



Scientific Report on the ERNI-HSF funded workshop, Combining Human Brain Imaging Techniques

National University of Ireland, Galway. 29/04/2011-01/05/2011

Summary

The aim of this symposium was to bring together experts from the fields of neuroimaging, neuroscience and (neuro) psychology in order to introduce new techniques combining existing techniques in neuroimaging. There have been many attempts to combine different neuroimaging techniques so as to overcome limits of each neuroimaging technique. Recently, it is feasible to combine brain stimulation techniques with brain imaging techniques. This workshop introduced the basic of general neuroimaging techniques as an introduction and concentrated on combining techniques.

The program focuses on two major subjects (imaging and recoding whole brain activity, and ‘perturb-and-record’ methods). The meeting included four symposia with discussion sessions two invited lectures and a variety of posters were on display. The workshop was held in National University of Ireland, Galway, Ireland and organized by Prof. Josh Balsters, Dr. Michael Hogan, Prof. Stephen Jackson, and Dr. Jacinta O’shea. 72 participants attended including 16 invited speakers and the four organizers.

Scientific content and discussion

The meeting aimed to introduce the combining techniques in neuroscience field and to show recent works using the techniques and its applications. The speakers were invited from the fields of neuroimaging, neuroscience and (neuro) psychology based on their expertise of neuroimaging techniques. The meeting was organized in four sessions and there was a poster session for young scientist to present their work.

The first day was on the introduction of neuroimaging techniques and combining neuroimaging techniques, specifically EEG combined with fMRI. The organizer, prof. Stephen Jackson started the meeting with the overview of the work of ESF. The first speaker, Joshua Balster presented ‘an introduction to (f)MRI’. He explained the basics of MRI and fMRI very well to understand people who are not familiar of the MRI. His presentation helped all attendees comprehend the later talks about fMRI combined with other techniques. Simon Eickhoff introduced the ALE meta-analysis. To begin with his presentation, he showed why and how meta-analysis is a very useful way to utilize existing data without doing a new experiment. He demonstrated the principle of ALE meta-analysis which he developed and showed the subdivision of insular according to its function resulted from ALE meta-analysis. The third speakers, Richard Roche and Paul Dockree introduced EEG technique. They accounted for the basics of EEG and its advantages and disadvantages. Their presentation provided opportunity for attendees to think why we need the combining techniques. The last introduction talk was by Jochen Kaiser. He presented the fundamentals of MEG based on its technical history. After all introductory presentations of neuroimaging techniques, Karen Mullinger illustrated her recent work using simultaneous EEG and fMRI. She pointed out the biggest challenge to combine EEG and fMRI which is to reduce the noise in EEG data

resulted from magnetic field of MRI. Using a new mathematical algorithm and setting of EEG equipment she developed, she demonstrated how to reduce artefacts in EEG data.

After lunch, the meeting continued with imaging and recording whole brain activity session. The sixth speaker was Tom Eichele who is also working on simultaneous EEG and fMRI. He introduced independent component analysis from event-related and resting EEG-fMRI data and explained the advantage of EEG-fMRI data. The next speaker, Richard Wise presented a method to investigate the pharmacological modulation of brain activity measured by BOLD-contrast fMRI. His method suggested the possibility that pharmacological modulation of specific brain activity may be generalized to other drugs that modulate brain activity.

The following tea break, Andy Bagshaw gave a presentation regarding the neurophysiology of sleep. He explained the physiological mechanism in the brain during sleep based on EEG-fMRI study. His talk offered understanding of the developing methods to improve data quality based on independent component analysis and methods to integrate the data based on information theory, as well as using these techniques to study questions in cognitive neuroscience, sleep and epilepsy. The last speaker of the first day, Dimitri Van de Ville gave a great talk about an interesting phenomenon in EEG and fMRI resting state data. He pointed out the similar pattern of EEG in milliseconds and fMRI timecourse data in minutes, which is called scale-free dynamics. This phenomenon suggests a possibility to connect EEG data to fMRI data across the timescale from the data.

The second day started with 'Perturb-and-record' methods session. In the first presentation, John Rothwell discussed novel combinations of techniques to

stimulate the brain. By stimulating the brain and measuring its influences, it is possible to establish the causal relationship between a brain area and its function clearly. The next speaker, Seven Bestmann extended John Rothwell's talk and described how useful combining technique (brain stimulation and fMRI) it is. Using concurrent TMS/fMRI technique, it is feasible to modulate changes in brain activity pattern and to investigate brain network. The third presentation of Hartwig Siebner showed how combining TMS with other brain mapping techniques are applied to study action selection specifically. Furthermore, these techniques characterize brain states with non-invasive brain mapping techniques. Christian Grefkes demonstrated the actual application of the combination of rTMS and fMRI in clinical population. Using fMRI, he showed the significant changes in the cortical connectivity caused by TMS in stroke patient group. Moreover, those changes were correlated with the improvement of the damaged functions evoked by the stroke. The final presentation of Paul Taylor gave us a new view to look into TMS/EEG studies. Applying TMS pulse during EEG recording provides very high temporal resolution which can tell us to when we should look at the effect of TMS.

Following lunch, the session continued the topic, 'perturb-and-record'. Charlie Stagg provided an overview of her excellent work using transcranial direct current stimulation (tDCS) and magnetic spectrography. She applied tDCS to the primary motor cortex and measured neurotransmitter (GABA) changes. According to the stimulation type, the changes in GABA responded differently. Unfortunately, Roshan Cools could not attend due to personal circumstances. Instead of Roshan Cools, one of organizer, Jacinta O'shea presented her recent work about the application tDCS as a therapeutic method for stroke patients. Using tDCS, she provided evidence for the effect of the stimulation showing the improvement in the damaged function.

Tea was followed by poster session with 10 poster presentations.

The third day started with an invited trainee talk. JeYoung Jung presented her work about combining TMS with fMRI to investigate the connectivity of motor network. Her study demonstrated that using concurrent TMS/fMRI, it is possible to modulate the connectivity in motor network observed by fMRI signal. The next speaker, Zoltán Vidnyánsky provided the locus and dynamics of noise effects on visual cortical processing using EEG and fMRI. He dissociated the effect of phase noise on sensory processing and overall decision difficulty. The last speaker, Michael Hogan presented studies concerning the coherence-performance mapping and network analysis across younger adults, older adults, and older cognitively declined adults using EEG signal.

Overall, the meeting succeeded in bringing eminent scientists working on neuroimaging, neuroscience and (neuro) psychology together and attracting many participants from many countries in Europe. This meeting provided a great chance to introduce a state-of-the-art techniques (combining brain imaging techniques) used contemporary academic and clinical field. The meeting also offered a very lively place for discussion during oral as well as poster sessions.

DAY ONE, Friday 29 April:

Imaging and recording whole brain activity (fMRI and EEG)

9am: Welcome

9.10-9.40: *Joshua Balsters (Dublin)*: An Introduction to (f)MRI

9.50-10.20: *Simon Eickhoff (Julich, Germany)*: The ‘Why’ and ‘How to’ of quantitative fMRI ALE meta-analyses

10.30 – 11.00: Coffee break

11.00 – 11.30: *Richard Roche (Maynooth)/ Paul Dockree (Dublin)*: An Introduction to EEG

11.40 – 12.10: *Jochen Kaiser (Frankfurt)*: An Introduction to MEG

12.20 – 12.50: *Karen Mullinger (Nottingham)*: Reducing artefacts in EEG data during simultaneous fMRI

1.00 – 2.00: Lunch

2.00-2.30: *Tom Eichele (Bergen, Norway)*: Independent component analysis of event related and resting EEG-fMRI data

2.40-3.10: *Richard Wise (Cardiff)*: A BOLD approach to pharmacological FMRI is rarely enough: multi-modal and calibrated approaches can help.

3.20 – 3.50: Coffee

3.50-4.20: *Andy Bagshaw (Birmingham)*: The neurophysiology of sleep

4.30 – 5.00: *Dimitri Van de Ville (Geneva, Switzerland)*: EEG microstates connect with fMRI resting-state networks through scale-free dynamics

DAY TWO, Saturday 30th April

‘Perturb-and-record’ methods: measuring the causal impact of neural interference on brain activity and behaviour in health and disease

9am: Welcome

9.10-9.40: John Rothwell (London) : "Novel combinations of techniques to stimulate the brain"

9.50-10.20: Sven Bestmann (London) : Studying brain networks with neuroimaging and neurostimulation

10.30 – 11.00: Coffee break

11.00 – 11.30: Hartwig Siebner (Copenhagen, Denmark): Combining TMS with other brain mapping techniques to study action selection

11.40 – 12.10: Christian Grefkes (Köln, Germany): Using fMRI to assess rTMS effects on cortical connectivity after stroke

12.20 – 12.50: Paul Taylor (Munich) : Combined TMS-EEG: can asking 'when' tell us 'how'?

1.00 – 2.00: Lunch

2.00-2.30: Charlie Stagg (Oxford) : Modulating GABA in the human motor cortex

2.40-3.10: Roshan Cools (Nijmegen) : Effects of cortical stimulation on striatal cognitive function

3.20 – 3.50: Coffee

4.00 – 6.00 Poster Session

7.30pm Conference Dinner

DAY THREE, Sunday, 1st May

9.30am: Welcome and introduction to the aims of the (half) day

9.40-10.00: Invited trainee Jeyoung Jung (Nottingham, UK)

Combining TMS with fMRI to investigate the connectivity of motor network

10.10 – 10.30: Zoltán Vidnyánsky (Hungary) : Characterizing the effect of noise on visual processing using EEG and FMRI

10.40 – 11.00: Michael Hogan (Ireland) : Combining coherence and performance data and network analysis : An examination across younger adults, older adults, and older cognitively declined adults

11.00 – 11.30: Coffee break

11.40 – 1.20 Walking Tour of Galway

Full list of speakers

Andrew Philip Bagshaw	BIRMINGHAM, (UK)
Joshua Balsters	Dublin, (IE)
Sven Bestmann	London, (UK)
Paul Dockree	Dublin, (IE)
Tom Eichele	BERGEN, (NO)
Simon Eickhoff	AACHEN, (DE)
Christian Grefkes	Cologne, (DE)
Michael Hogan	Galway, (IE)
JeYoung Jung	Nottingham, (UK)
Jochen Kaiser	Frankfurt, (DE)
Karen Mullinger	Nottingham, (UK)
Jacinta O'Shea	Headington, (UK)
Richard Roche	Dublin, (IE)
John Rothwell	London, (UK)
Hartwig Siebner	LYNGBY, (DK)
Charlotte Stagg	Headington, (UK)
Paul Taylor	München, (DE)
Dimitri Van De Ville	NYON, (CH)
Zoltán Vidnyánsky	BUDAPEST, (HU)
Richard Wise	CARDIFF, (UK)

Full list of participants

Claudia Civai	Trieste	Italy	SISSA/ISAS
Yin Wang	Nottingham	UK	University of Nottingham
Cathy Scanlon	Naas, Co. Kildare	Ireland	UCSF
SunYoung Choi	Nottingham	UK	Korea University
JeYoung Jung	Nottingham	UK	Korea University
Dara Cannon	Galway	Ireland	NUI Galway
Jenny Pridham	Manchester	UK	Salford Royal NHS Foundation Trust
Amelia Draper	Nottingham	UK	University of Nottingham
Denis Ohora	Galway	Ireland	NUI Galway
Linda Solstrand Dahlberg	Nottingham	UK	University of Nottingham
Karen Doyle	Galway	Ireland	NUI Galway
Andrew Magee	Galway	Ireland	Beaumont Hospital/ University College Dublin
Náíl Lally	London	UK	University College London
Winnie Chua Wei Ling	West Midlands	UK	University of Birmingham
Elise Lesage	Birmingham	UK	University of Birmingham
Joe Butler	Bangor	UK	Bangor University
James Harris	Manchester	UK	University of Manchester
Andrea Higgins	Dublin	Ireland	National Rehabilitation Hospital
Noeleen Brady	Maynooth	Ireland	NUI Maynooth
Stephen Mayhew	Birmingham	UK	University of Birmingham
Gál, Andor Viktor	Budapest	Hungary	Péter Pázmány Catholic University
Weiss, Béla	Budapest	Hungary	Péter Pázmány Catholic University
Luisa Allione	Ferrara	Italy	University of Ferrara
Chris Noone	Ennis	Ireland	NUI Galway
Owen Harney	Athlone	Ireland	National University of Ireland, Galway
Despina Panagiotidou	Thessaloniki	Greece	South East European Research Center
mason Liam	Manchester	UK	University of Manchester
Muhammad Enamul Hoque Chowdhury	Nottingham	UK	University of Nottingham
Fionn Clarke	Cork	Ireland	University College Cork
James McElligott	Roundwood	Ireland	
Jacinta McElligott	Roundwood	Ireland	NRH
Jennifer Murphy	Maynooth, Kildare	Ireland	RCS
Colin Lyons	Tralee, Co. Kerry	Ireland	
Jessica Van Doren	Regensburg	Germany	Regensburg University
Deirdre Twomey	Cork	Ireland	NUI Galway
Joseph Duffin	Maynooth	Ireland	NUI
Vanessa Johnen	Oxford	UK	University of Oxford
Jamila Andoh	Montreal	Canada	MNI

Barbara Leone Fernandez	La Laguna	Spain	University of La Laguna
Yinyin Zang	Nottingham	UK	University of Nottingham
Valentina Manfredi	Silvano d'Orba	Italy	University of Pavia
Olusola Olufemi Alabi	Gothenburg	Sweden	University of Gothenburg, Sahlgreska Academy
Ajay Halai	Manchester	UK	University of Manchester
Simon Tomlinson	Bangor	UK	University of Bangor
James Cousins	Manchester	UK	University of Manchester
Robert Hardwick	Birmingham	UK	University of Birmingham
Caroline Rawdon	Maynooth	Ireland	National University of Ireland Maynooth
Sarah Casey	London	UK	Institute of Psychiatry, King's College London
Fiadhnaid O'Keeffe	Dublin	Ireland	National Rehabilitation Hospital
Mark Glennon	Galway	Ireland	National University of Ireland, Galway
Georgina Jackson	Nottingham	UK	University of Nottingham