity and polar angle within the full visual field. This mapping is robust and repeatable, and the results are in quantitative and qualitative agreement with previous PET and MRI studies.

BIOSKETCH

Dr. Culver obtained a Ph.D. in physics at the University of Pennsylvania for work on developing ultrafast infrared laser spectroscopy methods. As a postdoc Dr. Culver developed diffuse optical tomography systems for imaging breast cancer, and for imaging cerebral metabolism and blood flow in animal models of stroke. In 2001, he moved to Boston to join the Photon Migration Lab at Massachusetts General Hospital (MGH) and Harvard Medical School. There he continued to work on mapping brain function in small animals. In 2003 Dr. Culver started a faculty position at Washington University in St. Louis in the Department of Radiology. His lab currently explores ways of exploiting differential optical measurements to map brain activity using blood spectroscopy, and to image bio-molecular activity, using fluorescing biochemical probes.

Randall Barbour, Ph.D.

An Integrated Methodological Framework for fNIRS Imaging

Functional imaging technologies continue gain favor as a portal to explore biological phenomena in their natural state. The associated technology, however, often is represented by large, fixed facilities that also impose severe constraints on subject interactions with their environment. Since our first description of NIRS tomography 20 years ago, the capability of this technique has continued to expand to where now a wide range of practical studies, free of the environmental constraints of fixed facilities, appear feasible. In this report, we summarize recent technology and information processing developments that support these advances with a focus on developing applications to neuroimaging. Strategies governing measuring system design, data analysis environment, information extraction, closed-loop validation and approaches for integration with structural imaging methods will be discussed.

BIOSKETCH

Dr. Randall Barbour obtained a Ph.D. in Biochemistry at Syracuse University in 1981 and was a post-doctoral trainee in Laboratory Medicine at SUNY, Buffalo from 1981–1983. He has served as Assistant Professor of Pathology and Biophysics, SUNY Health Science Center, Brooklyn, NY; Director of Clinical Chemistry, SUNY Downstate Medical Center, Brooklyn, NY; and Associate Professor of Pathology and Biophysics, SUNY Health Science Center, Brooklyn, NY.

He currently serves as Research Professor of Electrical Engineering at Polytechnic University and Professor of Pathology and Biophysics, SUNY Health Science Center at Brooklyn, both in New York. He also serves as CEO at NIRx Medical Technologies, LLC and Photon Migration Technologies, Inc.

Dr. Barbour has been Associate Editor of *Biomedical Optics* since 1997. He has also served as Chairman and Co-editor of the following: *SPIE*, vol. 3171, Computational, Experimental and Numerical Methods for Solving Ill-Posed Inverse Problems: Medical and Nonmedical Applications, 1997; SPIE, vol. 2570, Experimental and Numerical Methods for Solving Ill-Posed Inverse Problems: Medical and Nonmedical Applications, 1995; and *SPIE* vol. 1887, Physiological Imaging, Spectroscopy and Early Detection Diagnostic Methods, 1993.

Professional membership includes American Association for Clinical Chemistry and American Society for Biological Chemistry; IEEE; Society of Photo-optical Instrumentation Engineers (SPIE); Fellow, National Academy of Clinical Biochemistry.

Sergio Fantini, Ph.D.

Functional Near-Infrared Spectroscopy (NIRS):
Co-Registration with fMRI and Prospects for the Assessment of Mental Workload

We present NIRS images co-registered spatially and temporally with fMRI-BOLD images in a human subject. By comparing the optical signals with a properly spatially weighted BOLD signal, we report high spatial and temporal correlations between the oxy- and deoxy-hemoglobin concentration changes measured with NIRS and fMRI during a hand-tapping protocol. We also report our first NIRS study aimed at distinguishing different levels of mental workload on the basis of hemodynamic changes occurring on the prefrontal cortex in human subjects.

BIOSKETCH

Sergio Fantini received his Ph.D. in physics from the University of Florence, Italy, in 1992. His dissertation was based on a Raman scattering study of ceramic superconductors. From 1993 to 1999, Dr. Fantini held postdoctoral and faculty appointments at the University of Illinois at Urbana–Champaign, Department of Physics. In 1999, he joined the Department of Electrical Engineering and Computer Science at Tufts University as an Assistant Professor, and has been one of the inaugural faculty members of the Department of Biomedical Engineering, created at Tufts University in 2002. Dr. Fantini is currently Professor of Biomedical Engineering and Associate Dean for Graduate Education in the Tufts School of Engineering. Dr. Fantini's research in diffuse optical imaging and spectroscopy, in areas such as tissue oximetry, optical mammography, and functional brain imaging, has resulted in eight patents and more than 130 journal and conference proceedings publications.

Juliette Selb, Ph.D.

Clinical Applications of Near-Infrared Spectroscopy to Cerebral Monitoring and Imaging

Near Infrared Spectroscopy (NIRS) is an emerging modality for functional imaging of the human body, with growing applications in particular for cerebral monitoring and imaging. Based on the detection of diffuse near-infrared light—at two or more wavelengths—after propagation through the scalp, skull and superficial cortex, it enables distinction between oxy- and deoxy-hemoglobin concentrations, and consequently total hemoglobin, directly proportional to cerebral blood volume. NIRS is therefore exquisitely sensitive to hemodynamics changes associated with cerebral activation, and the technique has been widely used for functional imaging in children and adults, with a broad range of stimulations from motor, to visual, auditory or cognitive. However the possibilities of NIRS encompass further applications. Different NIRS technologies (continuous-wave, frequency-domain, time-domain) are available to the community and can target different clinical questions depending on the required features (temporal/spatial resolution, absolute vs. relative measures).

I will present a review of the clinical applications of NIRS that we developed in the Photon Migration Imaging Laboratory, at Massachusetts General Hospital, including measurements of cerebral oxygenation in infants, monitoring of patients undergoing test occlusion of the internal carotid artery, and assessment of cerebral autoregulation in stroke patients.

BIOSKETCH

Juliette Selb obtained her Ph.D. in 2002, from the École Supérieure de Physique et Chimie Industrielles in Paris, France. She worked under the supervision of Claude Boccara on the development of a new biomedical imaging modality based on the acousto-optics interaction. Combining near-infrared light and ultrasounds, this technique fuses the functional information of the former with the spatial resolution of the latter, with the long-term prospect of breast imaging. In 2003, Juliette Selb started her postdoctoral training in the Photon Migration Imaging Laboratory of David Boas, at the Athinoula A. Martinos Center, Massachusetts General Hospital, Boston. Her post-doctoral work focused on developing the Time-Domain (TD) Near Infrared Spectroscopy (NIRS) technology for functional cerebral imaging in adult humans. Since 2008, she is an Instructor in Radiology at MGH. Her research activities embrace TD NIRS imaging, and the translation of different NIRS methods to the hospital, including breast imaging, cerebral oxygenation monitoring in infants, and clinical studies in the Neurology Intensive Care Unit.

Jason Riley, Ph.D.

Optical Imaging in the Hemispherectomy—The Effects and Modeling of Clear Regions

Near Infrared Spectroscopy (NIRs) and Diffuse Optical Tomography (DOT) are becoming common tools for imaging the brain. Based on technologies which are cheap, portable, non-invasive, and non-ionizing, they represent a very useful potential clinical tool. The basis of these technologies is an approximation to the behavior of light under the assumption of diffuse photon transport. In the human head there are various regions which may not conform to this assumption. One area where there may be some difficulty is in the cerebro-spinal fluid (CSF) of the sub-arachnoid space (SAS) and ventricles. Here light does not scatter. The effect is well documented but often discounted, as in the adult case; the SAS is relatively thin and light penetration to the ventricles unlikely. In the case of hemispherectomy patients this effect becomes more important to consider. We will present theory on how this will be handled and why it is more important in this case. Further we discuss how to use results obtained here to be able to validate or otherwise the previous assumptions on NIRS and DOT, most likely in terms of focus and positioning of signal.

BIOSKETCH

Dr Riley started his career in electronic and electrical engineering at Leeds University (United Kingdom) graduating with first-class honors and being awarded the Elaida Faberge Prize for Control and Instrumentation Engineering. He then went on to obtain an M.A. and Ph.D. at University College London, where he studied Computer Vision Image Processing and Graphics, taking his Ph.D. in the field of Optical Imaging, under the supervision of Simon Arridge, a leader in the Diffuse Optical Imaging field. His work on examining non-scattering inclusions in diffuse domains as it pertains to optical imaging was the first of its kind and relates to handling the presence of the Cerebro-Spinal Fluid in Diffuse Optics. He has since moved on to work as a Visiting Fellow at the NIH, where his focus has moved to Analytical and Statistical models of light as well as examining more closely the effects of noise on data-types used in optical imaging. His work here has seen him awarded the Fellows Award for Research Excellence, Recently his interest has been retuned to the area of Diffuse Optical Imaging of the brain, by projects including work on hemispherectomy patients. Here he will be looking at both clinical aspects involving functional mapping and plasticity effects. He also intends to further theoretical understanding of brain imaging including advancing his work on non-scattering regions, and looking into the area of examining physiological noise in DOT and trying to quantify realistic depth penetration of the NIRS signal in the head.