

CURRICULUM VITAE

NAME *Dr. Urs Ribary,*
INSTITUTION *Simon Fraser University (SFU),
University of British Columbia (UBC),
BC Children's Hospital Research Institute (former CFRI),
Vancouver, Canada.*

WEBSITE *www.bcni-sfu.net*

TITLE / AFFILIATION *- Endowed BC LEEF Leadership Chair,
Cognitive Neuroscience in Childhood Health and Development;
- Director, Behavioral and Cognitive Neuroscience Institute (BCNI);
- Professor in Psychology (SFU);
- Faculty Member in Pediatrics, Faculty of Medicine (UBC);
- Faculty Member in Psychiatry, Faculty of Medicine (UBC);
- Consultant: Neurobiology and Mental Health - MIND (BCCH-RI);
- Member & Investigator: Brain Research Centre, Center for Brain Health, (UBC);
- Fellow, UBC Institute of Mental Health;
- Faculty Affiliate, National Core for Neuroethics (UBC);
- Faculty, Cognitive Science Program (SFU)
- Investigator: Center for Drug Research and Development (CDRD).*

EDUCATION *Dr.sc.nat.ETH (DSc): Swiss Federal Institute of Technology (ETH),
Neuroscience and Neuropharmacology*

CITIZENSHIP *Switzerland, USA, Canada.*
MARITAL STATUS *Married with one daughter.*

SUMMARY: *Urs Ribary is the Endowed BC LEEF Leadership Chair in Cognitive Neuroscience, the Director of the Behavioral and Cognitive Neuroscience Institute (BCNI), and Professor in Psychology, Pediatrics and Psychiatry at Simon Fraser University and University of British Columbia in Vancouver since 2007. He was originally trained in neuroscience and neuropharmacology at the prestigious Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland. For almost 20 years he was Professor in Neuroscience and Director of the functional Brain Imaging Center at NYU Medical Center in New York City, USA.*

He is a world-renowned neuroscientist & pioneer in human brain imaging with expertise in functional brain network connectivity and communication dynamics in the healthy human brain, cognitive disabilities and patients with neurological and psychiatric symptoms. His work covers a multidisciplinary range, reflected by over 200 publications (7'367 citations; 2'013 last 5yrs), over 100 invited talks and a total awarded funding of \$172M (consolidated in CAD) as PI, Co-PI or Co-I. His work has been highlighted in Nature Neuroscience, Neuron, the New York Times (twice) and various TV channels including the Discovery Channel, 60-Minutes and resulted in a patent and a 50M US\$ mandate from a single donor (as PI). In 2007, 3 of his papers (all published in PNAS) were among the 10 most cited publications in the field. His successful research career is continuously reflected in major discoveries and impacts relating to a better understanding of the underlying neurophysiological mechanisms and brain circuitry in health and disease, the development of neural biomarkers, and was further essential in the translation into interventional strategies, including cognitive training programs for dyslexia (Merzenich et al, Science 1996; Tallal et al, Science 1996) and neurosurgical DBS for minimal conscious patients (Schiff et al, Nature 2007).

EDUCATION and ACADEMIC AFFILIATIONS

- 1967 - 1975 Gymnasium (IB program) at the KSL in Luzern, Switzerland.
Graduated in 1975, typus C (Science and Technology).
- 1975 - 1981 **Student in experimental Biology** at the University of Basel, Switzerland (1975-79),
under direction of Prof. W.Arber (Nobel Laureate in Medicine, 1978), Prof.H.Thoenen,
Prof. Nuesch, etc. (*physics, chemistry, mathematics, physical-chemistry, biology,
experimental biology, physiology*) and at the Swiss Federal Institute of Technology (ETH)
in Zurich, Switzerland (1979-81), under direction of Prof.K.Akert, Prof. M.Cuenod,
Prof.K.Baettig, Prof.W.Lichtensteiger, and Prof.R.Wehrner, (*neurophysiology,
neuropharmacology, behavioral-physiology, physiology of senses and cognition*).
- Nov. 1981 **Master of Natural-Science (sc.nat.ETH)** in *Neuroscience and Cognition*,
Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.
*The Master thesis was carried out at the Institute of Pharmacology, University of Zurich
under direction of Prof. W.Lichtensteiger in "Developmental Neuropharmacology using
histochemical and autoradiographical techniques".*
- Dec / 5 / 1985 **Doctor of Natural-Science (Dr.sc.nat.ETH)** in *Neuroscience and Neuropharmacology*,
Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland.
*The PhD thesis was carried out at the Institute of Pharmacology (University of Zurich),
under direction of Prof. W. Lichtensteiger in "Developmental Neuropharmacology using
biochemical techniques".*
- 1986 - 1988 **Visiting Assistant Professor**
Simon Fraser University, Vancouver, Canada,
Clinical Neurophysiology (Electro- and Magnetoencephalography)
(Director: Prof. H.Weinberg, Brain Behavior Laboratory, SFU)
- 1988 - 1993 **Research Assistant Professor**, Dept Physiology and Biophysics,
New York University Medical Center, New York, USA,
Clinical Neurophysiology (Electro- and Magneto-encephalography)
(Dept. Chairman: Prof. R.Llinas, Member of the National Academy of Sciences USA)
- 1989 - 2005 **Director, Center for Neuromagnetism (CNM)**
New York University Medical Center, New York, USA,
- 1993 - 2007 **Associate Professor**, Dept Physiology and Neuroscience,
New York University School of Medicine, New York, USA,
Clinical Neurophysiology (Electro- and Magneto-encephalography)
(Dept. Chairman: Prof. R.Llinas, Member of the National Academy of Sciences USA,
Member of the French Academy of Sciences)
- 2004 – 2006 **PI and Co-Director**; Mandate towards setup of multimodal Brain Imaging Institute.
(MRI, fMRI, MEG-BabySquid, MEG-Children/Adult, EEG, Computational Core)
- 2007-retirement **Endowed BC LEEF Leadership Chair** (British Columbia's Leading Edge Endowment
Fund Chair) *in Cognitive Neuroscience in Childhood Health and Development*,
- 2007 – present **Professor** in Psychology, Simon Fraser University (SFU), Vancouver, Canada.
- 2008 – present **Director, Behavioral and Cognitive Neuroscience Institute (BCNI)**, Vancouver,
Canada.

- 2009 – present **Associate Faculty Member** in Pediatrics, Faculty of Medicine, University of British Columbia (UBC), Vancouver, Canada.
- 2010 – present **Associate Faculty Member** in Psychiatry, Faculty of Medicine, University of British Columbia (UBC), Vancouver, Canada.
- 2011 – present **Faculty Affiliate**, National Core for Neuroethics (UBC).
- 2014 - present **Faculty Member**, Cognitive Science Program (SFU).

OTHER PROFESSIONAL ENGAGEMENTS AND AFFILIATIONS

- 1990 **Consulting** on the book "The Brain", Time-Life series, USA.
- 1995 - 1999 **Scientific Consultant** for 4D-Neuroimaging (one major manufacturer of MEG scanners; San Diego, CA) and **Advisor** to the owners of 4D-Neuroimaging (Enrique Maso and Martin Egli).
Activities included providing scientific talks within USA, Europe and Japan.
- 1995 - 2005 **Scientific Consultant** to Artist and Painter Jonathan Cramer (New York); Discussions initiated a new direction of Art "Quantalism", the production of a series of 10 wall-size paintings, and an educational puzzle project with UNICEF involving several thousands of children around the world.
- 2003 **Co-Chair**: Workshop on Magnetoencephalography (MEG)
Cold Spring Harbor Laboratory (CSHL), Cold Spring Harbor, NY, USA,
hosted by Dr. James Watson (Nobel Laureate and co-discoverer of the DNA)
- 2003 - present **Co-Founder and Chairman** of the "Samanta S. Ribary Foundation Inc.",
A charitable organization to support orphans and children in need with basic support,
early stimulation and extended cognitive learning programs.
< <http://www.samanta-ribary-foundation.org/>>
- 2003 **Author of a children's book (in German)**: "*Samanta und die blaue Blume*", Urs and Evelyne Ribary, Ursula Aplanalp, Magda Blau, eds., Verlag Bad Ragaz (publisher), Switzerland, 2003.
- 2004 - 2007 **Advisory Council** to ReadNet Foundation (New York, USA); an organization to improve literacy in children.
- 2006 - 2012 **Scientific Advisory Board Member** of the "International Brain Research Foundation Inc. (Headquarter: New York, USA). Taking action to cure neurological disorders.
- 2007 - 2012 **Scientific Advisor**, Initiative for Dealing with Depression Issues (iDwDi).
- 2007 - 2013 **Board Director**: Down Syndrome Research Foundation, Vancouver, Canada. Resigned in 2013 due to lack of DSRF's vision, support, commitment and responsibility.
Engagement within the community by chairing and facilitating brain imaging technologies and research in cognitive disabilities across disciplines and institutions.
- 2007 – present **Member and Investigator**, Brain Research Centre and CBH (UBC), Vancouver, Canada.
Engagement and facilitation within the multidisciplinary neuroscience and brain imaging research community in Vancouver, Canada.
Outcome: Co-PI / PU (core applicant) and SFU representative for the successful fundraising and overall setup of the UBC Multimodal Neuroimaging Centre (MMI), including MRI-fMRI, PET-MRI, TMS, NIS, EEG, MEG.
- 2007 – present **Consultant**: Neurobiology and Mental Health, Cluster MIND, BC Children Hospital Research Institute (former CFRI), Vancouver, Canada.
Engagement and facilitation within the multidisciplinary clinical and developmental research community in Vancouver, Canada.
Outcome: PU (1/10 Core P'Applicants) and Executive Steering Committee Member (representing SFU) for the successful \$12M CFI grant and setup of the Child & Family

- Research Imaging Facility (3T-MRI, EEG).
- 2007 - present **Alumni-Mentor:** to the Swiss Federal Institute of Technology (ETH), Switzerland.
Engagement within the top educational and future neuroscience research community in Switzerland, and facilitating training abroad in Europe and North America.
- 2007 – present **Investigator:** Center for Drug Research and Development (CDRD), Vancouver, Canada.
2008 **Chair:** Session on Computation, Modeling and Simulation (#220). American Society for Neuroscience International Meeting, Washington DC, USA, November 16, 2008.
- 2008 - present **Co-founder and Member,** “BC Fast ForWord Intervention Consortium”, a BC school interdistrict strategy to facilitate implementation of interventional training programs for Learning Disabilities in BC schools.
<<http://bcfastforword.pbworks.com/w/page/6060644/FrontPage>>
Engagement in the BC school community with scientific education and interventions.
- 2009 **BC LEEF Chair related “Rix Student Award”** awarded to Teresa Cheung, PhD student in Physics, SFU.
- 2009 **Author of a children's book (in English):** “*Samanta’s Journey of Hope*”, Urs and Evelyne Ribary, Ursula Aplanalp, Michaela Egger, Magda Blau, eds., ISBN: 978-1-4389-6550-5 (sc), AuthorHouse Publishing, Bloomington, IN, USA, May 22, 2009.
Engagement with educational publishing for children in North America and beyond.
- 2009 - **Member,** Child & Family Research Institute’s BC-Sleep Alert Network, headed by Dr. Osman Ipsiroglu.
<www.childrensleepnetwork.org/WP/what-we-do/faculty/urs-ribary/>
- 2010 – present **Fellow,** UBC Institute of Mental Health, Vancouver, Canada.
Engagement within the BC’s clinical research community on Mental Health.
- 2010 – present **Co-Founder and Executive Board Member:** Canada Magnetoencephalography Consortium (CMC). A Consortium to facilitate MEG brain imaging research, expertise and training across Canada. The CMC does benefit all scientists and clinicians in the multimodal imaging community and all related necessary future research on brain connectivity dynamics.
(Elected **National Associate Director** in 2012, Elected **National Director** in 2013)
<www.canada-meg-consortium.org>
Engagement, facilitation, training within the Canadian brain imaging research community.
- 2010 – 2013 **Co-founder and Member,** Expertise Network and Organization of Community Leaders and Change Agents to the creation of a model for sustainable change, Head: Steve Cairns, Vancouver, Canada.
Engagement within the public community in BC, Canada to promote models for change.
- 2010 – present **Core Team Member** and grant-co-applicant, NeuroDevNet (Network on Human Brain Development), a National Network Centres of Excellence (NCE), Canada.
Engagement within the Canadian multidisciplinary neuroscience research community.
- 2011 - 2013 **Scientific Consultant** to the MEG Center of the “International Brain Research Foundation Inc. (New Jersey, USA).
- 2011 **Faculty:** International Workshop on Research Needs for the Sleep Problems of Children with Neurodevelopmental Disorders. Vancouver, Canada, May 12-13, 2011.
- 2011 **Co-Chair:** Session on Novel Technologies for Neurological Disorders: Brain Scan Technologies, NeuroTalk 2011, Dalian, China, May/24, 2011.
- 2012 - 2013 **National Associate Director,** Canada Magnetoencephalography Consortium (CMC). A Consortium of all MEG Centers across Canada.
- 2012 - present **Board Director (& Vice President > 2014):** The Laurel Foundation, Vancouver, Canada.
Commitment: To fund, facilitate and promote research, services, programs and activities to the community for the care, treatment, habilitation and rehabilitation of persons with autism spectrum disorders, or who otherwise exhibit, suffer from, or are diagnosed with mental health disorders and behavioural challenges.
Since 2014, the Laurel Foundation started spearheading a new initiative to massively increase funding towards a sustainable support-strategy for autism research, knowledge translation and intervention. This consortium-strategy includes experts from the University Sector (UBC and SFU), the Education Sector, Medical Sector, Community Organizations

and the BC Government.

Engagement within the public community (monthly Board meetings and assessment of sponsored programs) to improve quality of life of affected individuals with Mental Health.

- 2013 - 2016 **National Director**, Canada Magnetoencephalography Consortium (CMC). A Consortium of all MEG Centers across Canada.
- 2013 – 2014 **Scientific Committee Member**, Bi-Annual International Conferences on Biomagnetism, (Biomag). Dynamic Brain Imaging: technology development, data analysis processing, basic and clinical applications, brain network dynamics, connectivity and causality.
- 2013 – 2015 **Development and Setup of Engaging and Collaborating Partnership**: between SFU and Griffith University (GU) in Australia, to better understand the Cognitive Human Brain Network in Health and Disease: Urs Ribary and David Shum (Dean Research GU and Director Griffith Health Institute, GHI). SFU International was not interested to support the global Initiative but rather to sponsor just small individual projects.
- 2014 **Chair**: Session on “Biomarker and Drug Discovery of Neurodiseases”, NeuroTalk 2014, Nanjing, China, May/16, 2014.
- 2014 **External Appraiser** (for PhD candidates), The Institute of Medical Science, University of Toronto, Canada.
- 2015 **Co-Chair** (Adrian Owen and Urs Ribary), Session: Research on Disorders of Consciousness (DOC) through the Ethics Lense. International Workshop on Neuroimaging for Disorders of Consciousness - Charting the Canadian Landscape, Vancouver, Canada, January 28-29, 2015.
- 2015 **Invited Chair**: Session on “Neural Biomarker and Neuroscience”, Neurotalk 2015, Hangzhou, China, May/24, 2015.
- 2015 - present **Research Partner**, Institute for the Reduction of Youth Violence (IRYV): Dr. McMahon, Director and SFU's BC LEEF Leadership Chair.
- 2015 - 2018 **Co-Chair** (Benasich and Ribary) for the prestigious Ernst Strungmann Forum ES-25, "Manifestations and Mechanisms of Dynamic Brain Coordination over Development", Frankfurt, Germany. Program Advisory Committee: A.Benasich and U.Ribary, with W.Singer, T.Sejnowski, G.Buzsaki, C.Nelson, Y.Ben-Ari and J.Lupp: *Planning and Realization of a 1-week international 40+ experts forum and brain-storming (March 2017) including a forthcoming book at MIT Press (Mar/ 2018).* <www.esforum.de>
- 2015 - 2017 **Science Advisor** to new start-up company: Nervanix.com: Nervanix is an exciting company in the learning industry that applies groundbreaking advances in the field of neuroscience to improve attention and focus in order to make learning more efficient and effective. Pioneering an entirely new category in learning known as “Attention Adaptivity”, their mission is to increase academic achievement by responding to and nurturing an individual’s cognitive abilities. The ultimate goal at Nervanix is to improve attention and focus in order to optimize a learner's engagement and achievement.
- 2016 - present **Faculty Affiliate**: UBC Language Sciences Initiative, www.languagesciences.ubc.ca/people/affiliates/urs-ribary/
- 2016 **Invited Chair**: Session on “Neurophysiology, Neurogenesis and Developmental Neuroscience”, Neurotalk 2016, Beijing, China, May/22, 2016.
- 2016 - 2017 **Oversight and Steering Committee Member**, SFU President’s Dream Colloquium: “*Understanding Medical Marijuana*”, Simon Fraser University, Jan-Apr/ 2017.
- 2016 - 2017 **Local Organizing Committee Member**: International OHBM (Organization Human Brain Mapping) Conference with 3,000+ scientists, Vancouver, Canada, June 2017.
- 2017 **Co-Organizer**, Symposium: Myelin Water Imaging in Human Brain: Principles, Validation and Applications. International HBM Conference, Vancouver, Canada, June 2017.
- 2017 - 2022 **Management Committee Member**, SFU Surrey ImageTech Management Committee (IMC) for multimodal brain imaging and translation.

HONORS and PROFESSIONAL MEMBERSHIPS

- 1984 - present Member: European Neuroscience Association (ENA)
1986 Young Scientist Fellowship Award from the Swiss National Science Foundation
1987 Young Scientist Fellowship Award from the Swiss National Science Foundation
1988 - present Member: American Society for Neuroscience (SfN)
1990 - present Member: New York Academy of Sciences (NYAS)
1991 - present Member: American Association for the Advancement of Science (AAAS)
1993 Research highlighted in: The New York Times;
1995 - present Member: Organization for Human Brain Mapping (HBM)
1996 Honorary Lecturer at the Medical Imaging Symposium, Tokyo, Japan;
1997 - present Member: Society for Cognitive Neuroscience (CNS)
1999 Research highlighted in: Neuron, Nature Neuroscience, The New York Times, The Washington Post (Washington DC);
1999 - Inclusion in Who's Who in Science and Engineering, USA (5th Edition, pp.1107, 2000)
2000 - Inclusion in Who's Who in America (55th Edition, pp.4390, 2001)
2001 - Inclusion in Who's Who in the World (19th Edition, pp.1801, 2002)
2002 - Inclusion in Who's Who in Medicine and Healthcare, USA, (4th Edition, 2003)
2003 - Inclusion in Who's Who in American Education, USA, (6th Edition, 2004)
2004 PI and Recipient of a \$50M USD mandate, the largest single-donor commitment to neuroscience in American history. A mandate together with a scientific colleague to establish and direct a Multimodal Functional Brain Imaging Institute.
2006 3 Research Articles were identified among the "10 most cited papers in the field of MEG", as #1, #3, and #10. (*ISI SciSearch: 1970-2005*);
2006 Keynote Speaker: 15th Internatinal Conference on Biomagnetism, Vancouver, Canada;
2007 Elected: Endowed BC Leadership Chair in Cognitive Neuroscience in Childhood Health and Development, British Columbia (BC), Canada. Review by Provincial/Federal Government and by National/International Scientific Community;
2008 Distinguished Lecturer, Thompson River University (TRU), Kamloops, BC, Canada;
2008 Member, Swiss Talents Network;
2009 Keynote Speaker: BC-CASE: British Columbia's Council of Administrators of Special Education, Vancouver, Canada;
2009 Keynote Speaker: BC School District SD57, Administrators for Special Education, Prince George, Canada;
2012 Keynote Speaker: BC School District SD45, Administrators for Special Education, West Vancouver, Canada;
2013 Annual Inclusion: "Who's Who in America" and "Who is Who in the World", for more than a decade.
2013 Keynote Speaker: Health and Medical Research Conference, Gold Coast, Australia;
2014 Distinguished Speaker: Neurotalk 2014, Nanjing, China.
2015 Invited Chair & Distinguished Speaker: BIT's Annual World Congress, Hangzhou, China.
2015 Plenary Speaker: Vancouver Elementary Prinipal and VicePrincipal Association (VEPVPA), Vancouver, Canada.
2016 Invited Keynote Speaker and Session Chair: BIT's Ann. World Congress, Beijing, China.
2016 Total of 7'292 citations to published research articles (Google Scholar Citation Index); with one paper alone cited 1,172 times by 2016 (Llinas and Ribary, PNAS 1993).

US Patents

- 2001 Detecting Oscillatory Slowing and Thalamo-Cortical-Dysrhythmia (TCD) in the human brain using functional brain imaging techniques; Biomarkers and objective diagnostic procedures for Neurology and Psychiatry.

Patent: LL101-US; Llinas, Ribary, Jeanmonod
Title: Method and system for diagnosing and treating thalamocortical dysrhythmia
Application # 09/876,895
Date filed: 6/2001
Licensee reference: 5986/1F798US1
Link: https://scholar.google.ca/citations?view_op=view_citation&hl=en&user=8gaDiggAAAAJ&citation_for_view=8gaDiggAAAAJ:8k81kl-MbHgC
(This patent is held by NYU School of Medicine, not an individual)

SCIENTIFIC REVIEWS

- 1988 - present Ad-hoc Reviewer (Scientific and Medical Journals):
Science
PNAS; Proceedings of the National Academy of Sciences USA,
Proceedings of the Royal Society (London), Biological Sciences,
PlosOne (Public Library of Science Online Publishing)
Neuroscience,
Journal Neuroscience,
Brain Research,
Cerebral Cortex,
J. Cognitive Neuroscience,
Neuroimage
Human BrainMapping,
Neurology,
Autism Research,
Human Frontiers,
American Journal of Psychiatry,
Progress Brain Research,
Behavioral and Brain Sciences,
Behavioural Brain Research,
Brain Research Bulletin,
Neuroscience Letters,
Biomedical Engineering Letters,
- 1988 - present Ad-hoc Reviewer (Grant committees):
NIH, NIH RO1 grants, USA.
Swiss National Science Foundation,
- 2007 - present Ad-hoc Reviewer (Grant committees):
CIHR (Canadian Institutes of Health Research), Systems & Clinical Neurosciences,
NSERC (National Science Engineering Research Council), Canada,
CFI (Canada Foundation for Innovation (CFI),
MSFHR (Michael Smith Foundation for Health Research), Clinical Panel, Canada,
MSFHR (Michael Smith Foundation for Health Research): Biomedical Research Panel,
University Toronto's prestigious "Connaught Global Challenge Award", Canada,
Fraser Health Authorities, Canada.
POGO (Pediatric Oncology Group of Ontario) Research Unit Seed Funding Grants,
Nova Scotia Health Research Foundation (NSHRF),

RESEARCH FUNDING

- 1986 Young Scientist Fellowship Award: Swiss National Science Foundation (~ \$ 30,000 TDC)
1987 Young Scientist Fellowship Award: Swiss National Science Foundation (~ \$ 30,000 TDC)

- 1988 – 2005 Co-PI of several funding grants from federal agencies (NIH, NIAA) and private foundations (Charles A. Dana Foundation, Watson Foundation, etc.) together with Dept. Chairman Dr. Llinas. (~US \$ 1,500,000 TDC)
- 1994 – 2005 Co-PI: Setup and Director of MEG Clinical Application Procedures including Presurgical Mapping of tumor and epilepsy patients for over 200 patients (during 1997-1999) in collaboration with Depts. Neurosurgery and Neurology. (~US \$ 500,000 TDC).
- 1998 - 2003 Co-PI of consortium sub-project (1 of 7) for NIH M01 General Clinical Research Center (GCRC) Grant awarded to NYU Medical Center (~ US\$ 18,000,000 TDC).
Co-PI of highest scoring sub-project within the consortium indicated that our project may have saved the entire grant.
- 2003 - 2008 Co-PI of consortium sub-project (1 of 7) for NIH M01 General Clinical Research Center (GCRC) Grant awarded to NYU Medical Center (~ US\$ 20,000,000 TDC).
- 2004-2006 PI: Recipient of a Mandate, together with a scientific colleague, from a private anonymous Donor to establish and direct a Multimodal Functional Brain Imaging Institute with a committed full support for 7years (business plan was approved by Board of Trustees and all scientific/clinical consultants). As Co-Director, efforts were to establish a multidisciplinary brain-imaging institute to study cognitive brain functions ranging from babies, children to adults in health and disease, using complementary brain imaging techniques (MRI; fMRI; 3 MEGs: one novel system for babies [BabySQUID], one for children, and one for adults; and 3 EEGs). Unfortunately, during negotiations with a top-ranking US university, trying to divert the funds, the donors halted the efforts. US\$ 50M.
This mandate reflected the largest single-donor commitment to neuroscience in American history!
- 2005-2006 PI: Scientific advisory/consulting, sponsored by an anonymous donor, in connection with the mandate for a Functional Brain Imaging Institute. US\$ 315,000.
- 2007-retirement PI: Elected as the Endowed BC LEEF Leadership Chair (BC Leading Edge Endowment Fund Leadership Chair) in Cognitive Neuroscience. Endowment: CAD 4,500,000.
- 2007-2012 PI: Rix Family Fund; to sponsor LEEF Chair related Rix Student Award. CAD 25,000 (5yrs).
- 2007-2009 PI: Presidents Research Grants (SFU). Initial Setup of Infrastructure in Cognitive Neuroscience Brain Imaging. CAD 10,000 (2yrs).
- 2008 – 2013 Co-PI: NSERC, Discovery Grant. Naznin Virji-Babul and Urs Ribary. The neural basis of action understanding. CAD 75,000 (5 years).
- 2008 – 2010 Supervisor: Michael Smith Foundation for Health Research (MSFHR), Research Trainee Program Grant. Teresa Cheung (Applicant). Modeling Dynamical Neural Activity of MEG Measurements using a Real Time Hardware Phantom. CAD 45,000 (2 yrs).
- 2008 – 2014 Co-Applicant and Senior Supervisor of MEG imaging: National Institutes of Health, NICHD RO1. PI: Ruth E. Grunau. Pain in preterm infants: Development and effects. Operating Grant. USD 1,250,000 (5 Years); plus 1 year extension (2013-2014).
- (2009 - 2014) (PI: NSERC-MRS; Vancouver Burnaby Neuromagnetic Imaging Laboratory. Awarded but funds were never released: Scientific reviewers successfully rated as “Must Be Funded” with the maximal possible score (A+, priority 1, highly relevant and unique) with funding to full extent. However due to Federal cut-backs, the NSERC-Executive shut down all MRS support to provincial resources and did not release the funds (and overruling the referees decision), by directing that the Province or Host-Institution should cover, although such allocated Provincial Infrastructure Operating Funds did not exist in BC. CAD 750,000 [5 years].)
- 2009-2014 PU (1/10 Co-PI's) and Executive Steering Committee Member (representing SFU): CFI New Initiatives Fund (NIF). PI: Steven Miller. Title: Child & Family Research Imaging Facility (3T-MRI, EEG). CAD 12,121,897 (total infrastructure fund).
- 2009 - 2011 Supervisor: Michael Smith Foundation for Health Research (MSFHR), Research Postdoctoral Trainee Program Grant. Sam Doesburg (Applicant). Magneto-

- encephalographic (MEG) investigation of cortical processing in children born very preterm. CAD 58,500 (2 years).
- 2010 - 2015 Co-Applicant and Core Team Member/Representative of Imaging study group: National Network Centres of Excellence (NCE). PI: Daniel Goldowitz. NeuroDevNet (Neuro Development Network). CAD 19,000,000 (5 years).
- 2011 - 2012 PI: Simon Fraser University, VP Research Grants. Magneto-encephalography (MEG) Brain Imaging and Signal Processing Technologies; (Matching funds to our successful NCE grant). CAD 20,000 (total).
- 2012 - 2018 PI: CFI Leaders Opportunity Fund (LOF, plus BCKDF Matching Fund). Behavioral and Cognitive Neuroscience Institute (BCNI); Awarded: Oct/2009, but funds released 3yrs later in Spring/2012. CAD 518,170 (total infrastructure fund).
- 2012 - 2018 PI: CFI-IOF (Infrastructure Operating Grant). Behavioral and Cognitive Neuroscience Institute (BCNI); CAD 56,602.
- 2012 - 2017 Co-Applicant: CIHR Operating Grant. Neuroimaging for Disorders of Consciousness (DOC): Charting the Canadian Ethics Landscape, PI: Judy Illes. CAD 400,000 (5 yrs). (J.Illes, J.Stoessl, A.Owen and U.Ribary; Grant support to establish ethics guidelines for implementing multimodal brain imaging findings on Disorders of Consciousness into clinical practice).
- (2012-2015) Co-PI (Consortium Executive Member), and PI (Vancouver MEG Operation): NSERC-MRS. Canada Magnetoencephalography Consortium (CMC). PI: Pierre Jolicoeur. CAD 2,460,000 (3 yrs).
The external international scientific committee's peer-review rated very highly and most positive on all issues, even describing the grant efforts as a role-model for multimodal imaging infrastructure. The grant would have been awarded according to the very high scores, but, after the review process, NSERC shut down the entire national and international MRS program in spring 2012 and funds were never released.
CMC: www.canada-meg-consortium.org
- 2014 - 2015 PI (Ribary): Psychology Department Research Grants (PDRG). Pilot Study - Dyslexia: Behavioral Assessment and portable EEG brain imaging pre-/post- cognitive interventional training in BC Schools (with Ender-Fox, Siegel and Ward). CAD 7,500/yr.
- 2015 - 2020 Co-PI (1/10 PU) and SFU Representative: CFI-LEF Infrastructure Grant: 3T-MRI scanner and Electrophysiology and Neuromodulation Laboratory for the UBC Multimodal Neuroimaging Centre. Alex Mackay (PI), Urs Ribary, Lara Boyd, Martin McKeown, Anthony Traboulee, David Li, Jane Wang, Max Cynader, William Honer. *Setup and Operating of a multimodal structural, functional and temporal brain imaging facility at UBC's CBH; including a 3T-MRI, a behavioral suite (NIS, TMS, EEG) and a computational core, with further fundraising for a hybrid MRI-PET, and MEG.* CAD 7,698,390 (total). Plus additional CFI-IOF Funds).
- 2015 - 2016 PI (Ribary, Moiseev and Baird): Private Donation (AMG Global Research Inc.) plus SFU-FASS Matching Fund: Development of real-time MEG (rtMEG) brain imaging in CTF Systems; Collaborative project between BCNI Institute and MISL (MEG International Services Limited), with a \$30K in-kind from MISL. CAD 61,250 (6 months).
- 2016 - 2016 PI (Ribary): Personal contribution from LEEF Endowment Fund. BCNI Institute's Expertise Operation. CAD 10,000 (6 months).
- 2017 - 2018 PI (Ribary): Psychology Department Research Grants (PDRG). Implementation of Software Prototype for Real-time MEG Brain Imaging. CAD 7,500/yr.

In Progress:

Private Fundraising (in progress):

ACADEMIC TEACHING ACTIVITIES

- 1983 - 1986 Providing Postgraduate Courses in Experimental-Medicine and Experimental-Biology, University of Zurich, Switzerland.
- 1983 - 1986 Providing laboratory demonstrations for students in Pharmacy and Biology, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.
- 1986 - 1988 Supervising graduate students during experimental studies, Brain Behavior Laboratory, Simon Fraser University, Vancouver, Canada.
- 1989 - 2005 Training and Supervision of postdocs, MD Residents, MD/PhD students, undergraduate students, and technicians in functional brain imaging studies using MEG (Magnetoencephalography), as the Director of the CNM, New York University School of Medicine, New York, USA.
- 1995 - 2005 Lectures, Neuroscience course for medical students: “Functional Human Brain Imaging; Techniques and Applications”, New York University School of Medicine, New York, USA.
- 1997 Lectures, Workshop on Neuronal Data Analysis (WAND), Marine Biological Laboratory (MBL), Woods Hole, MA, USA.
- 1999 - 2005 Lectures, Systems-Neuroscience course for MD/PhD students, “Available Functional Brain Imaging Techniques today and its Applications”, New York University School of Medicine, New York, USA.
- 2007 - - **Teaching-Exemption as Endowed (tenured) Chair (BC LEEF Chair)**, according to international standards.
- 2008 – present Plenary and Public Lectures, Seminars and Workshops to BC school districts (School Boards, District Boards, Teachers, Staff, Students and Parents), on imaging of the cognitive human brain at work in health and disease.
Engagement: To raise public awareness on the state-of-the-art technologies on brain imaging, advances in neuroscience and intervention, and how such knowledge and applications benefit routine and special education.
- 2009 Career Lecture for undergraduate and graduate students, Cognitive Science Program, “Brain Imaging Technologies and Applications“, Simon Fraser University, Vancouver, Canada.
- 2009 Directed Study Course in Psychology (Psych-997: student T.Cheung). “Analysis of brain oscillations and circuitry in Epilepsy patients”. Simon Fraser University (SFU), Canada.
- 2010 - present Guest Lectures for Psychology course 300W, “Brain Imaging Technologies and Applications”. Simon Fraser University (SFU), Canada.
- 2010 Guest Lecture, Psych in the City Lecture Series, SFU Surrey Campus, Simon Fraser University (SFU), Canada.
- 2011 – present Faculty of the Canadian MEG Consortium (CMC)’s annual workshop. The annual MEG workshop’s aim of scientific teaching and training highly qualified personnel (students and scientists) at national level.
- 2013 - 2014 Directed Reading Course in Neuroscience (PhD candidate Adrian Byram). From models of consciousness, to brain imaging applications to ethical implementation into the clinical practice. University of British Columbia (UBC), Canada.
- 2015 - 2016 Directed Study Course in Psychology (Psych-493: student Emily Hirst). “Dyslexia: Emotional Impact and Consequences”. Simon Fraser University (SFU), Canada.
> *This course resulted in 2 scientific abstracts, and 1 scientific paper.*

ACADEMIC TRAINING ACTIVITIES

Since 1989 until 2014, I have trained in various capacities at different levels, and have personally supervised or co-supervised a total of 6 PDFs, 8 post-docs, 3 MD Residents, 19 MD/PhD or PhD students, 26 Medical or undergraduate students, and was further the supervisor/mentor for 4 Sr Research Staff and 5 Technical Staff.

1989-2006:

Director of the Center for Neuromagnetism CNM (Brain Imaging Center) at NYU Medical Center (New York, USA): in charge for the supervision of the day-to-day MEG brain imaging operations, for the initiation-, design-, setup and coordination of national/international basic and clinical research projects using MEG technologies, and mentoring/training of scientists, research staff, including post-doctoral students, MD Residents, MD/PhD students, PhD students, medical students, undergraduate students and various technical staff.

In addition, responsible for the setup and supervision of MEG Clinical Application Procedures (1994-2005) as a service to the Clinic at NYU Medical Center. Service was provided for evaluating over 200 tumor and epilepsy patients, as pre-surgical mapping and surgical guidelines procedures in collaboration with the Depts of Neurosurgery and Neurology at NYU Medical Center..

Training and Supervision of CNM imaging center's staff, posdocs and graduate students (1989-2006):

- Senior research staff:
- Post-doctoral students and MD Residents:
- MD/PhD students and PhD students:
- Medical students and undergraduate students:
- Technical staff:

<<< **No Names posted on website** >>>

2007- present:

BC LEEF Leadership Chair, and Director BCNI Institute:

- Multimodal Brain Imaging (SFU, CFRI-BCCH, UBC) > 2007 – present;
- MEG Brain Imaging Operation (DSRF, SFU) > 2007 - present;
- Portable EEG and portable Eye-Tracker Operation (BCNI) > 2013 – present;

Scientists, Postdocs, Graduate Students, (2007 – present):

<<< **No Names posted on website** >>>

2008-present: Alumni-Mentor to the Swiss Federal Institute of Technology (ETH).

As Alumni of the ETH in Zurich (Switzerland), engaging on online data-base programs to mentor students at the ETH to facilitate Career Advancement. **The ETH is rated as one of the top ten universities in the world and has been home to 21 Nobel Prize Laureates, including Albert Einstein and Wilhelm Roentgen (discoverer of X-ray as the first medical imaging technology).**

2011-present: Faculty of the Canadian MEG Consortium (CMC)'s workshops.

(CMC's National Associate Director: 2012-2013; CMC's National Director: 2013-2016)

The MEG workshop's aim of training HQP -highly qualified personnel- (undergraduate and graduate students, postdocs, scientists) with all available scientific and technical expertise at national level, by reducing the unnecessary costs and burden to individual MEG sites, and therefore accelerating research training and productivity in dynamic brain imaging across Canada.

Engagement within the National Canadian multidisciplinary brain imaging community with scientific teaching and collaborative fundraising at national level.

2013-present: Director of the BCNI (Behavioral and Cognitive Neuroscience Institute), a collaborative and multidisciplinary training platform across disciplines and institutions, on brain imaging, software technology development, basic and clinical research, knowledge translation, neurodiagnostics and intervention.

> *Supervision of senior/junior staff and students, and initiating multidisciplinary team/training efforts.*

RESEARCH INTERESTS

The Neurophysiological Framework toward Unified Principles of Cortical Processing: Local and Large-Scale Brain Network Connectivity and Dynamics in the Typical and Atypical Human Brain:

Contributions of thalamocortical local and long-range oscillatory connectivity and dynamics to perception, cognition, memory, and integrative problems of Neurological and Psychiatric pathologies, including Traumatic Brain Injury.

- Doesburg, Ward, and Ribary, *Curr. Trends Neurol.*, 2015.

RESEARCH GOALS

Basic and Clinical Research > Translational Applications > Neurodiagnostic Strategies >

Intervention: To study the underlying biological mechanisms and functional significance of distributed neuronal networks, their global organization and their structural, functional and temporal connectivity, and how they relate to normal and pathological human brain function, in order to establish objective neurodiagnostic procedures for cognitive abnormalities and pathologies in Neurology and Psychiatry, relating to cognitive, pharmacological and surgical interventions.

- Ribary, *Progr. Brain Res.*, 2005;

- Ribary, Doesburg and Ward *Magnetoencephalography*, 2014.

SCIENTIFIC DISCOVERIES AND ACHIEVEMENTS

Basic and Clinical Research > Applications > Neurodiagnostic Strategies > Intervention:

1985

Ontogeny and alteration of monoamine neurotransmitter metabolites (animals):

A Doctorate degree was awarded for the achievement to quantitatively measure monoamine metabolites in fetal rat brains for the first time, and for the demonstration that the ontogeny of these neurotransmitter metabolites in fetal and early postnatal forebrains were altered by various drugs such as nicotine.

- Ribary et al. *Neuropharmacology*, 1986,

- Ribary and Lichtensteiger, *J.Pharmacol. Exp. Ther.*, 1989,

>> This article received 110 citations by 2016 (Google Scholar Citation Index)

1986 – 1988

Dynamic organization of gamma-band oscillatory activity in health and disease:

We provided the first evidence of global organization of dynamic human steady-state gamma-band brain activity in healthy adults and its alterations in severely depressed patients, leading to the hypothesis of the existence of coupled thalamocortical gamma oscillations.

- Ribary, Weinberg, Cheyne, Johnson, Holliday, and Ancill. *EEG and MEG (magnetoencephalography) mapping for indexing pathological changes in human brain. European J. Neurosci. Suppl.*, 1988.

1991-1993

Thalamo-cortical origin and dynamics of gamma-band oscillatory brain activity:

Using combined Magnetoencephalography (MEG) and Magnetic Field Tomography (MFT) techniques, we demonstrated for the first time the reset and coupling of transient human gamma-band oscillations within the thalamocortical network, which was altered in pathological states such as Alzheimer's disease. We further demonstrated for the first time that human gamma-band activity is continuously generated by the central nervous system and altered during different states of consciousness, being evident during awake and rapid eye movement (REM) sleep but not during deep sleep states. In addition, spontaneous gamma-band oscillations were modified by sensory stimuli in the awake state but not during REM or delta sleep. These studies provided important evidence that gamma oscillations related to cognitive brain states and the temporal integration of sensory input and further provided an explanation of underlying brain circuitry for the generation and maintenance of such oscillations within thalamocortical networks.

- **Ribary, Ioannides, Singh, Bolton, Lado, Mogilner, and Llinás.** *Magnetic Field Tomography (MFT) of coherent thalamocortical 40-Hz oscillations in humans.* Proc. Natl. Acad. Sci. USA, 1991.
 >> **This reference has been identified in 2005 as #1 among the “10 most cited research articles” in the field (ISI SciSearch: 1970-2005)**
 >> **This article received 523 citations by 2016 (Google Scholar Citation Index)**
- **Llinás and Ribary.** *Coherent 40-Hz oscillation characterizes dream state in humans.* Proc. Natl. Acad. Sci. USA, 1993.
 >> **This reference has been identified in 2005 as #3 among the “10 most cited research articles” in the field (ISI SciSearch: 1970-2005)**
 >> **This research contribution has been highlighted in The New York Times**
 >> **This article received 1,091 citations by 2016 (Google Scholar Citation Index)**

1993

First Imaging Evidence of functional plasticity in the human brain:

A PhD thesis from A. Mogilner at our MEG Center provided the first functional imaging based evidence that plastic changes, earlier discovered in animals, also occurs in the human somatosensory cortex relating to a functional reorganization in the human brain.

- **Mogilner, Ribary et al.** Proc. Natl. Acad. Sci. USA, 1993.

>> **This article received 283 citations by 2016 (Google Scholar Citation Index)**

1994-1998

Thalamo-cortical dynamics of gamma-band oscillatory brain activity correlating with normal and altered sensory perception:

We provided first evidence that human gamma-band activity correlates with behavior, namely with early sensory perception and the temporal binding of incoming sensory stimuli. We also demonstrated for the first time that the human brain could process sensory information in discrete time quanta of as low as 15msec. In collaboration with P.Tallal and S.Miller at Rutgers University, we further demonstrated that such a temporal processing mechanism is altered during cognitive impairment such as in dyslexia. We identified quantitative abnormalities in the time course and dynamics of cortical processing. These studies helped to better understand underlying brain substrates of early sensory processing and indicated a possible objective neurophysiological marker for dyslexia.

- **Joliot, Ribary, and Llinás.** *Human oscillatory brain activity near 40 Hz coexists with cognitive temporal binding.* Proc. Natl. Acad. Sci. USA, 1994.

>> **This reference has been identified in 2005 as #10 among the “10 most cited research articles” in the field (ISI SciSearch: 1970-2005)**

>> **This article received 585 citations by 2016 (Google Scholar Citation Index)**

- **Ribary, Cappell, Mogilner, Hund, Kronberg, and Llinás.** *Functional imaging of plastic changes in the human brain.* Advances in Neurology, 1999.

- **Llinás, Ribary, Miller, Tallal et al.** In: *Basic Mechanisms in Cognition and Language*, VonEuler, Lundberg and Llinás, eds., Elsevier Science, New York, 1998.

1998

Dissociation of thalamo-cortical gamma-band activity in traumatic brain injury:

In collaboration with F.Plum and N.Schiff at Cornell Medical College (New York Hospital), we provided evidence for the first time, that human gamma-band activity was severely fractured in permanently unconscious vegetative patients. Oscillatory activities were abnormal, incomplete or absent, probably due to a partial or complete disconnection of thalamocortical systems. Our findings further indicated that there was a correlation between islands of partially preserved but fractured brain structure and function (MRI, MEG, PET) and isolated and meaningless fragments of behavioral patterns. These studies helped to better understand the underlying brain substrates and circuitry in traumatic brain injury patients and provided an explanation for the first time for the observation of meaningless fragments of behavior frequently observed in such unconscious patients and providing a possible diagnostic framework for recovery.

- **Schiff, Ribary, Moreno, Beattie, Kronberg, Blasberg, Giacineo, McCagg, Fins, Llinás,**

and Plum. Residual cerebral activity and behavioural fragments can remain in the persistently vegetative brain. *Brain*, 2002.

>> **This article received 316 citations by 2016 (Google Scholar Citation Index)**

- Plum, Schiff, Ribary et al. *Phil. Trans. Royal Society London*, 1998.

- Schiff, Ribary et al. *J. Cogn. Neurosci.*, 1999.

1999

Thalamo-cortical network dysrhythmia in neurology and psychiatry:

In collaboration with the University of Zurich and Bell Laboratories, our MEG studies provided evidence for the first time that altered human brain network oscillations may be related to positive symptoms in several neurological and psychiatric patients, due to a dysrhythmia within thalamocortical systems, proposing a clinical syndrome of thalamocortical dysrhythmia (TCD). These studies provided a better understanding of underlying brain substrates and brain circuit connectivity in some neurological and psychiatric patients proposing a possible correlation to positive symptoms.

- Llinás, Ribary, Jeanmonod, Kronberg, and Mitra. *Thalamocortical Dysrhythmia: A neurological and neuropsychiatric syndrome characterized by magnetoencephalography*. *Proc. Natl. Acad. Sci. USA*, 1999.

>> **This research contribution has been highlighted with commentaries in**

Neuron, Nature Neuroscience, The New York Times and the Washington Post.

-- Also, a US Patent was obtained on the basis of this work. <<

>> **This article received 861 citations by 2016 (Google Scholar Citation Index)**

2005

Timing within thalamo-cortical brain networks:

Findings of our brain imaging data within the context of the current literature indicates the importance of analyzing the temporal aspects of fine-tuned brain network oscillation dynamics and temporal connectivity within thalamo-cortical network functions. Specifically, it indicates their precise relation to early sensory integration processing in the healthy human brain and its alterations in dyslexia, neurology and psychiatry, including a loss of overall connectivity in unconsciousness during traumatic brain injury.

- Ribary, *Progr. Brain Res.*, 2005.

>> **This article received 93 citations by 2016 (Google Scholar Citation Index)**

2007 – present

Achievement-Award: Endowed British Columbia's LEEF Leadership Chair in Cognitive Neuroscience in Childhood Health and Development, reviewed and supported by the Canadian Provincial/Federal Government and by the International Senior Scientific Community: Engagement in expanding brain imaging expertise, coordinating multimodal brain imaging resources development, facilitating research programs in cognitive neuroscience across disciplines and institutions including SFU, the Down Syndrome Research Foundation, the Child & Family Research Institute, BC Children Hospital, UBC and others. Research Vision: to interconnect behaviour, brain structure and brain function with particular emphasis to capture local and large-scale brain network dynamics and to quantify temporal connectivities in five dimensions (3D space, across frequency and time) and underlying cognitive functions. Goal: to better understand the developing human brain in health and disease, in order to develop better objective neuro-diagnostic procedures for cognitive abnormalities, neurological and psychiatric pathologies, translating into better pedagogical applications and better cognitive, pharmacological and surgical interventional therapies.

- Ribary, *Progr. Brain Res.*, 2005.

- Ribary, Doesburg and Ward. In: *Magnetoencephalography – From Signals to Dynamic Cortical Networks*, S.Supek and C.J. Aine, eds, Springer Verlag Heidelberg, 2014.

2007 - present

Brain network oscillations, synchronization and connectivity in health and disease:

Based on successful pioneering and career-long team efforts (with 3 research articles identified among the “10 most cited papers” in the field in 2005), continuation of collaborative efforts with **Lawrence Ward** (UBC) and **Sam Doesburg** (SFU, former

University Toronto) on better understanding the biology and neurophysiology of underlying brain network connectivity relating to sensori-motor and cognitive functions, and its alterations in cognitive disabilities and in patients with neurological or psychiatric symptoms. In particular the focus relates to brain network oscillation dynamics, its synchronization, cross-correlations across space/frequency/time, and task-specific functional connectivity dynamics among local and large-scale networks.

- **Ribary, Doesburg and Ward**, *Magnetoencephalography*, 2014.

Synchronization and functional connectivity across the entire brain space in relation to clinical symptoms and consciousness: Conceptual Overview: We published several conceptual review-overviews of current findings and their implications for how dynamic brain imaging technologies can be further used to probe structural, functional and temporal connectivity to better understand, diagnose and treat cognitive disabilities and neuro-psychiatric pathologies including the many forms of traumatic brain injury.

- **Ribary and Ward**, *Phenomenological Neuropsychiatry*, in press.

Evidence for first neurophysiological framework toward unified principles of cortical processing: Neural oscillations at various frequencies and their synchronization among brain areas have been associated with numerous cognitive processes, but strong theories to integrate such findings remain elusive. Our comprehensive review into the animal and human literature indicates thinking beyond synchrony and connectivity and the readiness for more hypothesis-driven research and modeling toward unified principles of cortical processing and we introduced a possible subsequent framework: "The alpha-theta-gamma (ATG) switch". This framework further challenges the dominant view in neuroscience regarding brain activation per se and rather suggests a "inhibitory and related dis-inhibition" of intrinsic brain activity during sensory and cognitive processing integrating local and large-scale brain networks in health and disease.

- **Doesburg, Ward, and Ribary**, *Curr. Trends Neurol.*, 2015.

- **Ribary, Doesburg and Ward**, *Biomedical Engineering Letters*, 2017.

Brain network dynamics and connectivity underlying cognition (word reading): In collaboration with **Lawrence Ward** (UBC), we reported for the first time the fast dynamics of functional and effective (causal) brain network connectivity during word reading within a msec time-scale. These results, using high-density EEG imaging, highlight the interplay between local and long-distance neural dynamics involved at each stage of the reading process.

- **Bedo, Ribary and Ward**, *PlusOne*, 2014.

2008 – present ***Alterations in brain network connectivity dynamics in children born very preterm:***

In collaboration with **Ruth Grunau** (Pediatrics, UBC) and colleagues, as senior supervisor of additional MEG brain imaging project, as supervisor of related postdocs and signal processing scientists, and as co-applicant of related NIH-RO1 grant, I have stressed and facilitated a more comprehensive strategy/approach beyond traditional ones, namely focusing on the detailed underlying brain network's oscillation and connectivity dynamics across 5 dimensions, and relating with cognitive or behavioral correlates:

Imaging studies have provided some of the very first insights into how altered MEG oscillatory brain activity in developing brain networks underpins problems in the psychological development of these vulnerable children. We demonstrated (i) first experimental evidence of altered spontaneous neuromagnetic activity (oscillatory slowing) in children born very preterm, (ii) evidence that this altered resting activity is related to cognitive performance problems in preterm children, (iii) sequential activation within a network of cortical regions during short-term memory processing in school age children, (iv) specific differences in regional activation in very preterm children during short-term memory retention, (v) reliable patterns of communication and connectivity dynamics between brain regions during short-term memory retention in children age 6–10 years, (vi) first MEG evidence for altered patterns of communication and connectivity dynamics

between brain regions in very preterm children, and (vii) that these highly specific alterations of functional connectivity in very preterm children are predictive of selective problems in cognitive development in these vulnerable children.

- Doesburg, Herdman, **Ribary**, Cheung, Moiseev, Weinberg, Liotti, Weeks, Grunau. *Exp. Brain Res.*, 2010.

>>> Dr. Doesburg - Best Young Investigator in 2010: Award of the International MEG Society.

- Doesburg, **Ribary**, Herdman, Moiseev, Cheung, Miller, Poskitt, Weinberg, Whitfield, Synnes and Grunau. *Pediatr. Res.*, 2011.

- Doesburg, **Ribary**, Herdman, Miller, Poskitt, Moiseev, Whitfield, Synnes and Grunau. *Neuroimage*, 2011.

- Doesburg, Chau, Cheung, Moiseev, **Ribary**, Herdman, Miller, Cepeda, Synnes and Grunau. *Pain*, 2013.

- Bichin, Chau, Doesburg, Herdman, **Ribary**, Grunau, *NDN Brain Development Conference*, 2016.

In addition and more recently, further analysis of BCNI's signal processing scientist **Alex Moiseev** provided the first source-based analysis of task-dependent neuromagnetic connectivity in children born very prematurely. Atypical oscillatory synchronization during short term memory processes suggested disruption of interregional functional connectivity supporting cognition. We demonstrated altered coherence in multiple frequency ranges, but identified alpha, beta and low-gamma band frequency ranges as particular pertinent to reduced functional interactions among brain areas in this group. We further identified specific brain regions as expressing reduced task-dependent functional connectivity and dynamics, including middle frontal gyrus, suggesting impaired ability to recruit sufficient coordinated activity among frontal and widespread cortical regions which may further contribute to a better understanding of difficulties in executive abilities in children born very preterm.

- Moiseev, Doesburg Herdman, **Ribary**, Grunau. *Brain Topography*, 2015.

2008 – 2013

Altered Brain network connectivity dynamics in individuals with Down Syndrome (DS): In collaboration with **Naz Virji-Babul** (UBC, former DSRF) and as co-applicant of related NSERC Discovery grant, I have stressed and facilitated a more comprehensive strategy/approach beyond traditional ones, namely focusing on the detailed underlying brain network's oscillation and connectivity dynamics across 5 dimensions, and relating with cognitive or behavioral correlates:

Mirror Neuron System in Down syndrome (DS): Functional brain imaging data indicated a dysfunction in the execution/observation mirror neuron system in subjects with DS. Motor responses were strongly lateralized to the ipsilateral rather than the contralateral side during execution, and the underlying functional connectivity dynamics was altered during sensory-motor integration. These data shed more light on how subjects with DS may differently understand the actions and intentions of others.

- Virji-Babul N, Moiseev A, Cheung T, Weeks D, Cheyne D, and **Ribary U**. *Hum. Brain Mapp.*, 2010.

- Virji-Babul N, Moiseev A, Cheung T, Weeks D, Cheyne D, and **Ribary U**. *Am. J. Intellect. Dev. Disabil.*, 2010.

Voluntary movement in Down syndrome (DS): In the DS population, we observed two distinct patterns of neural activation of motor networks, (i) an ipsilateral dominance and (ii) a typical contralateral dominance, both in conjunction with altered underlying functional network connectivity dynamics, indicating a possible neurophysiological explanation related to differences in sensorimotor organization in DS.

- Virji-Babul N, Moiseev A, Moiseeva N, Sun W, **Ribary U**, and Lott I. *NeuroReport*, 2011.

Perception of human motion: Functional brain imaging data indicated that perception of both, random or human motion involves de-synchronization of oscillatory activity in alpha/beta bands in similar cortical regions. However, only human motion was associated with a larger network and further related significant alterations in the alpha/beta band particularly in the right hemisphere, in addition to persistent increases in the gamma band. These data suggest that the visual perception of dynamic motion relates to de-/synchronized oscillatory activity of neuronal populations in distinct frequency bands, with activation of occipital and parietal regions in the early stages of processing, and subsequently of task-specific cortical locations.

- Virji-Babul N, Moiseev A, Sun W, Fesharaki A, Beg F, **Ribary U.** *NeuroReport*, 2012.

2008 – 2012 **Expansion of MEG technology strategies and new applications:** In collaboration with **Karen Kavanagh** (Physics, SFU) and **Ash Parameswaran** (Engineering, SFU), our PhD student **Teresa Cheung** explored and expanded MEG technology strategies for (1) assessing the accuracy and explanation of MEG brain imaging data, focusing on a scanner independent approach to modeling neural activity with a hardware phantom model, and (2) developing new MEG applications towards the assessment of biochemical compounds in the human brain/body, focusing on a new technique for magnetic nanoparticle imaging using magnetoencephalography frequency data.

- Cheung, T, Wong, J, Parameswaran, A, Babul, A, Beg, F, Kavanagh, KL, Jirasek, A, and **Ribary, U.** In: *Biomagnetism*, R.Kakigi, et al. eds, Hokkaido University Press, 2008.

- Cheung, T, Kavanagh, KL, **Ribary, U.** *IFMBE Proceedings*, 2010.

>>> **Teresa Cheung received the LEEF Chair related Rix Student Award (2009).**

2008 – present **Facilitating the integration of brain-based interventional cognitive training programs for Learning Disabilities (Dyslexia) in BC schools:**

The “**BC Fast ForWord Intervention Consortium**” with Co-founders: **Cairns, Chow, Hernandez, Todd, Collins** and **Ribary**; a BC school interdistrict strategy to facilitate the knowledge and integration of such programs in BC schools.

In the early 90’s, our previous brain imaging research was part of a consortium effort further facilitating translation into cognitive interventions for learning disabilities; Our collaborators had then developed such interventional programs and started a company (Scientific Learning) in 1996, based on two publications in “Science”, having successfully trained over 1.2M children in 45 countries (as of 2008), and more than 2M children by 2014. On behalf of my tenure as BC LEEF Chair, I continuously help to facilitate such cognitive interventions at various levels, including BC Ministers, BC-CASE (BC Council of Administrators of Special Education), BC school districts, BC schools and by providing scientific talks and consulting.

Facts: Prior to founding the BC FFW Consortium during the 2007-2008 school year, fewer than 250 students used the FFW intervention in BC schools. Two years later, by the 2009-2010 school year, the number of students enrolled in FFW intervention at BC Consortium schools had increased more than 400%/yr to a total of 1,208 students. As of 2012, more than 3,000 students have been successfully enrolled in FFW interventional training in BC over a five-year period, with average training of 43 days, average attendance of 72% and average participation of 92%. Students ranged from Kindergarten through High School, with an average grade level of early 5th grade. **As of Dec/2016, the interventional FFW training platform has further grown; close to a total of 9,000 students have been trained within 130 schools across 22 districts in BC with an overall gain of 0.7-2.0 years in reading level, including elementary and secondary schools. This is by far the largest effort across Canada with 49% training in BC (AB-26%, ON-8%).**

The training sites are mostly dominated by:

- Burnaby;
- Coquitlam;
- New Westminster;

- Surrey;
 - Vancouver, West Vancouver, Richmond and all other school districts.
- <http://bcfastforword.pbworks.com/w/page/6060644/FrontPage>

2016-present: Expanding efforts together with **Mike MacKay** (former Superintendent of Surrey), **Marlene Lewis** (Clinical Psychologist), **Sandy Collins** and **Janet Chow** (BC FFW Consortium) to further facilitate the awareness and engagement of cognitive brain-based interventional training programs in BC schools to educators, academics and the public, and the possible exploration of "Intervention Centers for Child-Dyslexia" within the private sector.

- *Public Forum, in preparation Fall 2017.*

2010 – present **Co-Founder and Executive Board Member of the Canada Magnetoencephalography Consortium (CMC):** A Consortium to facilitate MEG brain imaging research, expertise and training across Canada, with the hosting of hands-on workshops. The CMC does benefit all scientists and clinicians in the multimodal imaging community and all related necessary advanced and clinical research on brain connectivity dynamics in the healthy human brain, and relating to the diagnosis of cognitive disabilities and neuro-psychiatric pathologies.

Goals and Objectives:

- *Public relations and communications:* Communication of advances in MEG research to the scientific community and the general public;
- *Interdisciplinary collaboration:* Access to MEG laboratories for university, hospital, and government laboratory researchers across Canada, and interdisciplinary research involving MEG;
- *Training:* Education in MEG methods and applications (training of highly qualified personnel -HQP);
- *Research and development:* State-of-the-art research using MEG to understand normal and altered brain function in cognitive disabilities and neuro-psychiatric pathologies;
- *Clinical MEG:* State-of-the-art Safety and Practice guidelines;
- *Operations:* Generating support to maintain operating costs of MEG centres across Canada.

www.canada-meg-consortium.org

- **National Associate Director, 2012-2013,**

- **National Director, 2013-2016.**

2011 – present **Advancing the analysis of multimodal brain imaging and correlation to behavioral and clinical observations:** Collaborations with **Todd Woodward** and colleagues and provision of three-times funding support (2011, 2012, 2013) on behalf of the BCNI (Behavioral and Cognitive Neuroscience Institute) for expanding their existing constrained PCA analysis on fMRI data, to be combined (i) with MEG dynamic brain imaging data, and (ii) with EEG dynamic brain imaging data, to achieve a multimodal analysis matrix including structural/ functional imaging (MRI, fMRI, MEG, EEG) and clinical-behavioral observation parameters.

In particular, a continuing development of multivariate fMRI software and application of Constrained Principal Component Analysis (cPCA). The services provide a user-friendly functional GUI that affords (a) all matrix combinations available to cPCA ; (b) multi-platform compatibility (Linux, Windows, and Macintosh); (c) incorporation of HRF and FIR models from SPM, FSL or AFNI; (d) output functions that produce brain images and also graphs of predictor weights that estimate the hemodynamic response associated with each component, (e) significance tests on the components for effect of the conditions of interest for MRI/fMRI and MEG/EEG data.

>>> The program committee of the "International Organization of Human Brain Mapping (OHBM)" invited Dr.Woodward for a special symposium to present initial parts of these multimodal analysis efforts at their annual meeting in Beijing (China)

in 2012.

- Chau CMY, Doesburg SM, **Ribary U**, Ranger M, Miller SP, Synnes A, Woodward TS, Grunau RE. *Pediatric Academic Societies*, 2015.
- Whitman JC, Takane Y, Cheung TPL, Moiseev A, **Ribary U**, Ward LM, Woodward TS. *NeuroImage*, 2016.

2012 – present ***Establishing and Directing the Behavioral and Cognitive Neuroscience Institute (BCNI)*** as a head-quarter and larger comprehensive platform for facilitating collaborative team efforts towards a coherent, multidisciplinary and world-class networking research center of brain imaging in developmental cognitive neuroscience. The BCNI's mission is to interface and facilitate between multidisciplinary brain imaging resource development on one hand and translate into cognitive neuroscience brain imaging research and applications among disciplines and institutions on the other hand. The BCNI serves as a catalyst for new research, discoveries and developments in diagnostic procedures in neurocognitive brain imaging research and clinical applications for disabilities and pathologies and address society's critical need for further knowledge and understanding of how the brain functions during perception, sensory integration, language, learning and memory, and how the medical community can help people affected with disabilities and neuro-psychiatric illnesses. *(CFI grant was awarded in Oct/2009, funding was released 3 years later in Spring/2012; renovation of the BCNI space ended in Spring/2013).*

BCNI website: www.bcni-sfu.net

Members:

- Core Members (see website): www.bcni-sfu.net/#!test-prep/cihc
- Associate Members (see website): www.bcni-sfu.net/#!research-associates/c10dw

The BCNI facilitates the research and access to multimodal brain imaging facilities (across disciplines and institutions) and further provides:

- **Networking Area:** A larger conference/networking area within the BCNI, including WIFI, smart-board, projectors, white-boards and skype-capabilities made available to the research community at large across disciplines and institutions, to allow further collaborative discussions on imaging technology, data analysis strategies and applied/translational research, knowledge translation and intervention.
- **Expertise and training** in brain imaging and data signal processing.
- **Merger with SFU's FAS Mega-Cluster (together with MIAL) and contribution to boost computing power, visualization and data storage:** The BCNI contributes and has full access to SFU's FAS Mega-Cluster to expand the overall computing power (400+ GB RAM) to the brain imaging research community at large, further adding (1) centralized analysis, (2) visualization capabilities (adding 96GB RAM) and (3) adding 10TB of data storage for the BCNI.
- **Centralized software to boost data analysis and visualization:** The BCNI further facilitates the harboring and expansion of centralized brain imaging expertise and analysis software platforms and development, packed into user-friendly and semi-automatic on-line pipelines (on centralized Mega-Cluster, together with FAS's MIAL), including centralized commercial data analysis/visualization packages.
 - **Portable EEG scanner:** The BCNI's portable EEG system (64-channel) allowing further complementary dynamic brain imaging capabilities directly into the multidisciplinary research and public community.
 - **Assessment area:** The BCNI's behavioral/clinical assessment area, with portable behavioral assessment, portable eye-tracker and portable EEG recordings is available to the brain imaging community at large, especially across SFU's related disciplines.
 - **Data analysis-imaging area:** The BCNI's available area for multimodal imaging data analysis, directly connected with the SFU's FAS and Engineering's MIAL Mega-Cluster, providing workstations with direct access to centralized platforms, user-friendly and semi-automatic software analysis and visualization, further adding 12TB of data storage at the BCNI.

The analysis-wing, including a meeting-area, projectors and white-boards, is further used for other faculty's training courses.

- **Upgrades for the MEG operation (Surrey Memorial Hospital):** in hardware and software, including the access to the BCNI's services, data analysis platforms, portable EEG system, eye-tracker and behavioral assessment, plus the access to the enormous SFU's FAS-MIAL-BCNI computer clusters and platforms for processing and storage of large imaging data sets.
- *Engaging in collaborative efforts within the larger multimodal brain imaging community (across SFU, BCCH and UBC)*, and the publication of a comprehensive book-chapter highlighting the advances in emerging neuroimaging technologies (MRI, fMRI, PET, MEG, EEG, signal processing and visualization) towards future personalized diagnostics, prognosis, targeted intervention and ethical challenges.
- **Ribary et al.**, *In: Neuroethics, Illes and Hossain, eds., Oxford University Press, 2017.*

- 2012 – present **Collaborative Team-effort with Neuroethics Core (UBC) on Disorders of Consciousness:** Collaborative team-effort with **Judy Illes** (UBC), **Adrian Owen** (Western University) and colleagues on Neuroimaging for Disorders of Consciousness (DOC): Charting the Canadian Ethics Landscape. The goal is to establish ethics guidelines for implementing multimodal brain imaging findings on Disorders of Consciousness into clinical practice. In light of promising brain imaging research advances, it is important to identify and address ethical, legal, and policy challenges at the interface of translation to clinical care. To this end, we conducted semi-structured interviews with physicians, lawyers, ethicists, and researchers selected for their expertise with this subject. We probed their concerns about using signals of consciousness for communication, diagnosis or treatment of patients with impaired consciousness.
- **Lee G, Byram AC, Owen AM, Ribary U, ... and Illes J.** *Can J. Neurol. Sci.*, 2015.
- **Illes et al.** *Can J. Neurol. Sci.*, 2016.
- **Byram AC, Lee G, Owen AM, Ribary U, Stoessel J, Townson A, Illes J.** *CQHE*, 2016.

- 2012 – present **Setup of a Research Consortium on Dyslexia:** As PI together with collaborative expert teams across **SFU, CFRI-BCCH, UBC, Canada, USA** including the **BC school system:** The comprehensive research consortium includes behavioral assessments, multimodal brain imaging (MRI, fMRI, pEEG, MEG, pEye-Tracking) applied pre- and post interventional cognitive training programs, and neuroethics in conjunction with children at BC schools towards a better understanding of the underlying integration problems and brain network connectivity in language disabilities and its possible plastic restorations. We are currently approaching the necessary larger funding sources.
- **Ribary et al.**, *National Funding Sources and Private Fundraising (2017-2020)*.

Pilot Project - 2014-present: As PI and in collaboration with **Linda Siegel** (UBC), **Lawrence Ward** (UBC) and the **Burnaby school district (Janet Chow):** Behavioral Assessment, pEEG brain imaging including pEye-Tracking applied pre/post interventional cognitive training programs in learning disabilities. This pilot project is aimed at understanding how reading ability and word fluency develops and alters in the human brain. Reading is a multi-stage process that incorporates multiple facets of language, including the meaning of words, how they sound, and how they look, among other things. In particular, we are interested in understanding the underlying brain activity that gives rise to student's ability to learn how to read and the underlying mechanisms of remediation following FFW training in poor readers.
- **Bedo et al.**, *in preparation*.

Developmental Dyslexia - Emotional Impact and Consequences: As PI (with student **Emily Hirst**) and in collaboration with **Linda Siegel** (UBC), conducted a comprehensive review into current literature, focusing on consequences for the (i) individual, (ii) family

and (iii) society, demonstrating the need for further research into high-quality assessment, diagnosis and intervention of dyslexia. The primary and secondary consequences of dyslexia are highly related and therefore suggest multiple avenues of support for academic, emotional, and self-esteem needs, early diagnosis, education and especially including interventions. This review further illustrates and recommends routine screening for dyslexia at early age, including behavioural and brain-imaging research to improve early and accurate diagnostic markers for dyslexia.

- *Hirst, Siegel and Ribary. CNS, 2016.*

- *Hirst, Siegel and Ribary. AJLD, in revision.*

2012 - present **Collaboration with University of California San Diego (UCSD): Huang and colleagues** (Depts. Engineering, Radiology): Engaging in collaborations with the MEG center at UCSD, to expand (conceptually and technically) their existing automated MEG analysis programs of specifying detailed localization of slowing dynamics in patient pathologies, and specified on individual structural MRI. Such further and more detailed signal processing analysis procedures of precise slowing dynamics and subsequent changes in correlated functional connectivity dynamics will further our understanding of the underlying neurophysiological mechanisms related to cognitive disabilities, neuropsychiatric pathologies and TBI; these efforts will further allow a better correlation of dynamic brain imaging data with behavioral and clinical observations, towards more objective neurodiagnostic procedures.

<http://radiology.sdsc.edu/?q=about-us/people/faculty/mingxiong-huang>

2013 - present **Collaboration with Showa University School of Medicine, Tokyo, Japan: Koiwa and colleagues** (Department of Physiology) - *Auditory Localization Processing using state-of-the-art dynamic EEG brain imaging analysis:*

Application of more advanced data analysis strategies, analyzing time/frequency data plots and differentials on previously recorded EEG data sets across all subjects and all auditory-location conditions with different demands (passive, easy, difficult). Time/frequency data analysis in source space included: (i) beamformer source analysis, (ii) significant activation-locations, (iii) time/frequency analysis of activation within these specified sources, (iii) connectivity analysis across spatial locations, frequency and time. Outcome: consistent trends and significant new findings consistent with expected neurophysiology and with Koiwa's previous publication, (1) indicating early local primary activation, then (2) formation of more long-range networks, and later (3) formation of more long-range networks and more involvement of non-sensory frontal/parietal areas.

- *Training in state-of-the-art brain imaging data analysis.*

2014 - present **Advancing the analysis of dynamic MEG/EEG brain imaging data:** BCNI's senior scientist **Alex Moiseev** demonstrated that new data analysis signal processing algorithms provide significant better reconstruction quality than traditional ones. In particular, using simulations and real MEG measurements, he was able to significantly (a) improve source-level SNR and yield more accurately reconstructed time courses; (b) provide more accurate estimates of inter-source correlations; (c) reduce adverse influence of the source correlations. Importantly, these new techniques come at no additional computational cost, but the economic scientific outcome is poised to significantly increase by improving source-based analysis of EEG and MEG data and subsequent local and long-range connectivity and causality measures.

In addition, Alex challenged the current applications and use of minimum variance beamformer for analyzing dynamic EEG/MEG brain imaging data and revisited their algorithms especially focusing on specific weights.

- *Moiseev A, Doesburg SM, Grunau R, and Ribary U. Neuroimage, 2015.*

BCNI's Associate Director **Tony Herdman** demonstrated further improvement of EEG

signal processing strategies towards more reliable source localization and functional brain network connectivity dynamics, using novel approaches and simulation studies.

- Herdman A, Moiseev A, and **Ribary U.** *CNS*, 2017.

- Herdman A, Moiseev A, and **Ribary U.** *Brain Topography*, in revision.

2014 - present **Collaboration with Moscow State University of Psychology and Education, Russia: Tatiana Stroganova (Head of MEG Center) and colleagues:** Collaborative efforts on training and strategies of analyzing state-of-the-art dynamic brain imaging data of human cognitive processes and their alterations in pathology.

- Training Anna Baturina (visiting PhD student) for training Lab personnel.

2015 - present **Implementation of real-time MEG (rtMEG) brain imaging in CTF Systems:** Collaboration between BCNI Institute (with senior scientist **Alex Moiseev**) and **MISL (MEG International Services Limited)**, a Vancouver-based MEG manufacturing company. This project generates and tests the first worldwide prototype for "Real-Time Imaging of Dynamic Brain Activity" on the fly with NO time delay while a subject is scanned. MISL anticipates a significant translational related revenue in their sales by including this real-time system, a huge economic benefit to Canada and further for the basic/clinical research and the healthcare system.

- Moiseev A, Peatfield N, Doesburg S, Cheung TPL and **Ribary U.** *Biomag*, 2016.

- Moiseev A, Peatfield N, Doesburg S, Cheung TPL and **Ribary U.** in submission.

2015 - present **Collaboration with Fidel Vila-Rodriguez, Psychiatry UBC, and Master student Mina Ekramnia (visiting from Max Planck Institute, Germany):** Training and assistance in state-of-the-art EEG brain imaging data analysis strategies for evaluating brain network oscillations and connectivity in medication-resistant depressed patients before and after interventional therapies using TMS (trans magnetic stimulation).

- Training for Lab personnel; Mina Ekramnia, MA Thesis, UBC, 2016.

2015 - present **Collaboration with Aalto University School of Science, Dept. of Neuroscience and Biomedical Engineering, Espoo, Finland: Risto Ilmoniemi and PhD student Petteri Hyvarinen:** Collaborative efforts on novel conceptual and technical state-of-the-art brain imaging data analysis strategies including training, 1) focusing on slowing in resting state and how it affects evoked oscillation dynamics pre/post intervention using a generic head-model, based on their MEG data on tinnitus patients, and 2) testing the BCNI's portable eye-tracker for the possible use on control subjects processing auditory stimuli.

- Training for Lab personnel; Petteri Hyvarinen, PhD Thesis, Finland, Dec/ 2016.

2016 - present **Engaging in collaborative efforts within the larger multimodal brain imaging community (across SFU, BCCH and UBC),** and the publication of a larger comprehensive book-chapter highlighting the advances in emerging neuroimaging technologies (MRI, fMRI, PET, MEG, EEG, signal processing, visualization, and conceptual scientific frameworks) towards future personalized diagnostics, prognosis, targeted intervention and ethical challenges.

- **Ribary U**, Mackay AL, Rauscher A, Tipper CM, Giaschi D, Woodward TS, Sossi V, Doesburg SM, Ward LM, Herdman A, Hamarneh G, Booth BG, and Moiseev A., In: *Neuroethics, Illes and Hossain, eds., Oxford University Press, 2017.*

INVITED PLENARY LECTURES // INVITED SCIENTIFIC TALKS

- U.Ribary. Rauchen in der Schwangerschaft: Neue experimentelle und klinische Daten zur Hirnentwicklung. Contribution to lecture: "Drogeneffekte in Hirnentwicklung", organized by Prof. W. Lichtensteiger for students in Medicine and Experimental-Biology, University of Zurich, Switzerland, June

7, 1984.

- U.Ribary. Nikotin in der Schwangerschaft: Effekte auf zentrale Monoaminsysteme im foetalen Rattenhirn. Institute of Pharmacology, University of Zurich, Switzerland, Jan 11, 1985.

- U.Ribary. Nicotine in pregnancy: Acute and persistent effects on central monoaminergic systems in rat fetus and offspring. Promotion for the degree of Doctor of Natural Sciences, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, Dec 5, 1985.

- U.Ribary. MEG-technology: Application in psychiatric diseases. Dept. of Psychiatry, New York University Medical Center, New York, USA, June 25, 1991.

- U.Ribary. Magnetoencephalography (MEG) in aging and alzheimer's disease. Aging and Dementia Research Center, New York University Medical Center, New York, USA, July 9, 1991.

- U.Ribary, A.Ioannides and R.Llinas. Coherent thalamo-cortical 40-Hz oscillations in humans as analyzed by magnetic recordings (MEG). Symposium: Neural Nets and Rhythms, Bordeaux, France, September 1991.

- U.Ribary, R.Llinás and A.Ioannides. Oscillatory properties of neuronal assemblies in human brain as measured with MEG. MEG workshop, CNRS, Centre de formation permanente, Gif sur Yvette, Paris, France, 1992.

- U.Ribary. Application of distributed inverse solutions with 3D-MR Images. MEG workshop of the American Society for Biomagnetism, Albuquerque, USA, 1993.

- U.Ribary. The use of MEG in analyzing human brain function. Institute of Pharmacology, University of Zurich, Switzerland, Aug 25, 1993.

- U.Ribary. Discussion Round: Quantitative EEG analysis in sleep research; new possibilities, 8th Annual APSS meeting, Sleep Research Society, Boston, USA, 1994.

- U.Ribary. Magnetoencephalography: a useful clinical tool and a powerful technique for clinical and basic research. The Neuroscience Institute (NSI), San Diego, USA, Mar 22, 96.

- U.Ribary. Magnetoencephalography: a useful clinical tool and a powerful technique for clinical and basic research. Biomagnetic Technologies (BTi), San Diego, USA, Mar 25, 96.

- U.Ribary. Magnetoencephalography: a useful clinical tool and a powerful technique for clinical and basic research. UCSF, Dept. Radiology, San Francisco, USA, Mar 27, /96.

- U.Ribary. Plasticity of the human somatosensory cortex revealed by magnetoencephalography (MEG). Symposium: Plasticity and Epilepsy. Nurnberg, Germany, May, 1996.

- U.Ribary. Functional brain imaging using Magnetoencephalography (MEG): Clinical applications and basic research. Honory Lecturer at the Medical Imaging Symposium, Tokyo, Japan, Jul 27, 96.

- U.Ribary. Functional brain imaging using Magnetoencephalography (MEG): Clinical applications and basic research. University of Hokkaido, Sapporo, Japan, Jul 30, 96.

- U.Ribary. Functional brain imaging using Magnetoencephalography (MEG): Clinical applications and basic research. NIPS (National Institute for Physiological Sciences), Okazaki, Japan, Jul 31, 96.

- U.Ribary. Functional brain imaging using Magnetoencephalography (MEG): Clinical applications and basic research. University of Nagoya, Nagoya, Japan, Jul 31, 96.

- U.Ribary. The use of MEG in studying dynamic human brain function: clinical application, clinical and basic research. Nuclear Research Institute (KFA), Juelich, Germany, October, 96.
- U.Ribary. Grundlagenwissenschaftliche und klinische Anwendungen der Magnetencephalographie an der New York University. Dept. of Neurology, Heinrich Heine University of Dusseldorf, Germany, Oct 21, 96.
- U.Ribary. Functional imaging of human cognitive brain function using MEG. Center for Complex Systems, Florida Atlantic University, Boca Raton, USA. Jan 3, 97.
- U.Ribary. The use of functional human brain imaging with a high temporal resolution in clinical and basic research. Service Hospitalier Frederic Joliot, Commissariat a l'Energie Atomique (CEA), Orsay, France, Feb 17, 97.
- U.Ribary. Functional brain imaging using Magnetoencephalography (MEG). Dept. Engineering, Columbia University, New York, USA. May 6, 97.
- U.Ribary. The use of functional brain imaging (MEG) for clinical application and clinical research. University of Konstanz, Konstanz, Germany, July 8, 97.
- U.Ribary. Physics and biology of MEG. Lecture and Tutorial at Marine Biological Laboratory, Woods Hole, USA. August 28, 97.
- U.Ribary. Functional human brain imaging using MEG. Seminar at the fMRI laboratory at Memorial Sloan Kettering Cancer Center (MSKCC) in New York, USA, January 16, 98.
- U.Ribary. I) Introduction: The use of magnetoencephalography in the clinical environment. II) Coherent oscillatory activity underlying normal and abnormal human perception. Seminar at the Center for Complex Systems, Florida Atlantic University, Boca Raton, USA. Feb 5, 98.
- U.Ribary. Spatio-temporal organization of coherent brain activity and the correlation to human perception. Titisee Conference on gamma-band activity, organized by Wolf Singer, Titisee, Germany, March, 98.
- U.Ribary. Underlying brain dynamics of human perception. Workshop on multimodal neuroimaging, organized by Neuroscan Inc., National Institute of Neurological Disorders and Stroke, National Institute of Health (NIH), Bethesda, USA, April, 98.
- U.Ribary. Coherent gamma-band activity underlying human cognition. Society for Psychophysiological Research (SPR), Denver, USA, September, 98.
- U.Ribary. The spatial and temporal aspects in functional brain imaging: The use of MEG in the clinical environment and in clinical research. Wellcome Dept. of Cognitive Neurology, University College of London, Queen Square, London, England, May, 99.
- U.Ribary. The functional significance and the possible generation of the human gamma-band response. Seminar on consciousness, Wellcome Dept. of Cognitive Neurology, University College of London, Queen Square, London, England, May, 99.
- U.Ribary. Thalamo-kortikale Oszillationen im Zusammenhang mit kognitiven Hirnfunktionen: Eine MEG Untersuchung. 8th German EEG/EP Mapping Meeting, Giessen, Germany, September, 99.
- U. Ribary. Non-continuous spatio-temporal activations in thalamo-cortical systems. National Foundation: Functional Brain Imaging, University of New Mexico, Albuquerque, February, 2000.

- U. Ribary. Functional brain imaging (MEG) of thalamo-cortical dysrhythmia underlying positive symptoms. Pain Management Center, Dept. Anesthesiology, NYU Medical Center, New York, USA, October, 2000.
- U. Ribary. The functional significance of thalamo-cortical networks in human brain pathology. Society for Psychophysiological Research (SPR), San Diego, USA, October, 2000.
- U. Ribary. Binding of coherent oscillatory brain activity underlying human perception. MEG-Workshop at Cold Spring Harbor Laboratory (CSHL), Cold Spring Harbor, USA, Jul 30, 2003.
- U. Ribary. Fracture of thalamo-cortical networks in persistent vegetative state (PVS). Meeting of the International Society for Brain Electromagnetic Topography (ISBET), Santa Fe, New Mexico, USA, Nov 23, 2003.
- U. Ribary. Timing of thalamo-cortical oscillations underlying normal and abnormal perception. University of Geneva, Switzerland, Feb 23, 2004.
- U. Ribary. The capabilities of non-invasive brain imaging techniques to better understand cortical sensory-motor representations and plasticity and neural substrates of underlying cognitive functions and pathological states: An overview. Simon Fraser University, Canada, March 27, 2006.
- U. Ribary. The impact of science on our society with special emphasis on medical diagnostics and intervention. Keynote Speaker, 15th International Conference on Biomagnetism, (also addressed to the World Conference on Down Syndrome, and to the Public). Vancouver, Canada, August 25, 2006.
- U. Ribary. The importance of time in human brain imaging. Dept. Kinesiology, Simon Fraser University, Vancouver, Canada, October 30, 2007.
- U. Ribary. Human Brain Imaging; structure, function and temporal connectivity. Dept. Physics and Astronomy, University of Victoria, Victoria (BC), Canada, January 30, 2008.
- U. Ribary. Invited Panel member for Town Hall Meeting “Brains R Us: The Science of Education”, moderated by Science Network. Salk Institute, San Diego, USA, March 3, 2008.
- U. Ribary. Human brain imaging technologies to better understand normal, altered and pathological brain function. Distinguished Lecture Series, Thompson Rivers University (TRU), Kamloops, BC, Canada, April, 23, 2008.
- U. Ribary. Human Brain Imaging: Research Vision and Plan. Presentation to the Board of the CFRI (Child Family Research Institute) at BC Children’s Hospital, Vancouver, Canada, May 14, 2008.
- U. Ribary. The approach of understanding functional temporal connectivity. Macquarie University, Sydney, Australia, June 13, 2008.
- U. Ribary. Fracture of thalamo-cortical networks in unconsciousness. Seminar, Cleveland Clinic, Cleveland, Ohio, USA, October, 2008.
- U. Ribary. Brain Network Dynamics and alterations in Neurology and Psychiatry. SFU-BCCH-UBC Psychiatry Network, Vancouver, Canada, (A. Thornton), November 28, 2008.
- U. Ribary. Brain Imaging Technologies and Applications. Career Lecture: Cognitive Science Program, Simon Fraser University, Vancouver, Canada, January 28, 2009.
- U. Ribary. Human Cognition: Reflecting Sequential Network Oscillation Dynamics. Dept. Psychology,

University of Victoria, Victoria (BC), Canada, February 13, 2009.

- U. Ribary. Brain Network Oscillations and Human Perception. Cognitive Science Program, Simon Fraser University, Vancouver, Canada, February 18, 2009.

- U. Ribary, M.Connolly, H.Weinberg, D.McKenna, S.McLeod. Clinical MEG Application procedures for Epilepsy Patients. Presentation to BC Provincial Health Services Authorities (M.Marchbank), Vancouver, Canada, April 2, 2009.

- U. Ribary. Window into the Human Brain: How we Perceive and Process the Outside World, how the Brain can Reorganize itself, and how the Brain alters in Cognitive Abnormalities and Pathologies. Keynote Presentation to BC-CASE: British Columbia's Council of Administrators of Special Education, Vancouver, Canada. April 16, 2009.

- U.Ribary. Towards Diagnostic Markers for normal and altered Cognitive Brain States. Developmental Neurogenomics Seminar Series, Child Family Research Institute, BC Children's Hospital, Vancouver, Canada, April, 16, 2009.

- U.Ribary. Neural Network Oscillation Dynamics underlying normal, altered and pathological Brain States. Neurosciences Sleep Rounds (Royal College accredited Continuous Medical Education Course Series (CME), BC Children's Hospital, Vancouver, Canada, May, 1, 2009.

- S.Doesburg, A.Herdman, U.Ribary, R.Grunau. Magnetoencephalography (MEG) reveals altered cortical processing in children born very preterm. Human Early Learning Partnership (HELP) Research Day, Vancouver, Canada, May, 22, 2009.

- U.Ribary. Neural Network Connectivity Dynamics in the Healthy and Pathological Human Brain. Hospital for Sick Children, University of Toronto, Toronto, Canada, September 25, 2009.

- U.Ribary. The Inclusion of Neural Network Connectivity Dynamics towards a Brain-based Diagnostic for Cognitive Disabilities and Pathologies. Neuroethics Special Guest Series, University of British Columbia (UBC), Vancouver, Canada, September 30, 2009.

- U.Ribary. The Behavioral and Cognitive Neuroscience Institute (BCNI) at SFU towards facilitating neurodiagnostics and intervention. Developmental Neurosciences and Child Health Strategic Planning Day, BC Children's Hospital, Vancouver, Canada, October 2, 2009.

- U.Ribary. Window into the Human Brain: How we Perceive the Outside World, how the Brain alters in Cognitive Abnormalities and Pathologies, and how the Brain can Reorganize itself. Regional Circle Meeting for Special Education, School District 57 Northern BC, Organizer: Truman Spring (BC-CASE Executive), Prince George, BC, Canada, October, 23, 2009.

- U.Ribary. Human Brain Imaging towards Neurodiagnostics and individual Interventional Therapies. Brain Research Centre, University of British Columbia (UBC), Vancouver, Canada, October 30, 2009.

- U. Ribary. Multimodal Brain Imaging Technologies and Applications. Guest Lecture, Dept Psychology, Simon Fraser University, Vancouver, Canada, February 2, 2010.

- U.Ribary. The Dynamics of Human Brain Network Connectivity in Health and Disease. Cyclotron Research Center, University of Liege, Belgium, March 24, 2010.

- U.Ribary. Functional Connectivity Dynamics in Health and Disease using MEG. ULB-Hospital Erasme, Brussels, Belgium, March 25, 2010.

- N.Virji-Babul and U.Ribary. CNS Pathophysiology: Down Syndrome. Satellite Symposium on

Advances in Human Brain Development Research, Dubrovnik, Croatia, March 28, 2010.

- U.Ribary. Functional Connectivity Dynamics underlying normal and altered Cognitive States. Univeristy of Montreal, Montreal, Canada, April 20, 2010.

- U. Ribary. Psych in the Brain. "Psych in the City" Lecture Series, Simon Fraser University (SFU), Surrey Campus, Vancouver, Canada, April 28, 2010.

- U.Ribary. Brain Connectivity Dynamics: Closing the gap to Human Cognition, Seattle Cildren's Research Institute and Center for Integrative Brain Research, Seattle, USA, June 25, 2010.

- U.Ribary. Brain Network Connectivity and Alterations in Disabilities and Pathologies. Invited Speaker: International Meeting on Brain Development and Learning (A.Diamond Organizer), Vancouver, Canada, July 18, 2010.

- U.Ribary and colleagues. Vancouver MEG Brain Imaging Efforts on studying Cognitive Functions in Health and Disease. Canadian MEG Consortium Meeting, Univeristy of Montreal, Montreal, Canada, August 26, 2010.

- U. Ribary. Multimodal Brain Imaging Technologies and Applications. Guest Lecture, Dept Psychology, Simon Fraser University, Vancouver, Canada, October 26, 2010.

- U. Ribary. Brain Imaging towards Neurodiagnostics in Neurology and Neuropsychiatry. UBC Psychiatry Brain-Talks, Vancouver General Hospital (VGH), Vancouver, Canada, January 20, 2011.

- U. Ribary. Brain Imaging of altered Cognitive Functions in Learning Disabilities and Beyond: Introduction and Educational Value. University of British Columbia (UBC), Dept of Education, Vancouver, Canada, March 3, 2011.

- U. Ribary. Functional Connectivity Dynamics and Dissociation in Traumatic Brain Injury Patients. National Research Council, Halifax, Canada, April 14, 2011. (canceled due to medical emergency in family).

- U. Ribary. Brain Network Connectivity Dynamics towards Neurodiagnostic Markers and individual Interventional Therapies for Disabilities and Pathologies. Invited Speaker; Neurotalk 2011, Dalian, China, May 24, 2011.

- U. Ribary. Brain Dynamics and Translation into Neurodiagnostic Markers. Invited Speaker; 8th Annual World Congress of IBMISPS (International Brain Mapping & Intraoperative Surgical Planning Society), An interdisciplinary confrence addressed to scientists, clinicians, industry, government, policy makers and the society, San Francisco, USA, June 8, 2011.

- U. Ribary. Neural Oscillations and Network Connectivity Dynamics: Alterations in Disabilities, Neurology and Psychiatry. Invited Speaker: Canada Network Centers of Excellence, NeuroDevNet Annual Meeting, Vancouver, Canada, June 19, 2011. >>> link to talk: <https://vimeo.com/27254969>

- U. Ribary. Network oscillations and connectivity. Invited Speaker: International Society for the Advancement of Clinical Magnetoencephalography (ISACM), Las Vegas, USA, November 5, 2011.

- U. Ribary. Neural oscillations and connectivity: perspectives on pathology. Invited Speaker and Faculty: Canadian MEG Consortium's Workshop on Magnetoencephalography, Montreal, Canada, November 17, 2011.

- U.Ribary. Imaging into the human brain: How we perceive and process the outside world, how the brain can reorganize itself, and how the brain alters in cognitive disabilities. Keynote Lecture: SD-45 West

Vancouver, Canada, January 20, 2012.

- U. Ribary. Imaging into the brain of neuro-psychiatry patients. Breakout Session Talk: SD-45 West Vancouver, Canada, January 20, 2012.

- U. Ribary. Imaging Brain-based Intervention. Meeting of the interdisciplinary BC school-district FFW-Intervention Consortium, Vancouver, Canada, February 1, 2012.

- U. Ribary. Oscillations and network connectivity: Underlying mechanism in cognitive disabilities and neuropsychiatric pathologies. UCSD Radiology Imaging Center, University California San Diego (UCSD), San Diego, USA, February 9, 2012.

- U. Ribary. Functional Connectivity Dynamics: Closing the Gap to better Understanding the Human Brain in Health and Disease. MRI/fMRI Center Retreat Conference (Alex MacKay: Director), University of British Columbia, Vancouver Canada, Jun/5, 2012.

- U. Ribary. Multimodal Brain Imaging Technologies and its Applications. Guest Lecture, Dept Psychology, Simon Fraser University, Vancouver, Canada, June 26, 2012.

- U. Ribary. Imaging of Brain Networks Connectivity Dynamics: cognitive correlates and neuro-diagnostic impact. Cognitive Neuroscience Seminar, Simon Fraser University, Vancouver, Canada, October 5, 2012.

- U. Ribary. The Behavioral and Cognitive Neuroscience Institute: Collaborative link to the BC-FFW consortium and cognitive interventions. BC-FFW Consortium Meeting, Vancouver, Canada, March 6, 2013.

- U. Ribary. Panel Member, Advances in Brain Imaging Research for Brain Injury and Consciousness. Café Neuroethique: A Public Forum Discussion, Vancouver, Canada, June 11, 2013.

- U. Ribary. Thalamo-cortical oscillations and global functional connectivity dynamics in health and disease. Invited talk: International Connectivity Workshop, Vancouver, Canada, June 14, 2013.

- U. Ribary. Window into the Human Brain. Invited Keynote Speaker: BC School District 40, New Westminster, Canada, November 5, 2013.

- U. Ribary. The Cognitive-Brain-Network in Health and Disease. Keynote Speaker; Gold Coast Health and Medical Research Conference, Gold Coast, Australia, November 28, 2013.

- U. Ribary. Brain Imaging and the Cognitive-Brain-Network. Griffith Health Institute, Gold Coast, Australia. December 2, 2013.

- U. Ribary. The Cognitive-Brain-Network in Health and Disease. Griffith University Hospital Medical Center, Gold Coast, Australia. December 2, 2013.

- U. Ribary. Brain Imaging and the Cognitive-Brain-Network. Griffith University, Brisbane, Australia. December 3, 2013.

- U. Ribary. The Behavioral and Cognitive Neuroscience Institute (BCNI): Establishment of Biomarkers for the Cognitive Human Brain Network in Health and Disease. Brief presentation: SFU Health Research Day, Vancouver, Canada, April 10, 2014.

- U. Ribary. The BCNI Institute: Neuromarkers at the Brink of Translational Technologies and further Basic/Clinical Brain Imaging Research. Brief presentation: Fraser Health and SFU Research Day, Surrey, BC, Canada, May 1, 2014.

- U. Ribary. Neural Biomarkers for the Cognitive-Brain-Network in Health and Disease. Invited Speaker; Neurotalk 2014, Nanjing, China, May 16, 2014.

- U. Ribary. Local and distributed brain network connectivity and dynamics in development, health and disease. Neuroscience Cluster Rounds, BC Children's Hospital, Vancouver, Canada, June 9, 2014.

- U. Ribary. Thalamo-Cortical Connectivity and Dynamics in Health and Disease. Hospital for SickKids, University of Toronto, Toronto, Canada, June 19, 2014.

- U. Ribary. Window into the Human Brain: How can we Image typical or atypical Cognition in Children and Adults? Kerrisdale Elementary, Vancouver, Canada, November 28, 2014.

- U. Ribary. Brain Imaging Diagnostic and Prognosis for TBI: Applications and Challenges. International Workshop: Neuroimaging for Disorders of Consciousness - Charting the Canadian Landscape, Vancouver, Canada, January 28, 2015.

- U. Ribary. Human Oscillatory Network Connectivity and Dynamics in Health and Disease. Rutgers University, Newark NJ, USA, February 10, 2015.

- U. Ribary. Research Overview: Functional Brain Imaging (brief presentation). Behavioral Neuroscience Student Society Networking Event, Simon Fraser University, Vancouver, Canada, March 24, 2015.

- U. Ribary. Window into the Human Brain: How can we Image Cognition in Health and Disease? Plenary Speaker, Vancouver Elementary Prinipal and VicePrincipal Association (VEPVPA), a closed forum for Vancouver Administrators, Principals, VicePrincipals, Teachers, District Staff and Parents, Vancouver, Canada, April 16, 2015.

- U. Ribary. A unified framework for local and large-scale brain networks in health and disease. Distinguished Speaker; Neurotalk 2015, Hangzhou, China, May 24, 2015.

- U. Ribary. Imaging of the Human Brain in Health and Disease: New insight into intervention for children with special needs. College of Early Childhood Education, Capital Normal University (CNU), Beijing, China, May 28, 2015.

- U. Ribary. Multimodal Brain Imaging Technologies and Applications. Guest Lecture, Dept Psychology, Simon Fraser University, Vancouver, Canada, October 13, 2015.

- U. Ribary. Local and Large-scale Brain Network Connectivity: Unified Mechanisms of Network Transformation in Typical/Atypical States. Invited Speaker, International Workshop on "Brain States: Characterization and Neuromodulation by DBS", University of Cologne, Germany, November 11, 2015.

- U. Ribary. Local and Large-scale Brain Network Connectivity and Dynamics in Humans. Keynote Lecture, Neurotalk-2016, Beijing, China, May 20, 2016.

- U. Ribary. A Unified Framework for the Manifestation of Functional Cognitive Brain Networks. Neurotalk-2016, Beijing, China, May 22, 2016.

- U. Ribary. Local and Large-scale Brain Network Connectivity and Dynamics in Humans. Fourth Military Medical University, Xi'an, China, May 24, 2016.

- U. Ribary. Brain Imaging of Local and Large-scale Network Connectivity and Dynamics in Health and Disease. Universitaets Klinikum, University Duesseldorf, Neurology, Germany, July 5, 2016.

- U. Ribary. Imaging of Local and Large-scale Network Connectivity and dynamics in Typical/Atypical Brain States. Neurologische Klinik, University Wuerzburg, Germany, July 7, 2016.

- U. Ribary. Unified Mechanisms for Local and Large-scale Brain Network Connectivity Dynamics. University of Korea, Seoul, Korea, October 6, 2016.

Future Talks:

- U. Ribary. Imaging of Cognitive Human Brain Networks. TGIF Lecture Series - BC Children's Hospital Research Institute, Vancouver, Canada, May 5, 2017.

PUBLICATIONS

Functional Biochemical and Imaging Studies on the Animal Brain (1981-1986), and
Functional Brain Imaging on Humans (1986-present)

(A) PEER REVIEWED PUBLISHED PAPERS

- W.Lichtensteiger, M.Schlumpf and **U.Ribary**. Effects of nicotine on the developing gonadal axis and on central catecholamine systems of the male rat fetus. In Developmental Neuroscience: Physiological, Pharmacological and Clinical Aspects; F.Caciagli, E.Giacobini and R.Paoletti, eds.; Elsevier Science Publishers B.V., pp. 131-135, 1984.

- **U.Ribary**. Nicotine in pregnancy: Acute and persistent effects on central monoaminergic systems in rat fetus and offspring. ETH (Swiss Federal Institute of Technology, Zurich, Switzerland) Doctoral-Thesis, No. 7939, 1985.

- W.Lichtensteiger, M.Schlumpf and **U.Ribary**. Drugs and neurotransmitters in fetal and early postnatal ontogeny of neuroendocrine systems. In: Proc. International Symposium on Systemic Hormones, Neurotransmitters and Brain Development, Berlin 1985, Doerner ed., Karger Basel, 1985.

- **U.Ribary**, M.Schlumpf and W.Lichtensteiger. Analysis by HPLC-EC of metabolites of monoamines in fetal and postnatal rat brain. Neuropharmacology, 25, 981-986, 1986.

- W.Lichtensteiger, M.Schlumpf and **U.Ribary**. Modifications pharmacologiques de l'ontogenese neuroendocrine: Developpement de recepteurs, nicotine et catecholamines. Ann. d'Endocr., 48, 393-399, 1987.

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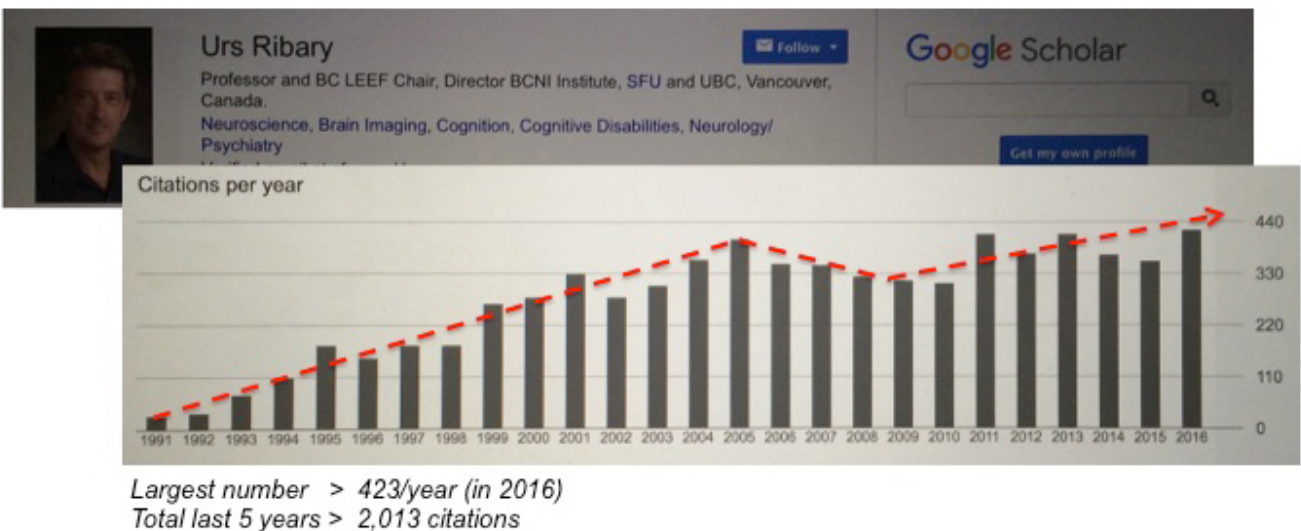
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