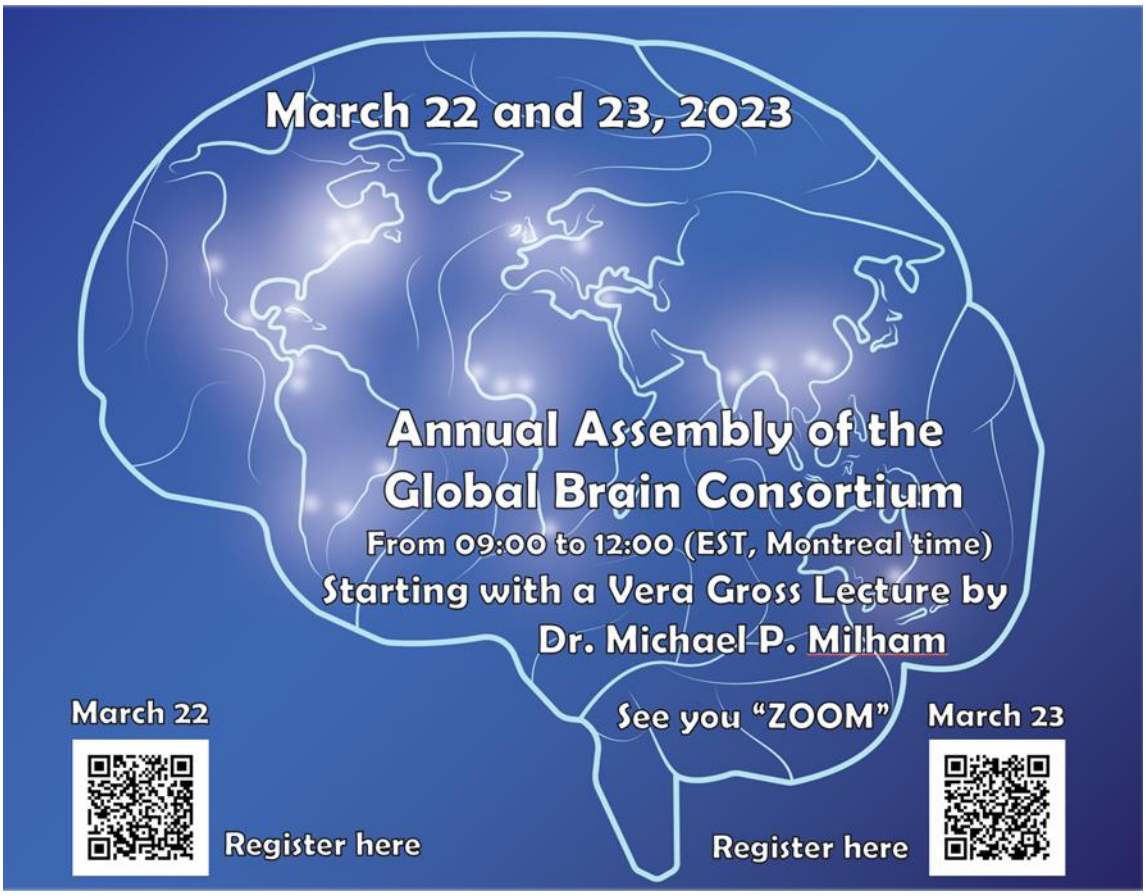
2023 Annual Assembly of the Global Brain Consortium

Scientific Program



Registration Links:

March 22: https://zoom.us/meeting/register/tJYocOusrzkoHtOKhmbCl5Kadu8P_3hPaTEi

March 23: https://zoom.us/meeting/register/tJIrd-ysqD0qH9X0vMhERfJ5R95LIhKGz-9g

Your buddy world time converter: https://www.worldtimebuddy.com/

GBC Chairs

Alan C. Evans

Pedro Valdes-Sosa

Local Organizing Committee

- Pedro Valdes-Sosa
- Jorge F. Bosch-Bayard
- Ariosky Areces
- Michael Kpiebaareh
- Christine Rogers

Moderators	Email	Technical Assistant	email
Shahwar Yasir (Sherry)	Shahwar.Yasir@neuroinformatics-collaboratory.org	**Usama Riaz**	usama.riaz@neuroinformatics-collaboratory.org
Anisleidy González (Ani)	anisleidy@neuroinformatics-collaboratory.org	Carlos López	clopez@neuroinformatics-collaboratory.org
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GLOBAL BRAIN CONSORTIUM

2023 Annual Meeting Agenda

DAY 1 – Wednesday, March 22, 2023 - 9:00am-12:10pm EST/EDT (Montreal time)

Time	Events	Topic(s)	
9:00-9:30	Opening remarks Donor message	Welcome and Updates from the GBC Co-Chairs Welcome message from Irving Ludmer	**Chairs**: Pedro Valdes-Sosa, Alan Evans
9:30-10:30	Vera Gross Lecture	Multimodal characterization of brain and behavior: the last missing ingredient for precision neuropsychiatry?	**Lecturer**: Michael P. Milham, Child Mind Institute
10:30-10:40		*Small Break*	

Time	Events	Time	Topic(s)	Room	Moderator
10:40-12:40	*Breakout Room Sessions*	*10:40-12:40*	The Neuroscience of brain development	Room 1-1	Sherry
		10:40-12:40	COVID-19-induced Brain Dysfunctions	Room 1-2	Ani
		10:40-12:40	Brain Apparatus Communications	Room 1-3	Mykie

DAY 2 – Thursday, March 23, 2023 - 9:00am-12:25pm EST/EDT (Montreal time)

Time	Events	Time	Topic(s)	Room	Moderator
09:00-11:00	*Breakout Room Sessions*	09:00-11:10	Advances in quantitative EEG	Room 2-1	Mykie
		09:00-10:40	Approaches to Alzheimer's and Parkinson's diseases	Room 2-2	Sherry
		09:00-10:20	The non-linear brain	Room 2-3	Ani
		10:20-11:10	Personalized Medicine in neurodegenerative diseases	Room 2-4	Deirel
11:00-11:10		*Small break*			
11:10-12:00	Summary of sessions	Report by workgroups		Chairs	
12:10-12:25	Closing	Summary of discussions and directions forward		Alan Evans & Pedro Valdes-Sosa	

ROOM 1-1. March 22nd, 2023

The Neuroscience of brain development ***Chair: Damien Fair.*** ***Moderator: Shahwar Yasir***	
10:40-11:10	Damien Fair *The GLAD project: an opportunity to leverage developmental cognitive neuroscience, bioinformatics and public health systems to inform strategic global policies and foster population-level brain health*
11:10-12:00	Janina Galler *The neuroscience of early adversity* Panel Jorge Bosch-Bayard (10) Early protein energy malnutrition impacts life-long developmental trajectories of the sources of EEG rhythmic activity Fuleah A Razzaq (10) Early malnutrition-induced premature cognitive aging is mediated by brain state set at school-age Anne Gallagher (10) Impact of Early Childhood Malnutrition on Adult Brain Function: An Evoked-Related Potentials Study Arielle Rabinowitz (5) Intergenerational effects of early malnutrition on attention and executive control: DNA Methylation Signatures Janina Galler (15) TBA
12:00-12:15	Faisal Mushtaq *City-Scale Neuroscience: Planning to Track Adolescent Neural Development in the Born in Bradford Longitudinal Cohort Project*
12:15-12:30	Giuseppe Chiarenza & Jorge Bosch-Bayard *The clinical subtypes of developmental dyslexia have a distinct neurophysiological pattern*

ROOM 1-2. March 22nd, 2023

COVID-19-induced Brain Dysfunctions ***Chairs: Ben Becker and Mitchell Valdes-Sosa*** ***Moderator: Anisleidy González***	
10:40-10:55	**Benjamin Becker** COVID-Induced Brain Dysfunctions – status and challenges
10:55-11:10	**Christian Montag** Technological use disorders and the COVID-pandemic: an affective neuroscience framework
11:10-11:20	**Roberto Rodriguez** The Cuban Longitudinal COVID cohort project
11:20-11:35	**Joel Gutierrez Gil** Incidence of neurological manifestations associated with covid-19. A population-based study in two municipalities of Havana, Cuba.
11:35-11:45	**Yu Kin** qEEG Mediates the Effect of Infection Severity on COVID-Induced Brain Dysfunction
11:45-11:55	**Winnie Tso** COVID and the young brain *ECR feature
11:55-12:10	**Benjamin Klugah-Brown** Effects of mask wearing on brain activity
12:10-12:25	**Daniel Scharfenberg** The Long-Term Impact of COVID-19: Cognitive Impairment and Neuropsychiatric Symptoms in Post-COVID Syndrome *ECR feature

ROOM 1-3. March 22nd, 2023

Brain Apparatus Communications ***Chair: Dezhong Yao*** ***Moderator: Michael Kpiebaareh***	
11:25-11:40	**Dezhong Yao** The first year of the "Brain-apparatus communications" Journal
11:40-12:10	**Tomas Ros** Restored Alpha Brain Rhythms and Reduced Symptoms in Posttraumatic Stress Disorder Following a Double-Blind, Randomized Controlled Trial of EEG Neurofeedback

ROOM 2-1. March 23rd, 2023

Advances in quantitative EEG ***Chair: Pedro Valdes-Sosa*** ***Moderator: Michael Kpiebaareh***	
09:00-09:30	Scott Makeig *Imaging cortical dynamics across development (30 min)*
09:30-09:45	Thomas Koenig *Towards a more objective use of resting-state EEG microstate findings across studies (15 min)*
09:45-10:00	Yuri Pavlov *Delivering #EEGManyLabs – Challenges & Opportunities (15 min)*
10:00-11:00	Panel co-chairs: Kay Robbins and Dora Hermes *Directions in EEG data-sharing* Panelists Kay Robbins *Analysis-ready event annotation with HED* Dora Hermes *Annotating (i)EEG-BIDS data and the HED-SCORE library schema* Bruno Colombet *EEG annotations with Anywave* Christine Rogers *EEGNet data and analytics hub for open EEG standards*

ROOM 2-2. March 23rd, 2023

Approaches to Alzheimer's and Parkinson's diseases ***Chair: Claudio Babiloni*** ***Moderator: Shahwar Yasir***	
09:00-09:45	Claudio Babiloni *The Alzheimer's disease dark side: EEG biomarkers of vigilance and cognitive dysfunctions.* Panel Claudio Babiloni *Biomarkers of resting state EEG rhythms of vigilance dysfunctions in Alzheimer's and related diseases.* Görsev Yener *Biomarkers of cognitive event-related eeg oscillations in Alzheimer's and related diseases* Discussants Bahar Guntekin The Medipol University of Istanbul, Faculty of Medicine, Izmir (Turkey). Josefina Cruzat University Adolfo Ibáñez, School of Psychology, Santiago of Chile (Chile). Mario Parra University of Strathclyde, School of Psychology, Glasgow (UK).
09:45-10:00	Maria L. Bringas *qEEG in Parkinson's clinincal trials*
10:00-10:30	Vassiliy Tsytsarev *Wireless optogenetic modulation of cortical neurons enabled by radioluminiscent nanoparticles*

ROOM 2-3. March 23rd, 2023

The non-linear brain ***Chair: Pedro Valdes-Sosa*** ***Moderator: Anisleidis Gonzalez***	
09:00-09:05	Pedro Valdes-Sosa *Presentation (5 min)*
09:05-09:25	Ludovico Minati *On nonlinear electronic circuits: some phenomena, experiments and applications (20 min)*
09:25-09:35	Shiang Hu *ξπ: a nonparametric model for EEG/MEG power spectra decomposition (10 min)*
09:35-09:45	Ying Wang *The EEG Xi (aperiodic) spectral component, but not the Alpha rhythm, is linear and Gaussian (10 min)*
09:45-10:55	Anisleidy González Mitjans *Efficient integration of high-dimensional Neural Mass Models with distributed delays (10 min)*
10:55-10:05	Carlos Lopez *EEG cross-spectra mediate the effects of early malnutrition on cognition. A Riemannian perspective (10)*
10:05-10:15	Ronaldo Garcia Reyes *Multivariate Intrinsic Local Polynomial Regression on Isometric Riemannian Manifolds: Applications to Positive Definite data. (10 min)*

ROOM 2-4. March 23rd, 2023

Personalized Medicine in neurodegenerative diseases ***Chair: Paolo Rossini*** ***Moderator: Deirel Paz***	
10:20-10:45	Paolo Maria Rossini *THE ROLE OF NEUROPHYSIOLOGICAL TECHNIQUES IN THE QUEST FOR EARLY DIAGNOSIS OF DEMENTIA*
10:45-11:00	Yasser Iturria *On the importance of individualized disease progression models*

GLOBAL BRAIN CONSORTIUM

ABSTRACTS

The Neuroscience of brain development

Wednesday, March 22, 2023- 10:40am-12:25pm ET (US/Canada)/14:00-17:00 UTC

Damien Fair, **PA-C, Ph.D.**
Redleaf Endowed Director, Masonic Institute for the Developing Brain
Professor, Institute of Child Development, College of Education and Human Development
Professor, Department of Pediatrics, Medical School
University of Minnesota

The GLAD project: an opportunity to leverage developmental cognitive neuroscience, bioinformatics and public health systems to inform strategic global policies and foster population-level brain health

Ongoing advances in developmental neuroscience research have increased our knowledge base about the brain and brain health, and yielded promising diagnostics and treatments. However, a major limitation in the field is that most findings are based on small homogenous samples, methodological approaches or assessments that have not been adequately validated across diverse populations and cultural settings. Thus, the science of infant, child and adolescent brain development is often distorted by unrepresentative samples, and might not be scientifically valid across the great diversity of societies and situations worldwide. These issues are serious threats to the credibility and multicultural relevance of global brain health policies or clinical guidelines, and could seriously mislead policy makers, planners or healthcare providers around the world. In this presentation, the speaker would highlight examples of ongoing research projects in the US, highlight existing challenges, and describe or promote the need for sustainable global research on child and adolescent brain development. Finally, the speaker would discuss ongoing conversations and essential elements of the Global Brain Consortium's GLAD White paper- aimed at leveraging interdisciplinary expertise, strategic infrastructure and collaborations as well as cross-cultural systems to address knowledge gaps and inform policies or interventions to foster population-level brain health for all children worldwide.

Janina Galler

The neuroscience of early adversity

Panel

Jorge Bosch-Bayard (10)
Early protein energy malnutrition impacts life-long developmental trajectories of the sources of EEG rhythmic activity

Fuleah A Razzaq (10)
TBA

Anne Gallagher (10)
Impact of Early Childhood Malnutrition on Adult Brain Function: An Evoked-Related Potentials Study

Arielle Rabinowitz (5)

TBA

Janina Galler (15)

TBA

Faisal Mushtaq

City-Scale Neuroscience: Planning to Track Adolescent Neural Development in the Born in Bradford Longitudinal Cohort Project

Adolescence is a period in which the brain undergoes considerable changes in morphology and function. Through interaction with our genes and the environment, the development of the teenage brain ultimately shapes life-long chances affecting social, behavioural, academic and health outcomes. Understanding these trajectories of change is critical for effective intervention to prevent and mitigate negative outcomes. But the myriad of factors involved, and the complexity of their interplay, presents a considerable challenge that requires large-scale multifactorial longitudinal data. Over the next 7 years, the Born in Bradford (BiB) longitudinal birth cohort study will be tracking the lives of approximately 24,000 young people from the age of 13 to 20 from the multi-ethnic and socioeconomically diverse UK city of Bradford as they make the move from childhood to adolescence and then transition into adulthood. This project already has a large, existing rich dataset that includes information on genetics, culture as well as mental, reproductive, sexual, cognitive and cardiometabolic health of 13,818 of these participants (a sub-cohort of this project that has been followed from birth). In this critical period of development for the BiB cohort, we are embarking on a city-scale project that will constitute one of the largest studies of adolescent neural development. Our approach, currently being piloted in schools and with children from across the city, will employ 3 data acquisition methods to sample the cohort at multiple points over the next 5 years at different degrees of depth (Levels 1-3). In Level 1, 1000 participants will be invited to the laboratory every two years to undertake a 100-minute battery of ERP experiments (using well-established paradigms for studying components related to reward, attention, memory and motor processes) with 128 channel EEG. In Level 2, 4,000 participants will be recruited and tested in "pop-up laboratories" using 32 channel EEG with 40-minute testing sessions (including rest and task-related activity) at two time points in School Sports Halls across the city. In Level 3, all participants in the cohort will be invited to take part in an innovative curriculum-aligned Citizen Science workshop delivered in a classroom setting biennially. Here, classes of students will collect 18 minutes of data (8 minutes resting state, 10 min task-related) from one another simultaneously, with a combination of remote-assist and automated quality control methods. These data will be linked to existing and planned measures from the Born in Bradford cohort. Our intention is to create a comprehensive linked dataset that will allow scientists in the medium-term to develop a more complete understanding of adolescent brain development. In the long term, this repository will support future researchers and clinicians in creating models that predict onset and progression of neurological disease.

Giuseppe Chiarenza

The clinical subtypes of developmental dyslexia have a distinct neurophysiological pattern

Giuseppe A. Chiarenza1, Jorge Bosch- Bayard2, Min Li3, Ying Wang3,

Tania Perez-Ramirez4, Pedro Valdes-Sosa3

1 Centro Internazionale Disturbi di Apprendimento, Attenzione,

Iperattività, CIDAAI, Milano Italy

2 Montreal Neurological Institute, McGill University, Canada

3 The Clinical Hospital of Chengdu Brain Science Institute, MOE Key Lab for Neuroinformation, University of Electronic Science and Technology of China, Chengdu, China

4 Cuban Neuroscience Center, La Habana, Cuba

In 1973, Elena Boder, a pediatric neurologist at the University of California, Los Angeles, published a test to identify dyslexia subtypes in the journal Developmental Medicine and Child Neurology. According to Boder's model, reading and spelling are represented in widely distributed neural networks that are interactive and overlapping. This model described reading as a two-channel function that required the perfect dynamic interplay of intact visual-gestalt and analytic-auditory functions, as well as the integration of both peripheral and central processes. The normal dynamic network interplay of Gestalt and analytic-synthetic processes is disassociated with dyslexic children. The dyslexic child reads and spells differently from normal readers, both qualitatively and quantitatively. Consequently, from the analysis of reading and writing errors, Boder described three main subtypes of dyslexia: dysphonetic (DD), dyseidetic (DYD), and mixed (MD), plus a fourth group defined as reading retardation. These subtypes have also been described in Italian mother-tongue subjects. The research conducted in recent years has been to verify the hypothesis that the disruption of the dynamic network interplay of gestalt and analytic synthetic processes could have a neurophysiological, not only clinical, pattern. With the new Harmonized Multinational qEEG Norms, which introduced the norms for the full cross-spectra matrices (doi: 10.1016/j.neuroimage. 2022.119190), we applied an EEG stable and sparse regression classifier, using the complex numbers of the cross-spectra z scores. We found that the best classifiers were in the off-diagonal elements of the cross-spectral matrices, i.e., the main differences among the groups are related to the information flow among different areas of the brain rather than in the log-spectra. Using this method, we dramatically improved the classification power of the EEG to differentiate the different dyslexia subtypes. The areas under the ROC were DDvsDYD=0.85, DDvsMD=0.94, and DYDvsMD = 0.78. The control group was completely separated from the dyslexic subtypes. Furthermore, the number of variables required for classification was significantly reduced. A plot of the real part vs. the imaginary part of the Z-scores for each group and each classifier showed a more similar distribution for the dysphonetics and mixed than for the dyseidetics. This is consistent with the clinical evidence that the mixed group is the most severe type of dysphonetics with the lowest reading quotients. Our results are a neurophysiological corroboration of Boder's model that dysphonetics and dyseidetics have different dysfunctions in the reading and spelling of cerebral networks.

COVID-19-induced Brain Dysfunctions

Wednesday, March 22, 2023 - 10:40am-12:25am ET (US/Canada)/14:00-17:00 UTC

Benjamin Becker

University of Electronic Science and Technology of China

COVID-Induced Brain Dysfunctions – status and challenges

Christian Montag

Ulm University, Ulm, Germany

Technological use disorders and the COVID-pandemic: an affective neuroscience framework

The pandemic resulted in higher prevalences of technological use disorders. Therefore, in the presentation an overview is provided on changes in prevalences such as from Gaming Disorder when comparing numbers from before the pandemic and while the pandemic was going on. Further, it discussed how technological use disorders are related to Fear of COVID. In addition, the Panksepian Affective Neuroscience Framework is applied to shed light on the "self-medication-hypothesis" in the realm of technology use likely paving the way to overuse smartphones and other devices (and their contents). Finally, it is shortly demonstrated what we know at the moment about "smartphone addiction" from studies using magnetic resonance imaging.

Roberto Rodriguez

The Cuban Longitudinal COVID cohort project

Joel Gutierrez Gil
Department of clinical neurophysiology. Cuban institute of neurology and neurosurgery

Incidence of neurological manifestations associated with covid-19. A population-based study in two municipalities of Havana, Cuba.

Introduction: Covid-19 is very frequently associated with neurological manifestations. Review articles and case reports predominate in the literature on this topic. Very few studies have evaluated the incidence of neurological manifestations in patients with covid-19 versus the incidence in healthy controls from the same population.

Objective: To describe the incidence of neurological manifestations in patients with covid-19 and in matched healthy controls. Methods. A survey was designed to investigate the incidence of a wide variety of neurological manifestations. The survey was implemented on an application for mobile phones and was applied to 278 convalescents of covid-19 and to 190 healthy controls, all of them living in two municipalities of Havana.

Results: Two-thirds of covid-19 convalescents suffered at least one neurological symptom during or after the acute stage of covid-19. 20 to 40% of the patients suffered from headaches, smell disorders, motor disturbances (fatigue, myalgia), insomnia, and diarrhea. 10 to 20% of the patients suffered visual disturbances, dizziness, ataxia, and dysautonomias (cardiac arrhythmias, syncope, postural hypotension). The incidence of these disorders was significantly lower in healthy controls and showed a downward trend in the weeks and months following the acute phase of the disease.

Conclusions: The incidence of neurological disorders in subjects affected by covid-19 is much higher than that observed in the general population. A wide spectrum of neurological disorders is observed in these patients, which tend to disappear spontaneously in a few months after the disease.

Yu Kin

qEEG Mediates the Effect of Infection Severity on COVID-Induced Brain Dysfunction

Winnie Tso
University of Hong Kong

COVID and the young brain *ECR feature

Benjamin Klugah-Brown
University of Electronic Science and Technology of China

Effects of mask wearing on brain activity

Daniel Scharfenberg
Department of Medical Psychology | Neuropsychology & Gender Studies, Faculty of Medicine and University Hospital Cologne, University of Cologne, Cologne

*The Long-Term Impact of COVID-19: Cognitive Impairment and Neuropsychiatric Symptoms in Post-COVID Syndrome *ECR feature*

Post-COVID syndrome (PCS) describes the phenomenon that many patients experience persistent symptoms after COVID-19. PCS occurs not only in hospitalized patients but also in patients with mild to moderate acute courses of COVID-19. Persistent symptoms can include neuropsychiatric symptoms such as fatigue and affective symptoms as well as cognitive complaints. In a first study, we aimed to characterize the neuropsychological profile in a cohort of 52 patients with subjective cognitive complaints at least 3 months after their infection. For that, we assessed cognitive functioning across five neurocognitive domains in an extensive neuropsychological testing as well as several neuropsychiatric and health-related variables. Test results indicated objective cognitive impairment in almost 60% of patients. Impairments were present in all assessed neurocognitive domains, with a focus on learning/memory, executive functioning and attention. However, neuropsychiatric symptoms fatigue, depression or anxiety showed no associations with cognitive status. In a second study, we conducted follow-up assessments in the cohort at least six months after

baseline assessment. First results indicate that, while objective cognitive functioning generally improves over time, subjective cognitive complaints as well as levels of some neuropsychiatric symptoms such as fatigue, depression or anxiety remain stable. As solely neurological explanations struggle to explain how these PCS symptoms develop and persist over such a long time, we will also need psychological models that reflect the complex associations between cognition and neuropsychiatric symptoms in PCS.

Brain Apparatus Communications

Wednesday, March 22, 2023 - 11:25am-12:10pm ET (US/Canada)/14:00-17:00 UTC

Dezhong Yao

The first year of the "Brain-apparatus communications" Journal

Tomas Ros
Departments of Neuroscience and Psychiatry, University of Geneva; Campus Biotech, Geneva, Switzerland
Centre for Biomedical Imaging (CIBM), Lausanne-Geneva, Geneva, Switzerland

Restored Alpha Brain Rhythms and Reduced Symptoms in Posttraumatic Stress Disorder Following a Double-Blind, Randomized Controlled Trial of EEG Neurofeedback

Intrinsic connectivity networks in the human brain, including the default mode network (DMN), frequently display disrupted functioning among those affected by post-traumatic stress disorder (PTSD). Alpha (8-12 Hz) electroencephalogram (EEG) rhythms have previously been shown to positively correlate with DMN dynamics, and are therefore critical targets for neuroscientifically-informed neurofeedback (NFB) treatments for PTSD. In this symposium talk, Dr. Ros will present novel data from a 20-session, double-blind, randomized sham-controlled trial (RCT) of alpha desynchronizing EEG-NFB in patients with PTSD. The objective of this study was to provide mechanistic evidence underlying clinical improvements by examining changes in aberrant PTSD brain rhythms as a function of neurofeedback treatment. Here, significantly decreased PTSD severity scores in the experimental NFB group were observed when comparing post-NFB and 3-month follow-up scores to pre-NFB, with a remission rate of 60.0%. Importantly, it was found that only PTSD patients in the experimental group demonstrated a restoration of alpha rhythmicity in anterior regions of the DMN. These results replicate previous observations of restored alpha rhythms following NFB treatment, and suggest that homeostatic alpha resynchronization following NFB training may be a critical neuroplastic mechanism underlying PTSD symptom reductions. Results from this multi-session NFB study targeting aberrant DMN alpha rhythms suggest that NFB has the capacity to normalize dysregulated brain networks that have classically been implicated in PTSD.

Advances in quantitative EEG

Thursday, March 23, 2023 - 9:00am-11:00am ET (US/Canada)/14:00-17:00 UTC

Scott Makeig
Director, Swartz Center for Computational Neuroscience
Institute for Neural Computation
University of California San Diego

Imaging cortical dynamics across development

As the scalp is electrically far from the cortex, recorded scalp EEG signals give far from clear representations of the ever-shifting dynamics of cortical potentials. Brain contributions to scalp EEG signals are dominated by activity in cortical areas across which field potentials become fully or partly synchronous during the recording. Most of the EEG record sums projections from a few such spatially distinct cortical area source signals, plus potentials from non-brain sources (eye movements, muscle activity, line noise, etc.). To identify and separate all these contributions from the source-summing scalp channel signals is possible using Independent Component Analysis (ICA). Discovering their spatial origins requires an accurate model of how currents flow from cortex to the scalp. A key parameter of these models is the electrical resistance of the skull relative to the wet brain tissues, as this determines the spatial spread of each brain source signal in the scalp data. The brain-to-skull conductivity ratio changes from perhaps 4 at birth to 20-70 in adulthood, but varies widely within these ranges across individuals. Recently, Zeynep Akalin Acar and I published an algorithm (SCALE) to estimate this ratio noninvasively, while at the same time separating the brain-generated portion of the scalp EEG data into localizable cortical source areas. SCALE-optimized electromagnetic head models can now be constructed for any subject with an MR structural image and a high-density EEG recording (using any paradigm), thus enabling true cortical brain imaging across development. Using some of these tools, Caterina Piazza and I discovered that the cortical sources of infant EEG in an auditory orienting paradigm resemble those of adults, but exhibit a much larger amount of bi-hemispheric coupling that seems to be only an intermittent feature of adult EEG in this paradigm. The new tools now available to EEG researchers open a field of cortical imaging studies to observe and model the development of normal and abnormal cortical dynamics.

Thomas Koenig

Towards a more objective use of resting-state EEG microstate findings across studies

Over the last decade, EEG resting-state microstate analysis has evolved from a niche existence to a widely used and well-accepted methodology. The rapidly increasing body of empirical findings started to yield overarching patterns of associations of biological and psychological states and traits with particular microstate classes. However, currently, this cross-referencing among apparently similar microstate classes of different studies was typically done by “eye-balling” of printed template maps by the individual authors and lacked a systematic procedure. To improve this situation, we present an effort to systematically collect the actual data of template maps from as many published studies as possible and present them in their entity as a matrix of spatial similarity. In addition, the tool allows the import of novel template maps from ongoing studies and the systematic extraction of the findings associated with particular microstate maps in the literature. Once made available to the community, we hope that this tool will be useful in coming to a more comprehensive, objective, and overarching representation of microstate findings.

Yuri Pavlov

Delivering #EEGManyLabs – Challenges & Opportunities

Low statistical power of most EEG studies limits the value of any single published finding – a problem which is exacerbated by publication pressure, selective reporting, and a bias towards publication of novel and surprising findings. #EEGManyLabs project – a large-scale international collaborative replication effort – is working on examining some of the foundational findings using electroencephalography (EEG) with

unprecedented statistical power. In a multi-step procedure involving database search and expert input, the project has identified 27 of the most influential and continually cited studies in the field with a plan to directly test the replicability of key findings from 20 of these studies in teams of at least three independent laboratories. To ensure a high scientific standard, each replication will pass quality control through being reviewed by members of the advisory board and original authors, will use standardized experimental and analysis protocols across labs, and involve registered reports that will be published irrespective of the outcomes. To date, we have assembled 132 teams have committed to collect data from 5408 participants across the selected experiments. We will soon be entering the data acquisition phase of the project, having recently secured in-principle acceptance for one replication and a further 3 registered reports under review. We will describe the challenges and opportunities faced thus far in the implementation of this programme- which on completion will constitute the largest collection of open access EEG datasets in history. Our ambitions for the project are to better understand the factors that contribute to variation in EEG findings, update our confidence in widely cited phenomena and create a suite of open-source resources that facilitate a cultural shift away from small-scale single laboratory experiments towards high-powered, community driven collaborations.

Kay Robbins

EEG annotations using HED-SCORE in (i)EEG-BIDS

Panel

Kay Robbins

TBA

Dora Hermes:

Annotating (i)EEG-BIDS data and the HED-SCORE library schema

Bruno Colombet

EEG annotations with Anywave

Christine Rogers

Montreal Neurological Institute

EEGNet data and analytics hub for open EEG standards

EEGNet, a collaborative EEG platform supported by Brain Canada and the Ludmer Centre, extends an open scalable neuroinformatics hub for the investigation of biomarkers of brain disorders to be available to researchers worldwide.
As part of the Global Norms project of the GBC and the Canadian Open Neuroscience Platform (CONP), EEGNet aims to support open cross-collaboration in data sharing, standardization and analytics.

Approaches to Alzheimer's and Parkinson's diseases

Thursday, March 23, 2023 - 9:00am-10:30am ET (US/Canada)/14:00-17:00 UTC

Claudio Babiloni

The Alzheimer's disease dark side: EEG biomarkers of vigilance and cognitive dysfunctions.

Panel

Claudio Babiloni

Co-chair of the GBC Dementia Workgroup
Sapienza University of Rome (Italy)

Biomarkers of resting state EEG rhythms of vigilance dysfunctions in Alzheimer's and related diseases.

Görsev Yener

Biomarkers of cognitive event-related eeg oscillations in Alzheimer's and related diseases

Disscussants:

Bahar Guntekin

The Medipol University of Istanbul, Faculty of Medicine, Izmir (Turkey).

Agustín Ibañez

University Adolfo Ibáñez, School of Psychology, Santiago of Chile (Chile).

Mario Parra

University of Strathclyde, School of Psychology, Glasgow (UK).

Maria L. Bringas

qEEG in Parkinson's clinincal trials

Vassiliy Tsytsarev

University of Maryland

Wireless optogenetic modulation of cortical neurons enabled by radioluminiscent nanoparticles

While offering high-precision control of neural circuits, optogenetics is hampered by the necessity to implant fiber-optic waveguides in order to deliver photons to genetically engineered lightgated neurons in the brain. Unlike laser light, X-rays freely pass biological barriers. Here we show that radioluminescent Gd2(WO4)3:Eu nanoparticles, which absorb external X-rays energy and then downconvert it into optical photons with wavelengths of ∼610 nm, can be used for the transcranial stimulation of cortical neurons expressing red-shifted, ∼590−630 nm, channelrhodopsin ReaChR, thereby promoting optogenetic neural control to the practical implementation of minimally invasive wireless deep brain stimulation.

The non-linear brain

Thursday, March 23, 2023 - 9:00am-10:15am ET (US/Canada)/14:00-17:00 UTC

Ludovico Minati

On nonlinear electronic circuits: some phenomena, experiments and applications

One of the most interesting aspects of non-linear dynamics is, without a doubt, their universality, implying that very similar emergent behaviours can be observed across rather diverse systems. I will briefly overview my recent research attempting to "summarize" in simple electronic circuits, mainly chaotic oscillators, some phenomena arising in other biological and physical scenarios. Firstly, a gallery of atypical circuits will be walked through, surveying some oscillators based on transistors, gas-discharge tubes, memristors, nanomechanical devices, including electronic realizations of canonical equation systems. Secondly, elementary networks of these circuits will be considered, demonstrating the spontaneous emergence of patterns such as community structures, remote interdependences, chimera states and paradoxical effects of coupling on synchronization. Thirdly, some applications will be discussed, comprising the replication of neurophysiological hallmarks such as low-frequency amplitude fluctuations, the versatile generation of complex kinematic patterns for an insect-like robot, the construction of spiking physical reservoirs, and distributed sensing using wireless-coupled oscillators. While by no means a comprehensive introduction to this rapidly developing, multidisciplinary field, this presentation should hopefully provide some insight into a few current ideas and challenges of this area.

Shiang Hu

Anhui Provincial Key Laboratory of Multimodal Cognitive Computation, School of Computer Science and Technology, Anhui University, Hefei, China

ξπ: a nonparametric model for EEG/MEG power spectra decomposition

Current models that parameterize power spectra are parametric fitting, which may not perform well on the spectra consisting of multiple peaks or irregular shape. Here, we developed a nonparametric model termed ξπ using the shape language modeling. Its superiority to FOOOF was shown on the synthesized, intracranial and sleep EEG.

Ying Wang

The EEG Xi (aperiodic) spectral component, but not the Alpha rhythm, is linear and Gaussian

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The resting state electroencephalogram (EEG spectrum) has long been the mainstay of research and clinical application. Emphasis has shifted in recent years from nonparametric, frequency-resolved spectral descriptions to parametrizations distinguishing between components. The xi process (also known as the background, 1/f, or aperiodic component) and the alpha rhythm are the most prominent.

The components of the FOOOF model are multiplied and fitted by least squares to the spectrum (additively in a log scale). By contrast, the xi-alpha model proposed by Pascual-marqui in 1988 considers that spectral components are additive in the natural scale and based on a maximum likelihood approach that is advantageous in allowing formal statistical inference.

A limitation of these models is that they only parametrize the EEG spectrum, which is an incomplete description of any nonlinear system. Since any biophysically based model of EEG generation contains essential nonlinearities, we deemed it necessary to extend the xi-alpha model to the bispectrum, allowing us to examine the linearity, Gaussianity, and existence of harmonic relations among the components of the EEG.

In order to reduce issues of volume conduction, we base our analysis on Stereoelectroencephalography (sEEG) data described in Frauscher et al. 2018. 1772 electrodes wake stage recordings were separated into 17 segments, each with a duration of 3.8 seconds, from which we calculated the Spectrum, Bispectrum, and Bicoherence.

We model the spectrum with a slight modification of the traditional xi-alpha model in which the alpha rhythm is modeled with several harmonically related peaks. We use the Gaussian kernel for these peaks. This model is estimated by maximizing the Whittle likelihood.

On the other hand, the new bispectral xi-alpha model is modeled with the summation of the weighted product kernels of its spectrum. The joint model for spectrum and bispectrum is estimated with an approximate likelihood. We obtained an excellent spectral fit for all 1772 cases. Note the adequate description of the alpha peak and its harmonics. The harmonic relations are captured with their bicoherence. The Akaike information criteria comparing models with and without the xi process show that xi process can be eliminated from consideration in the bispectrum. This result indicates that the xi process is linear and Gaussian, which are conditions for it being zero. However, the alpha process is strongly nonlinear and shows harmonic coupling, as expected from neural mass modeling. This insight can lead to further links with more detailed biophysical modeling.

Anisleidy González Mitjans

Efficient integration of high-dimensional Neural Mass Models with distributed delays

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Introduction

Mesoscopic Neural Mass Models (NMMs) allow biophysical modeling and understanding of the properties of network properties and their reflection in EEG, MEG, or fMRI. An exciting new development is whole brain models that can even be tailored to specific subjects using their neuroimaging data. Each NMM is modeled by a set of stochastic or random differential equations (Neq), and the simulation of network activity hinges on solving these equations efficiently. Current algorithms scale poorly with the number of neural masses. These lengthy computations make real-time feedback difficult and impede their use in solving EEG/MEG inverse problems. This work deals with three critical aspects of this type of modeling:

We avoid numerical methods that destroy the dynamical properties of networks (attractors), employing the Local Linearization method (LLM)

We show that by drastically increasing simulation sampling frequency, inputs to each neural mass may be treated as already available that are exogenous, thus decoupling the integration of each neural mass. That integration is now of Neq equations and can be solved symbolically

Our differential algebraic formulation creates the present input to each NMM by an efficient tensor product between the past outputs of all masses and the Connectome Tensor (CT) (Figure 1)

We can now model any configuration of connectivity and delays, including distributed delays, which to our knowledge, have not been included in the previous neural mass model frameworks but are a physiological reality due to axonal diameter variation.

Methods

We illustrate the formulation by simulating different configurations of the Zetterberg-Jansen and Rit (ZJR) cortical columns (sampled at 1 ms). The ZJR NMM comprises three coupled second-order nonlinear random differential equations. Each competent differential equation is integrated symbolically with the LLM using MATLAB to yield a two-component multivariate AR(2) model. First, we simulate a single classical ZJR cortical column and then scale the number of cortical columns up to 1000. A three-dimensional sparse CT specifies the emitter neural masses projecting to receiver masses with different time lag distributions. Within each ZJR cortical column, we adopt the canonical connections. For the large-scale scenario, we test different topologies: the Nearest Neighbor, the Small World, and the Full Connected networks. We additionally implement three delays: the standard simple zero lag Dirac delta, the Dirac delta delays with a time lag, and the Distributed delays. The output of the networks report here is the spectrum of the average of all pyramidal cells.

Results

The large-scale NMM simulations showed that this type of network is exquisitely susceptible to changes in the CT. Some examples can be seen in Figure 2. We note that oscillatory activity is quenched for SE and FC networks with Delta Dirac delays, presenting alpha oscillations only for the NN case. Distributed delays restrict quenching only to the FC case. However, oscillation and harmonics are now shifted to the lower theta range. Simulation for the 1000 ZJR model only took 2.4 hours on a single PC without parallel computing. We estimate that traditional methods will scale proportional to (NmxNe)^2 while ours is linear in both quantities.

Further gains are to be expected by parallelizing the approach. An open-source toolbox with fundamental algorithms for enhancing brain simulation dimensions and allowing more comprehensive and realistic modeling is presented.

Conclusion

We provide a very efficient neural mass simulator that is an order of magnitude faster than traditional implementations that use the correct integration technique for random differential equations and that allows, for the first time, encoding distributed transmission delays between neural masses. The latter has not been systematically explored despite our preliminary results showing that they may change network dynamics drastically.

Carlos Lopez

EEG cross-spectra mediate the effects of early malnutrition on cognition. A Riemannian perspective

Ronaldo Garcia Reyes

Multivariate Intrinsic Local Polynomial Regression on Isometric Riemannian Manifolds: Applications to Positive Definite data

A new intrinsic non-parametric Riemannian regression method using Isometric Riemannian Manifolds (IRMs), which has potential applications in machine learning and neuroscience. Specifically, the Symmetric Positive Definite (SPD) manifold, a mathematical structure that arises in machine learning and neuroscience

applications, is considered. It is shown that several metrics on the SPD manifold are Euclidean Pullback Metrics (EPMs), which are used to derive a closed analytical expression for the multivariate Intrinsic Local Polynomial Regression estimator on the SPD manifold (ILPR-EPMs). The ILPR-EPMs are evaluated on simulated data on the SPD manifold and compared with extrinsic Local Polynomial Regression using the Affine-Invariant. The results show that the ILPR using the Log-Cholesky metric is computationally faster and provides a better trade-off between error and time than other metrics. Moreover, the Log-Cholesky metric on the SPD manifold implements an efficient and intrinsic version of Riem t-SNE, a technique for visualizing high-dimensional SPD data. The proposed method has several potential applications in neuroscience, including modeling Diffusion Tensor Imaging (DTI) images, analyzing Electroencephalography (EEG) signals, and studying resting-state functional Magnetic Resonance Imaging (rs-fMRI) connectivity. The code for implementing ILPR-EPMs and other relevant calculations is available on the GitHub page, which can be helpful for researchers and practitioners in the field.

Personalized Medicine in neurodegenerative diseases

Thursday, March 23, 2023 – 10:20am-11:00am ET (US/Canada)/14:00-17:00 UTC

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THE ROLE OF NEUROPHYSIOLOGICAL TECHNIQUES IN THE QUEST FOR EARLY DIAGNOSIS OF DEMENTIA

Early diagnosis of Dementia (Alzheimer & Others) is a pre-requisite for early intervention on modifiable risk-factors (both favoring and contrasting the neurodegeneration).

Technologies to intercept early or prodromal stages of dementia are presently either invasive (i.e. lumbar puncture for CSF) or excessively costly (i.e. PET-SCAN) for a nationwide screening of at-risk population.

Neurophysiological techniques, including EEG/MEG recordings of ongoing or task-related electromagnetic brain activity as well as TMS-EEG are non-invasive, widely available and at relatively low-cost.

Modern methods of EEG/MEG and TMS/EEG signal characteristics via graph-theory, Artificial Intelligence and connectivity analysis provided encouraging results in terms of accuracy/specificity/sensibility for early dementia recognition and follow-up.

Yasser Iturria

On the importance of individualized disease progression models