

BRAINTRAIN NEWSLETTER 3

BRAINTRAIN started in November 2013 and is coordinated by Cardiff University (Professor David Linden, Wales, UK). Our consortium brings together 12 complementary partners, including 9 academic research institutions, one small medium sized enterprise, a larger industrial partner and a technology transfer/management company.

To achieve our objectives, BRAINTRAIN program comprises 6 complementary workpackages. WP1: Coordination and management of the consortium, has strong links to all other WPs as its objective is to ensure good management and timely implementation of the BRAINTRAIN workprogramme, communication between the different WPs via regular meetings and reports. So far, we have met thrice: in Cardiff for the Kick-off meeting (2013) and in Maastricht (2014) and Tel-Aviv (2015) for the annual meetings. In between, we have had regular ExCom meetings, where WP leaders meet and discuss the strategic points of the project. You can find in the Braintrain secure intranet the main information related the contractual aspects and the meetings. We look forward to the next annual meeting to be held in Coimbra in October 2016.

Each team has now been working on its work packages for about two and a half years. The next pages provide an overview of what we have been doing so far and a focus on some important developments.

BRAINTRAIN will focus on 4 objectives

Objective 1

Develop new or optimize existing imaging technologies

Objective 2

Validate their application to mental disorders by integrating imaging data with complementary knowledge resulting from bioinformatics and clinical data.

Objective 3

Allow the diagnosis of mental disorders at the pre-symptomatic stage or early during development.

Objective 4

Better measure disease progression.

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SYMPOSIUM TALK 2 UR BRAIN

The Talk 2 UR Brain symposium and BRAINTRAIN Annual Meeting brought researchers from all over Europe and Israel to our front door to discuss neurofeedback research and practice. The symposium gathered 12 speakers – including David Linden, Talma Hendler, Rainer Goebel, Miguel Castelo-

Branco, Kathrin Cohen Kadosh and Nikolaus Weiskopf – and 200 attendees.

Ten posters were presented. Following the symposium came a very successful 2 days of meeting with the members of the BRAINTRAIN consortium and an enlightening Turbo Brain Voyager course taught by Rainer Goebel.

EUROPEAN FELLOWSHIPS – SCIENTIFIC EXCELLENCE

The European Commission has published a call for applications for individual fellowships under the MARIE SKŁODOWSKA-CURIE INDIVIDUAL FELLOWSHIPS scheme. The next deadline is 14 September 2016.

Applicants interested in working with the BRAINTRAIN partners are encouraged to contact BRAINTRAIN PIs or the coordinator (lindend@cardiff.ac.uk). See this link: http://ec.europa.eu/research/mariecurieactions/about-msca/actions/if/index_en.htm.

TALKS ON ADVANCED MRI METHODS IN CARDIFF

Nikolaus Weiskopf and Steffen Volz from partner UCL gave presentations to the BRAINTRAIN staff and wider neuroimaging communities in Cardiff on 2 February 2016.



Steffen told us about his work in BRAINTRAIN, which aims at optimising image acquisition and reconstruction for the purposes of real-time fMRI neurofeedback. Improvements of image quality can be achieved by optimising sequence parameters for the BOLD signal (blood oxygenation level-dependent signal, which is used for fMRI). Steffen has conducted fieldmap-based simulations and showed us how the proper choice of user-set parameters, shim gradient moment and slice angulation can affect BOLD sensitivity. Another way of improving image quality, especially relevant to real-time imaging, is by prospective motion correction. Steffen showed us examples of this using the Kinetico system. Speed of image acquisition is also of the essence. Steffen introduced us 2D multiband echo-planar

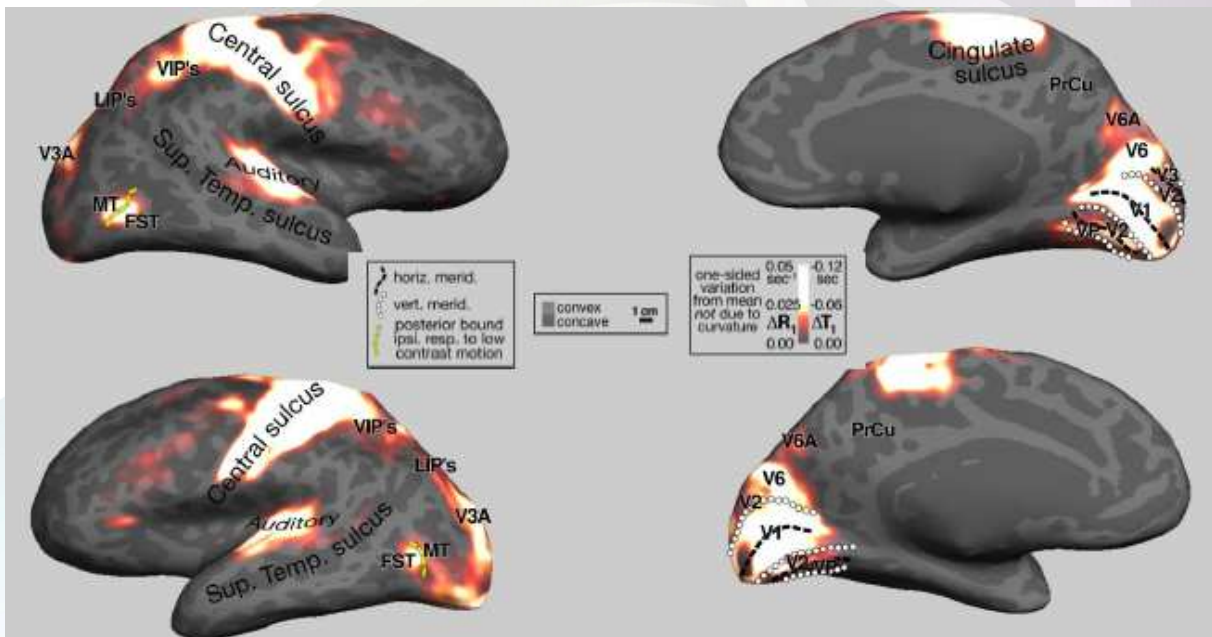
imaging (EPI) and 3D EPI and demonstrated examples of signal improvement, but also some of the pitfalls that can lead to false positive results. Additionally, the use of advanced sequences combined with high sophisticated image reconstruction algorithms comes at the cost of high raw data amounts and computational effort, not always manageable in real-time with the standard image reconstruction hardware and software. One way of dealing with this is to send the raw data to a separate computer for fast image reconstruction e.g. using Gadgetron. Aside from fast image reconstruction, another advantage of this approach is, that due to the open source architecture, new image reconstruction methods can be developed vendor independent and shared within the research community more easily. At the Functional Imaging Laboratory at partner UCL

real-time quality assurance was demonstrated as a first application using Gadgetron and the ability of 3D multi-echo EPI reconstruction with parallel imaging in two directions as the next step. In summary, the careful evaluation of new MRI techniques can make a substantial contribution to the signal quality and speed of real-time fMRI.



Nikolaus gave a talk on “In vivo histology” hosted by Cardiff’s Neuroscience and Mental Health Research Institute. He emphasised the importance of quantitative MRI, which can provide information about tissue structure

beyond the more conventional contrast-based imaging. One particularly attractive example is myelin mapping using R1 (the inverse of the T1 time constant). This has yielded characteristic patterns of more (bright colours) and less heavily myelinated cortical areas (see figure). Interestingly, these patterns were very similar to those described by the German anatomist Paul Flechsig on the basis of his developmental studies of myelination in post-mortem brains 100 years ago. Quantitative MRI will be very relevant to real-time fMRI studies if we want to improve the anatomical targeting and investigate neuroplastic effects of neurofeedback.



DISSEMINATION

The objective of WP6 is to insure an effective dissemination using different tools. A brochure was distributed to the partners, a logo for BRAINTRAIN was created and we have a public website which is updated regularly. In parallel, partners are very active presenting neurofeedback research at national and international conferences and invited seminar talks. We can list the following:

- ✚ Since our last newsletter, Andrea Petersen of the Wall Street Journal featured the work of BRAINTRAIN partners in her article on "Brain Training for Anxiety, Depression and Other Mental Conditions" published on January 18th, 2016.
- ✚ Kathrin Cohen Kadosh (University of Oxford) gave several talks on the work of the BRAINTRAIN consortium at British universities over the last months: she intervened on "Investigating cortical excitability and plasticity in developing brain networks during childhood and adolescence at the university of Sheffield's department (Sheffield, October 16th, 2015), "Cortical excitability and plasticity in developing brain networks during childhood and adolescence" at the University of Birmingham's department of Psychology (Birmingham, February 2nd, 2016) and "Plasticity and excitability in the developing brain" at the University of Sussex's school of Psychology (Brighton, February 9th, 2016). She also took part in the 3rd Annual Flux Congress in Leiden, Netherlands (September 18th, 2015) on the topic of "fMRI-based neurofeedback and the developing emotion network".
- ✚ David Mehler (Cardiff University) presented "Neurofeedback training for clinical applications - trial for alcohol dependence, news from depression" at the 1st French Workshop on Neurofeedback, hosted by the Brain and Spine Institute in the Hôpital de la Pitié Salpêtrière, Paris on January 19th, 2016.
- ✚ Nikolaus Weiskopf and Steffen Volz (University College London) gave talks on new MRI methods at Cardiff University Brain Research Imaging Center on February 2nd, 2016.
- ✚ Nikolaus Weiskopf also intervened at the Brain Forum's annual conference on May 27th, in Lausanne (Switzerland). He participated in the session "Advancing human neuroscience: encoding, decoding, and neurofeedback using functional neuroimaging" to present an overview of rtfMRI neurofeedback. Formerly at University College London, Dr Weiskopf is now working within the Max Planck Institute for Human Cognitive and Brain Sciences, as of April 1st, 2016.
- ✚ Ralf Veit (Eberhard Karls Universität Tübingen) gave two presentations featuring BRAINTRAIN during national conferences in Germany: he spoke on "Real time fMRI neurofeedback as a

therapeutic tool?" at the Biofeedback and Realtime Imaging in Brain Research symposium in Marburg (September 13th-15th, 2015) and intervened on "Wege des fMRT Neurofeedback in die Anwendung" (Ways of application of fMRI Neurofeedback) at the FMRT Neurofeedback: aktuelle Fortschritte und Herausforderungen (fMRI Neurofeedback: current progress and challenges) symposium in Berlin (May 25th-28th, 2016).

✚ As a part of the BRAINTRAIN project, the Institute for Biomedical Imaging and Life Sciences (IBILI, University of Coimbra) participated in different dissemination initiatives in the community, particularly in cooperation with patient organisations.

In February 2016, the talk entitled "BRAINTRAIN: from the functional mapping of the brain to the development of therapeutic techniques in Autism Spectrum Disorder" was given in the framework of the 3rd Autism Spectrum Disorder (ASD) Days: a longitudinal perspective - an event organised by the Portuguese Association of Autism Spectrum Disorder of Coimbra.

On April 1st, the Portuguese Federation of Autism organised a seminar to highlight the World Autism Awareness Day, in Lisbon. Again, IBILI was represented with a talk entitled "New technologies in service of ASD", in which the research team summarized the work done thus far in the scope of BRAINTRAIN, and advertised the ongoing clinical trials. The seminar gathered dozens of researchers, physicians, technicians, parents and friends of the community, and provided the opportunity to establish collaborations with research centers and patient associations from different regions.

Finally, on April 22nd, IBILI participated in the 7th Symposium on Bioengineering, at the Faculty of Engineering of University of Porto. This event offered the opportunity to disseminate IBILI's work with a younger, scientific community. The talk "New paradigms in neuroengineering" presented an overview of neuroengineering techniques used by IBILI's research team, with a particular focus on BRAINTRAIN.

✓ *The BRAINTRAIN website is available at the address:*

www.braintrainproject.eu

✓ *The extranet where you can find all the important documents regarding the agreement, the meetings and the dissemination is available at this address:*

<https://extranet-braintrain.atreal.fr/>

✓ *The Next Annual meeting will be held in Coimbra, Portugal on October 25th-26th, 2016*

Publications:

Patrick Freund, Karl Friston, Alan J. Thompson, Klaas E. Stephan, John Ashburner, Dominik R. Bach, Zoltan Nagy, Gunther Helms, Bogdan Draganski, Siawoosh Mohammadi, Martin E. Schwab, Armin Curt and Nikolaus Weiskopf (2016). Embodied neurology: an integrative framework for neurological disorders. *Brain, a Journal of Neurology*, 2016 Apr 21. doi:10.1093/brain/aww076

Niklas Ihssen, Moses O. Sokunbi, Andrew D. Lawrence, Natalia S. Lawrence and David E. J. Linden (in press). Neurofeedback of Visual Food Cue Reactivity: A Potential Avenue to Alter Incentive Sensitization and Craving. *Brain Imaging and Behavior*.

Cohen Kadosh, K., Lisk, S., & Lau J.Y.F. (in press). The ethics of (neuro)-feeding back to the developing brain. *American Journal of Bioethics*.

Sitaram, R., Ros, T., Stoeckel, L., Haller, S., Scharnowski, F., Lewis-Peacock, J., Weiskopf, N., Blefari, M.L., Rana, M., Oblak, E., Birbaumer, N., Sulzer, J. (in press). Closed-loop Brain Training: The Science of Neurofeedback. *Nature Review Neuroscience*.

Scharnowski, F., Veit, R., Zopf, R., Studer, P., Bock, S., Diedrichsen, J., Göbel, R., Mathiak, K., Birbaumer, N. Weiskopf, N. (2015). Manipulating motor performance and memory through real-time fMRI neurofeedback. *Biological Psychology*, 108, 85-97.

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