ANNUAL REPORT OF

AALTO NEUROIMAGING

AALTO UNIVERSITY SCHOOL OF SCIENCE

2017

Composed by personnel of Aalto NeuroImaging

Edited by Toni Auranen

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Director's executive summary

Finally, I have some great news. Last year was a very successful year in many ways. First of all, our budget was well balanced after a few negative years. The usage of our facilities increased and is now close to the financially sustainable situation. Our scientific output increased and reached 35 peer-reviewed publications and 8 PhD theses. We also gained new users at MEG Core from Hyksin Oy performing patient measurements.

There is also great news concerning our future, too. The School of Science decided to increase the support to our infrastructure from 40% to 50% as of January 2018. Aalto Behavioral Laboratory (ABL), the hangaround lab, is now part of Aalto NeuroImaging. MSc Veli-Matti Saarinen, the key person keeping the ABL in excellent shape is now officially working at Aalto NeuroImaging.

Last year we were about to seize the Aalto TMS operation. Fortunately, Aalto TMS will continue in 2018 although with a part-time support only. MSc Mikko Nyrhinen, the key person at Aalto TMS is now a PhD student providing part-time help at Aalto TMS.

Our 7T project, proposed two years ago, is in hold phase at the moment. We will try to continue the project when the time is right and we will have a critical mass available for the project. We are also very keen on sharing our ideas and expertise in 7T with other players in the field.

Last year Ronny Schreiber decided to take another job at industry in February 2017. Ronny Schreiber has been a very important person in maintaining and designing several gadgets at Aalto NeuroImaging. Fortunately, he decided to work at Elekta Oy (Helsinki, Finland) at the MEG service and support team and is still connected to our MEG Core. I would like to thank Ronny Schreiber for sharing his time and expertise with us for more than ten years and wish all the best to him in his new position.

In 2017, Aalto NeuroImaging received 40% of the budget from Aalto University School of Science. The support was, as previous year, mainly used to reduce the fees of the users from the Aalto University and NEUROIMAGING infrastructure. Hopefully, the financial support will continue in the future since it is crucial to the research and education at the Aalto University. Aalto Brain Centre (ABC, http://brainscience.aalto.fi), the neuroscience and neurotechnology initiative of the Aalto University, has also continued to support financially ANI measurements in 2017. I would like to thank Dean Jouko Lampinen and Professor Lauri Parkkonen for these funding sources. I would also like to thank the present Steering Board for useful comments and suggestions to improve our infrastructure.

In 2018, we will apply for the Finnish Infrastructure FIRI2018 call from the Academy of Finland to have an MEG system upgrade in 2019. At the same time we will take a leap for the next level introducing new MEG facilities with room for the forthcoming optically pumped magnetometers. The construction sites nearby and forthcoming Raidejokeri will cause more disturbances in the present MEG Core location and, thus, it is time to move on. Actually, on the May 23rd 2018 we will celebrate the 20th anniversary of our Neuromag Vectorview project with invited speakers.

Finally, I would like to express my gratitude to our staff and users. Aalto NeuroImaging has survived 5 years and your efforts have been crucial for our infrastructure, university, and neuroscience community.

Magnetically yours,
Veikko Jousmäki

1 Introduction

Aalto NeuroImaging (ANI, http://ani.aalto.fi) research infrastructure was established on January 1st, 2013 at Aalto University School of Science (SCI). ANI research infrastructure houses three functional neuroimaging modalities, navigated and repetitive transcranial magnetic stimulation (nTMS and rTMS) at Aalto TMS laboratory, functional magnetic resonance imaging (fMRI) at Advanced Magnetic Imaging (AMI) Centre, and magnetoencephalography (MEG) at MEG Core. ANI is part of Aalto University School of Science and administrated by Department of Neuroscience and Biomedical Engineering (NBE, http://nbe.aalto.fi). Both AMI Centre and MEG Core are well established and have a long history and tradition starting from the Helsinki University of Technology whereas Aalto TMS was established in 2013. Docent Veikko Jousmäki from the NBE has been the ANI director since February 1st, 2013.

ANI is part of NEUROIMAGING research infrastructure (http://neuroimaging.fi) administrated by Aalto University together with University of Helsinki (UH) and Hospital District of Helsinki and Uusimaa (HUS, Helsingin ja Uudenmaan sairaahoitopiirin kuntayhtymä) in the capital region. NEUROIMAGING established in 2011, is based on agreement between AU, UH, and HUS, and covers, in addition to Aalto NeuroImaging research infrastructure in the Otaniemi campus, also the BioMag Laboratory (http://www.biomag.hus.fi) located at the Meilahti hospital. The goal of the NEUROIMAGING agreement, in brief, is to enhance joint use and development of the large-scale brain imaging facilities. ANI and NEUROIMAGING, were granted with recognition on "Finland's strategy and roadmap for research infrastructures 2014–2020" (2014) by the Academy of Finland and Ministry of Education and Culture. ANI and NEUROIMAGING are also actively involved in establishing and strengthening the Finnish Infrastructures for Functional Imaging (FIFI, http://functionalimaging.fi) consortium. FIFI is a national-level large-scale infrastructure providing open access services in functional *in vivo* imaging of humans and animals. FIFI aims to guarantee that cutting-edge imaging technology is widely available for research and development projects both in academia and industry to enhance the science and to exploit the biomedical imaging infrastructures to the fullest. FIFI partners serve close to 1000 users annually.

The NEUROIMAGING Steering Board comprised two members from the Aalto University (Dean Jouko Lampinen, Professor Riitta Salmelin), two from the UH (Professor Kimmo Alho, Professor Sampsa Vanhatalo), and two from HUS (Chief Medical Officer Markku Mäkijärvi, Chief Physician Erika Haaksiluoto). The Directors of the units act as experts with the right to speak in Steering Board meetings (ANI: Director Veikko Jousmäki, DrTech Toni Auranen; BioMag: Director Jyrki Mäkelä, DrTech Juha Montonen). The Steering Board had one meeting in 2017; the appointed chairman of the Steering Board for the three-year period (2017–2019) is Dean Jouko Lampinen and the secretary in 2017 was DrTech Juha Montonen. Professor Riitta Salmelin has also played a vital role in the FIFI consortium coordination.

Aalto NeuroImaging infrastructure brings new possibilities and openings for the brain research community. Our aim is to maintain and develop the best possible infrastructure for functional brain imaging. All our units have their own transparent budgets and they are providing open-access for brain research community and other users. We have fixed user fees and we meet the requirements set by the Academy of Finland, Tekes (Business Finland from 2018), and European Research Council. We are strongly supporting neuroscience, one of the research focus areas of the Aalto University, as well as Aalto Brain Centre (established in 2014), Aalto University's initiative in neuroscience and neurotechnology.

In 2016–2017, MSc Veli-Matti Saarinen has successfully launched a new set of research tools within the Aalto Behavioral Laboratory (ABL), which meets the high standards and usage transparency of other ANI units. ABL annual activities are detailed separately in the end of this report and ABL will officially be part of ANI from the beginning of 2018.

1.1 Aalto TMS

Aalto TMS laboratory (http://tms.aalto.fi) was inaugurated in early 2013. It offers researchers unique possibilities within Finland for multi-modal neuroimaging techniques. The laboratory contains top-of-the-line navigated transcranial magnetic stimulation (nTMS) and electroencephalography (EEG) systems. Aalto TMS operates closely with other ANI units in developing novel equipment setups that aim to enable consecutive and concurrent TMS and functional magnetic resonance imaging (fMRI), for example.

nTMS -system with two stimulation units (Bistim^2 and Super Rapid^2 Plus^1, Magstim Company Ltd., United Kingdom) and various coils makes numerous TMS and rTMS examination setups possible. Bistim^2 consists of two Magstim 200 units with a connection module making possible to deliver paired pulses or one high-energy pulse in to a single stimulation coil. Connection module can also be disconnected making it possible to use two Magstim 200 units as separate stimulation devices. For this purpose the laboratory has two 70 mm figure of eight coils making dual-site stimulations with the system possible. Also the new neuronavigation software (Visor2; ANT Neuro, Enschede, The Netherlands) version has a support for dual coil navigation. Super Rapid^2 Plus^1 consists of three power supply units which enable highpower/frequency stimulations. 70-mm air-cooled figure-of-eight coil makes high power/frequency scenarios possible without having to change the coil during or between sessions. With the two stimulation systems together, it is possible to do even triple-site stimulations in the laboratory.

In addition, the 64-channel EEG-system with 16 EMG channels (NeurOne; Mega Electronics Ltd., Kuopio, Finland), specially designed for co-registration with TMS, can be used to map stimulus event-related responses simultaneously. The laboratory also contains a dedicated system for audio and visual studies with Matlab, E-Prime, and Presentation software available for stimulus delivery.

Aalto TMS has been designed to maximize user and test subject comfort. For example, there are four 42” LCD screens for neuronavigation, ceiling-mounted arm for the navigation camera, Salli Saddle Chair with elbow rest, three coil holders (2x Magstim and a custom build), an adjustable table and chair for visual stimulation system, and a head rest for test subject head support.

1.2 AMI Centre

AMI Centre (http://ami.aalto.fi) houses a research-dedicated, modern 3T Siemens Skyra (Siemens Healthcare, Erlangen, Germany) magnetic resonance imaging (MRI) scanner. For fifteen years, several research teams from Aalto University, University of Helsinki (UH), Helsinki and Uusimaa Hospital District (HUS), as well as other academic users and industry have used the facilities of AMI Centre for research and education. Since its inauguration, AMI Centre has operated smoothly with only a few notable interruptions of use, such as a three months downtime in 2011, when the Skyra system was installed to replace our previous 3T MRI scanner (SIGNA^{TM} GE Healthcare Ltd., Wauwatosa, WI, United States) operational since 2002.

The current system houses 48 independent measurement channels and our users have three distinct head coil arrays to choose from according to their needs; 32-channel head coil for excellent signal-to-noise ratio, a slightly more spacious 20-ch head-neck coil to be used with simultaneous EEG recordings, for example, and a custom-made modified version of the 32-channel head coil for excellent visual field of view for the volunteer. Our scanner is equipped with the TimTX TrueShape and syngo ZOOMit –updates enabling the latest possibilities in parallel transmission for MRI and fMRI. We have a Full HD Panasonic 3-DLP projector (PT-DZ110XE) with a custom made lens system for visual stimulation in addition to well-designed other stimulus (acoustic, pneumatic and tactile) delivery systems and robust eye tracking (EyeLink 1000; SR Research Ltd., Missisauga, Ontario, Canada) as well as simultaneous EEG recording (BrainAmp MR+; Brain Products GmbH, Gilching, Germany) and

physiological signal recording/monitoring (BIOPAC Systems, Inc., Goleta, CA, United States) capabilities. In addition, we offer access to a large number of MRI compatible subject response devices ranging, *e.g.*, from standard buttons to joysticks and from grip force measuring to foot pedals. We continue to offer exquisite surroundings for fMRI studies and neuroscience research.

1.3 MEG Core

The main research instrument of the MEG Core (http://meg.aalto.fi) is a 306-channel neuromagnetometer (Elekta Neuromag^{TM}, Elekta Oy, Helsinki), which was upgraded in 2008. It houses 204 gradiometers and 102 magnetometers with whole-scalp coverage. The device includes 64 EEG channels and 8 additional analog inputs for monitoring purposes. The MEG device is located within a 3-layer magnetically shielded room (MSR; Imedco AG, Hägendorf, Switzerland) that provides >100 dB attenuation of the external magnetic disturbances over a wide bandwidth. MEG Core has extremely low magnetic ambient noise level.

During MEG recordings, stimulators are available, *e.g.*, for auditory (Etymotic Research, Chicago, IL; ADU-2, Unides Design Ay, Helsinki; Sound Shower, Panphonics Oy, Tampere, Finland), tactile (constant current electric stimulator, Medizin Technik Schwind, Germany), pneumatic tactile stimulator (built for the purpose in Germany), vibrotactile stimulator (built in-house), manually-operated brush stimulator (built in-house), visual (Panasonic 7700 DLP projector with a back projection screen), and pain (Neurotest thulium-YAG laser, Baasel Lasertech GmbH, Starnberg, Germany) stimulation. For monitoring purposes, MEG Core has eye tracker (EyeLink 1000; SR Research Ltd., Missisauga, Ontario, Canada), and home-made accelerometer-based monitoring devices. In addition, MEG Core has several home-made response pads and strong knowhow in building and testing MEG and MRI compatible stimulators.

2 Location, facilities, and mission

The Aalto NeuroImaging infrastructure facilities are located on the campus of the Aalto University in Otaniemi area. Aalto TMS and AMI Centre are both located in the Magnet Building (Otakaari 5 I, Espoo, Finland), AMI occupying 350 m^2 in floors 1–3 and TMS about 50 m^2 in the fourth floor. MEG Core resides in Nano Building (Puumiehenkuja 2), having 120 m^2 of laboratory space. All the facilities are easily accessed using either public or private transportation in the greater Helsinki area with the Western Metro Extension further improving the site access for both researchers and volunteers for studies. All three parts of the ANI infrastructure have a joint online reservation system at http://anitime.aalto.fi. For more detailed information, see http://ani.aalto.fi.

The main research tools at Aalto TMS are two neuronavigated transcranial magnetic stimulation systems (Bistim^2 and Rapid^2, The Magstim Company Ltd., United Kingdom) combined with electroencephalogram mapping (NeurOne, Mega Electronics Ltd., Kuopio, Finland). The laboratory is in very close proximity of our MRI scanner, making it very easy to combine anatomical MR-images to TMS neuronavigation, and to make offline (in the future also online) fMRI-TMS studies accessible. Professor Synnöve Carlson is the Scientific Director of the TMS laboratory.

AMI Centre maintains the 3T MRI scanner (Siemens Skyra, Siemens Healthcare, Erlangen, Germany), develops the related infrastructure, and offers services to research teams at and outside the Aalto University. AMI Centre aims to provide an innovative environment for development and promotion of new imaging techniques in close collaboration with our users. The technical director of AMI Centre is Staff Scientist, DrTech Toni Auranen.

MEG Core offers excellent environment for magnetoencephalographic (MEG) measurements.

MEG Core has three strong supports, *i.e.*, a modern MEG device, a variety of stimulators and monitoring devices, and magnetically quiet laboratory space. The MEG Core with its low-noise, well-equipped environment is currently one of the world's best laboratories to make MEG research. In addition to his Aalto NeuroImaging directing duties, Docent Veikko Jousmäki acts as the MEG Core Director.

3 Achievements

Aalto NeuroImaging serves as an infrastructure that provides top-level brain imaging facilities for multiple research teams, among them many National Centers of Excellence selected by the Academy of Finland. ANI as such, has limited own research program, and thus the scientific achievements and key performance indicators listed below, containing data collected at one or many parts of ANI, reflect the research interests of all the users of the infrastructure in 2017.

Impact factors for the publication series are shown and the classification of the publications is based on the instructions by the Finnish Ministry of Culture and Education, 2010. The indication **TMS**, **AMI**, or **MEG** after the impact factor and classification mark, denote which resource or equipment was used in the work, respectively.

3.1 Scientific publications in international journals

PUBLISHED (situation in the beginning of January 2017)

1) Alakörkkö T, Saarimäki H, Glerean E, Saramäki J, and Korhonen O: **Effects of spatial smoothing on functional brain networks**. *European Journal of Neuroscience* 2017, 46(9): 2471–2480. (IF 2.941, JuFo: 1, A1, **AMI**)

2) Alexandrou A, Saarinen T, Mäkelä S, Kujala J, and Salmelin R: **The right hemisphere is highlighted in connected natural speech production and perception**. *NeuroImage* 2017, 152: 628–638. (IF 5.835, JuFo: 2, A1, **AMI**, **MEG**)

3) Alluri V, Toiviainen P, Burunat I, Kliuchko M, Vuust P, and Brattico E: **Connectivity patterns during music listening: Evidence for action-based processing in musicians**. *Human Brain Mapping* 2017, 38(6): 2955–2970. (IF 4.530, JuFo: 3, A1, **AMI**)

4) Bacha-Trams M, Glerean E, Dunbar R, Lahnakoski J, Ryyppö E, Sams M, and Jääskeläinen I: **Differential inter-subject correlation of brain activity when kinship is a variable in moral dilemma**. *Scientific Reports* 2017, 7(1): 14244. (IF 4.259, JuFo: 2, A1, **AMI**)

5) Bourguignon M, Piitulainen H, Smeds E, Zhou G, Jousmäki V, and Hari R: **MEG insight into the spectral dynamics underlying steady isometric muscle contraction**. *The Journal of Neuroscience* 2017, 37(43): 10421–10437. (IF 5.988, JuFo: 3, A1, **AMI**, **MEG**)

6) Burunat I, Tsatsishvili V, Brattico E, and Toiviainen P: **Coupling of action-preception brain networks during musical pulse processing: Evidence from region-of-interest-based independent component analysis**. *Frontiers in Human Neuroscience* 2017, 11: 230. (IF 3.209, JuFo: 1, A1, **AMI**)

7) Cattaneo Z, Bona S, and Silvanto J: **Not all visual symmetry is equal: Partially distinct neural bases for vertical and horizontal symmetry**. *Neuropsychologia* 2017, 104: 126–132. (IF 3.197, JuFo: 2, A1, **AMI**)

8) Gogulski J, Zetter R, Nyrhinen M, Pertovaara A, and Carlson S: **Neural substrate for metacognitive accuracy of tactile working memory**. *Cerebral Cortex* 2017, 27(11): 5343–5352. (IF 6.559, JuFo: 3, A1, **AMI**, **TMS**)

9) Hakonen M, May PJ, Jääskeläinen I, Jokinen E, Sams M, and Tiitinen H: **Predictive processing increases intelligibility of acoustically distorted speech: Behavioral and neural correlates**. *Brain and Behavior* 2017, 7(9): e00789. (IF 2.157, JuFo: 1, A1, **AMI**)

10) Halko M-L, Lahti T, Hytönen K, and Jääskeläinen I: **Entrepreneurial and parental love – are they the same?** *Human Brain Mapping* 2017, 38(6): 2923–2938. (IF 4.530, JuFo: 3, A1, **AMI**)

11) Hotta J, Saari J, Koskinen M, Hlushchuk Y, Forss N, and Hari R: **Abnormal brain responses to action observation in complex regional pain syndrome**. *The Journal of Pain* 2017, 18: 255–265. (IF 4.519, JuFo: 1, A1, **AMI**)

12) Hotta J, Zhou G, Harno H, Forss N, and Hari R: **Complex regional pain syndrome: The matter of white matter?** *Brain and Behavior* 2017, 7(5): e00647. (IF 2.157, JuFo: 1, A1, **AMI**)

13) Hämäläinen S, Sairanen V, Leminen A, and Lehtonen M: **Bilingualism modulates the white matter structure of language-related pathways**. *NeuroImage* 2017, 152: 249–257. (IF 5.835, JuFo: 2, A1, **AMI**)

14) Iivanainen J, Stenroos M, and Parkkonen L: **Measuring MEG closer to the brain: performance of on-scalp sensor arrays**. *NeuroImage* 2017, 147: 542–553. (IF 5.835, JuFo: 2, A1, **AMI**).

15) Kallio E-L, Öhman H, Carlson S, Kautiainen H, Hietanen M, and Pitkälä K: **Feasibility and baseline findings of a Finnish cognitive training (FINCOG) intervention in a randomised controlled trial among community-dwelling persons with dementia**. *European Geriatric Medicine* 2017, 8(3): 245–249. (IF 1.336, JuFo: 1, A1, **AMI**)

16) Komulainen E, Glerean E, Meskanen K, Heikkilä R, Nummenmaa L, Raij TT, Lahti J, Jylhä P, Melartin T, Isometsä E, and Ekelund J: **Single dose of mirtazapine modulates whole-brain functional connectivity during emotional narrative processing**. *Psychiatry Research: Neuroimaging* 2017, 263: 61–69. (IF 1.878, JuFo: 1, A1, **AMI**)

17) Koponen L, Nieminen J, Mutanen T, Stenroos M, and Ilmoniemi R: **Coil optimisation for transcranial magneticstimulation in realistic head geometry**. *Brain Stimulation* 2017, 10(4): 795–805. (IF 6.078, JuFo: 2, A1, **AMI**)

18) Laakso I, de Santis V, Cruciani S, Campi T, and Feliziani M: **Modelling of induced electric fields based on incompletely known magnetic fields**. *Physics in Medicine & Biology* 2017, 62(16): 6567–6578. (IF 2.742, JuFo: 1, A1, **AMI**)

19) Lahnakoski J, Jääskeläinen I, Sams M, and Nummenmaa L: **Neural mechanisms for integrating consecutive and interleaved natural events**. *Human Brain Mapping* 2017, 38(7): 3360–3376. (IF 4.530, JuFo: 3, A1, **AMI**)

20) Liu C, Brattico E, Abu-Jamous B, Pereira CS, Jacobsen T, and Nandi AK: **Effect of explicit evaluation on neural connectivity related to listening to unfamiliar music**. *Frontiers in Human Neuroscience* 2017, 11: 611. (IF 3.209, JuFo: 1, A1, **AMI**)

21) Moisala M, Salmela V, Hietajärvi L, Carlson S, Vuontela V, Lonka K, Hakkarainen K, Salmela-Aro K, and Alho K: **Gaming is related to enhanced working memory performance and task-related cortical activity**. *Brain Research* 2017, 1655: 204–215. (IF 2.746, JuFo: 1, A1, **AMI**).

22) Nora A, Karvonen L, Renvall H, Parviainen T, Kim JY, Service E, and Salmelin R: **Children show right-lateralized effects of spoken word-form learning**. *PLoS One* 2017, 12(2): e0171034. (IF 2.806, JuFo: 1, A1, **AMI**, **MEG**)

23) Nummenmaa L, Oksama L, Glerean E, and Hyönä J: **Cortical circuit for binding object identity and location during multiple-object tracking**. *Cerebral Cortex* 2017, 27(1): 162–172. (IF 6.559, JuFo: 3, A1, **AMI**).

24) Orenius T, Raij T, Nuortimo A, Näätänen P, Lipsanen J, and Karlsson H: **The interaction of emotion and pain in the insula and secondary somatosensory cortex**. *Neuroscience* 2017, 349: 185–194. (IF 3.277, JuFo: 1, A1, **AMI**)

25) Parkkonen E, Laaksonen K, Piitulainen H, Pekkola J, Parkkonen L, Tatlisumak T, and Forss N:

Strength of ~20-Hz rebound and motor recovery after stroke. *Neurorehabilitation and Neural Repair* 2017, 31(5): 475–486. (IF 4.107, JuFo: 2, A1, **MEG**)

26) Raij T and Riekki T: **Dorsomedial prefrontal cortex supports spontaneous thinking per se**. *Human Brain Mapping* 2017, 38(6): 3277–3288. (IF 4.530, JuFo: 3, A1, **AMI**)

27) Rikandi E, Pamilo S, Mäntylä T, Suvisaari J, Kieseppä T, Hari R, Seppä M, and Raij TT: **Precuneus functioning differentiates first-episode psychosis patients during the fantasy movie Alice in Wonderland**. *Psychological Medicine* 2017, 47(3): 495–506. (IF 5.230, JuFo: 2, A1, **AMI**)

28) Rinne T, Muers RS, Salo E, Slater H, and Petkov CI: **Functional imaging of audio-visual selective attention in monkeys and humans: How do lapses in monkey performance affect cross-species correspondences?** *Cerebral Cortex* 2017, 27(6): 3471–3484. (IF 6.559, JuFo: 3, A1, **AMI**)

29) Salo E, Salmela V, Salmi J, and Alho K: **Brain activity associated with selective attention, divided attention and distraction**. *Brain Research* 2017, 1664: 25–36. (IF 2.746, JuFo: 1, A1, **AMI**)

30) Salmi J, Koistinen OP, Glerean E, Jylänki P, Vehtari A, Jääskeläinen IP, Mäkelä S, Nummenmaa L, Nummi-Kuisma K, Nummi I, and Sams M: **Distributed neural signatures of natural audiovisual speech and music in the human auditory cortex**. *NeuroImage* 2017, 157: 108–117. (IF 5.835, JuFo: 2, A1, **AMI**)

31) Smeds E, Piitulainen H, Bourguignon M, Jousmäki V, and Hari R: **Effect of interstimulus interval on cortical proprioceptive responses to passive finger movements**. *European Journal of Neuroscience* 2017, 45(2): 290–298. (IF 2.941, JuFo: 1, A1, **MEG**)

32) Smirnov D, Lachat F, Peltola T, Lahnakoski J, Koistinen O-P, Glerean E, Vehtari A, Hari R, Sams M, and Nummenmaa L: **Brain-to-brain hyperclassification reveals action-specific motor mapping of observed actions in humans**. *PLoS ONE* 2017, 12(12): e0189508. (IF 2.806, JuFo: 1, A1, **AMI**)

IN PRESS (situation in the beginning of January 2017)

1) Kliuchko M, Puoliväli T, Heinonen-Guzejev M, Tervaniemi M, Toiviainen P, Sams M, and Brattico E: **Neuroanatomical substrate of noise sensitivity**. *NeuroImage* 2017, Electronic publication ahead of print. (IF 5.835, JuFo: 2, A1, **AMI**)

2) Riekki T, Salmi J, Svedholm-Häkkinen AM, and Lindeman M: **Intuitive physics ability in systemizers relies on differential use of the internalizing system and long-term spatial**

representations. *Neuropsychologia* 2017, Electronic publication ahead of print. (IF 3.197, JuFo: 2, A1, **AMI**)

3) Riekki T, Svedholm-Häkkinen AM, and Lindeman M: **Empathizers and systemizers process social information differently**. *Social Neuroscience* 2017, Electronic publication ahead of print. (IF 2.255, JuFo: 1, A1, **AMI**)

4) Salmela V, Salo E, Salmi J, and Alho K: **Spatiotemporal dynamics of attention networks revealed by representational similarity analysis of EEG and fMRI**. *Cerebral Cortex* 2016, Electronic publication ahead of print. (IF 6.559, JuFo: 3, A1, **AMI**)

3.2 Other scientific publications and influence in meetings and conferences

OTHER PUBLICATIONS

1) Gogulski J, Zetter R, Nyrhinen M, Pertovaara A, and Carlson S: **Aivojen magneettistimulaatio paransi tietoisuutta omista kognitiivisista kyvyistä**. *Duodecim* 2017, 133(24): 2379. (IF 0.12, JuFo: 1, D1, **AMI**, **TMS**)

BOOK CHAPTERS

1) Hari R: **Magnetoencephalography: Methods and Clinical Aspects**. In Niedermeyer's Electroencephalography: Basic Principles, Clinical Applicaions, and Related Fields. Edited by Schmore DL and Lopes da Silva FH. *Oxford University Press*, 2017. (B2, **MEG**)

2) Hari R and Puce A: **MEG–EEG Primer**. *Oxford University Press*, 2017. (C1, **MEG**)

ORAL PRESENTATIONS, INVITED TALKS AND POSTERS

Our users reported in the order of **tens of oral presentations, invited talks and posters in international and national scientific conferences and meetings** that contain data and/or results based on the fMRI/MRI, MEG or TMS data measured at Aalto NeuroImaging infrastructure. The reader is recommended to take into consideration that the achievements in this category are based solely on notifications from our users and the true number is likely considerably higher, yet very difficult to report accurately. Therefore, they are not listed with detailed information.

3.3 Theses

DOCTORAL THESES

1) Kirsi Harinen: **Categorical representations of phonemic vowels investigated with fMRI**. Dissertation for the degree of Doctor of Philosophy, University of Helsinki, Faculty of Arts, Department of Modern Languages, 2017. Supervisors: Professor Emeritus Olli Aaltonen and Doctor Teemu Rinne. (G5, **AMI**)

2) Jaakko Hotta: **Brain in complex regional pain syndrome**. Dissertation for the degree of Doctor of Medical Science, University of Helsinki, Faculty of Medicine, Clinical Neurosciences, Neurology and Aalto University, School of Science, Department of Neuroscience and Biomedical Engineering, 2017. Supervisors: Adjunct Professor Nina Forss and Professor Emerita Riitta Hari. (G5, **AMI**, **MEG**)

3) Lari Koponen: **Implementing advanced transcranial magnetic stimulation technology**. Dissertation for the degree of Doctor of Science in Technology, Aalto University, School of Science, Department of Neuroscience and Biomedical Engineering, 2017. Supervisor: Professor Risto Ilmoniemi, Advisors: Docent Matti Stenroos and Doctor Jaakko Nieminen. (G5, **AMI, TMS**)

4) Satu Massinen: **Specific reading disorder: Cellular and neurodevelopmental functions of suceptibilty genes**. Dissertation for the degree of Doctor of Medical Science, University of Helsinki, Faculty of Medicine, 2017. Supervisor: Professor Juha Kere. (G5, **MEG**)

5) Mona Moisala: **Brain activations related to attention and working memory and their association with technology-mediated activities**. Dissertation for the degree of Doctor of Philosophy, University of Helsinki, Faculty of Medicine, Department of Psychology and Logopedics, 2017. Supervisors: Professor Kimmo Alho and Docent Viljami Salmela. (G5, **AMI**)

6) Emma Salo: **Brain activity during selective and divided attention**. Dissertation for the degree of Doctor of Philosophy, University of Helsinki, Faculty of Medicine, Department of Psychology and Logopedics, 2017. Supervisors: Professor Kimmo Alho and Doctor Teemu Rinne. (G5, **AMI**)

7) Eero Smeds: **Cortical processes related to motor stability and proprioception in human adults and newborns**. Dissertation for the degree of Doctor of Medical Science, University of Helsinki, Faculty of Medicine, Clinical Neurosciences, Neurohysiology and Aalto University, School of Science, Department of Neuroscience and Biomedical Engineering, 2017. Supervisors: Professor Emerita Riitta Hari and Professor Lauri Parkkonen. (G5, **AMI**, **MEG**)

8) Ping Jiang: **Working memory-related brain activity and networks in typically developing children and young adults**. Dissertation for the degree of Doctor of Philosophy, University of Helsinki, Faculty of Medicine, Department of Physiology and Aalto University, School of Science, Department of Neuroscience and Biomedical Engineering, 2017. Supervisors: Professor Synnöve Carlson and Professor Yuanye Ma. (G5, **AMI**)

3.4 Promoting public awareness

Both the staff and users of Aalto NeuroImaging research infrastructure are **actively involved in giving interviews, material for TV and internet spots as well as showcasing the unique research environment to the interested media and visitors**. The reader is recommended to take into consideration that the achievements in this category are often not reported by the promoting parties rendering them very difficult, if not impossible, to be report accurately. Therefore, they are not listed with detailed information.

3.5 Scientific awards and positions of trust

Senior Scientist **Veikko Jousmäki** continued the part-time position as a visiting professor (3-year period starting from Oct 1, 2015) at the Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden as well as the part-time honorary visiting professor position (from March 2016) at the Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore.

3.6 Summary of achievements

This table depicts a summary of the highlights of the achievements presented in this chapter and from previous years since Aalto NeuroImaging started to operate in 2013.

	Refereed papers*	In-press papers*	PhD theses	MSc theses
ANI total 2017	**35**	**4**	**8**	**0**
TMS used in	*2*	*0*	*1*	*0*
AMI used in	*31*	*4*	*7*	*0*
MEG used in	*7*	*0*	*3*	*0*
ANI total 2016	**29**	**9**	**5**	**2**
TMS used in	*0*	*0*	*0*	*0*
AMI used in	*22*	*8*	*3*	*2*
MEG used in	*9*	*1*	*3*	*0*
ANI total 2015	**46**	**10**	**5**	**4**
TMS used in	*2*	*0*	*1*	*0*
AMI used in	*28*	*7*	*4*	*2*
MEG used in	*21*	*3*	*1*	*2*
ANI total 2014	**33**	**7**	**4**	**1**
TMS used in	*0*	*1*	*0*	*0*
AMI used in	*26*	*4*	*4*	*1*
MEG used in	*13*	*2*	*0*	*0*
ANI total 2013	**32**	**13**	**5**	**4**
TMS used in	*0*	*0*	*0*	*1*
AMI used in	*25*	*11*	*5*	*2*
MEG used in	*11*	*4*	*0*	*1*

* Including refereed conference proceedings papers and book chapters

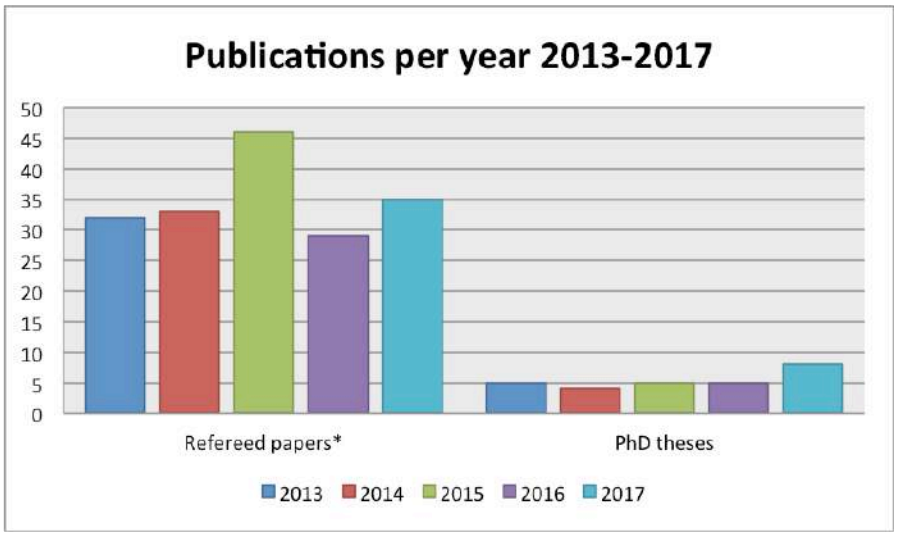

Figure 1 Total number of published achievements (2013–2017) where data gathered at the Aalto NeuroImaging –infrastructure were used.

4 Technical development

While keeping the infrastructure operational and of the highest quality for our users, ANI infrastructure personnel is also actively involved in many technological and methodological development projects that may not result in publications, but stand out as improved services and possibilities for the users to benefit from the infrastructure. Below, some important projects and advances made in 2017 are described. Many of these projects are done in direct collaboration with our users and, therefore, they often interact with academically funded research projects resulting in achievements listed in the previous chapter.

AALTO TMS

Improving of Aalto TMS laboratory's facilities continued in the year 2017. The testing of the concurrent TMS-fMRI system and considerations regarding the safety issues of acoustic noise pressure while operating a TMS coil in the presence of strong external magnetic field (3T MRI) continued while MSc Mikko Nyrhinen started to pursue his PhD at the Department of Neuroscience and Biomedical Engineering. He continues to offer his expertise (part-time) also in 2018 to Aalto TMS in addition to his new duties. In 2018, Aalto TMS aims to continue taking part in novel scientific projects within the department. Users' training will also be held to train and attract new users.

AMI CENTRE

We have been very pleased with the Siemens Skyra scanner since its installation at the end of 2011. In 2017, no major updates to the scanner itself or scanner software were made. The scanner has operated in the software level VD13C. AMI Centre continues to be involved in building a concurrent and consecutive TMS–fMRI measurement setup with Aalto TMS and researchers at the NBE.

Measurements of combined EEG–fMRI, eye-tracking, and acquisition of galvanic skin response and other physiological signals, such as respiration, plethysmography, ECG, and EMG, have been routinely performed throughout the year in AMI Centre. Minor updates were made in 2017 regarding stimulus delivery computers and software. Our staff constantly follows the current trends in fMRI stimulation/response systems and attends roadshows of different manufactures when applicable. Our devices (both custom-made and commercial ones) are always available to all users of AMI Centre.

The project of improving the quality assurance (QA) procedures of AMI Centre has continued in 2017. Our summer worker, Noona Välimaa, made improvements to our routinely used anatomical T1 acquisition protocol and optimized the parameters in order to get the best possible brain segmentations using the FreeSurfer software (https://surfer.nmr.mgh.harvard.edu).

There are plans of bringing the newest advancements with the functional magnetic resonance Inverse Imaging (InI) into full use at AMI Centre in collaboration with Professor Fa-Hsuan Lin from the National Taiwan University. In addition, Professor Lin has secured funding for developing and building a custom-made 48-channel head coil to be used at AMI Centre for undisclosed purposes.

Funding for the latest software/hardware update for the Siemens Skyra (E11C) providing, for instance, the simultaneous multi-slice (SMS) EPI acquisition for significantly improved temporal resolution of BOLD fMRI and faster diffusion-weighted imaging, has been internally secured and the upgrade should take place in 2018. This may prove to be an extremely vital update for our users. Further on in 2018, we continue improving our stimulus systems to meet the demands from our users. We are also seeking sources for funding the 128-channel RF-receiver expansion for the Skyra and a new 64-channel head/neck coil for advanced fMRI purposes.

MEG CORE

MEG Core plans to move to another location in 2019 to avoid possible magnetic artefacts due to *Raidejokeri* tramline expected to start its operation in 2020. The plans are in progress with several options for the location. At the same time, we plan to upgrade our MEG system. The next FIRI call opens in April 2018 and we aim to get the most of the funding for the upgrade from the FIRI call.

The upgrade will take us to the next level in training, teaching, and research. We plan to have the newest technology at the site with zero boil-off rate to reduce helium costs, better dynamic range to facilitate measurement, niobium-shielded MEG sensors to provide easier tuning and maintenance, lower sensor noise, and more additional channels to facilitate more complicated experimental settings.

5 Equipment use and infrastructure funding

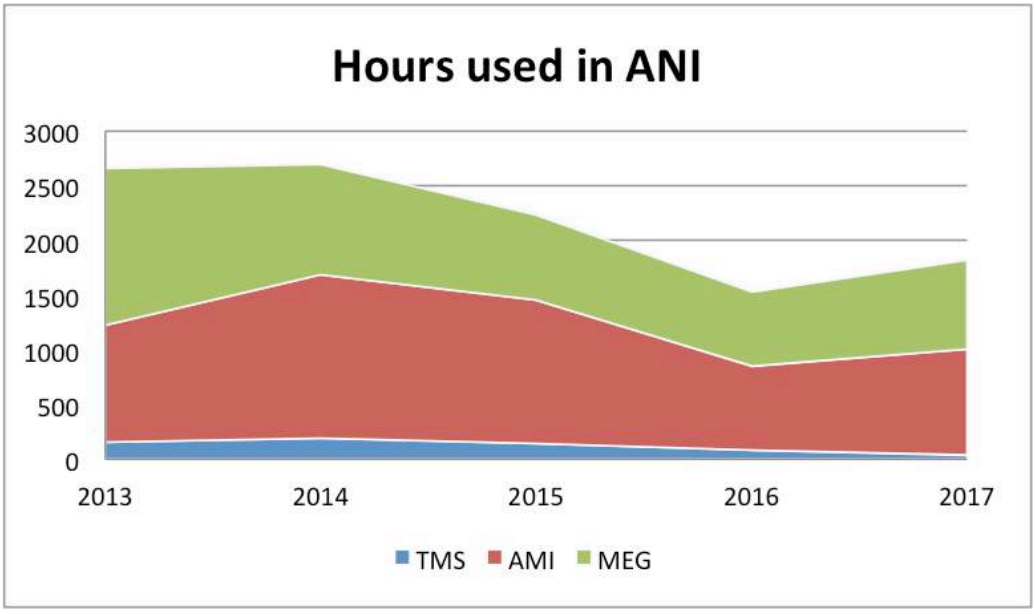

Figure 2 Total number of used hours of the Aalto NeuroImaging –infrastructure during 2013–2017. The numbers do not include service hours, but they include non-invoiced hours for scientific internal development, teaching purposes and similar use.

AALTO TMS

Total number of invoiced hours in 2017 was 4. A total of 18 hours was used to user and safety courses. A total of 18 hours was used to demonstrate the laboratory to various interested parties. In addition, a total of approximately 30 hours were used to technical development and service. In the fifth year of operation, the total number of invoiced hours in Aalto TMS was well below the expected.

	AALTO TMS (hours used)					**2017**
	2013	*2014*	*2015*	*2016*	**2017**	**%**
Users						
NBE (previously BRU)	*118.5*	*98*	-	-	2	5.0
ABC	-	-	*31.5*	*32*	-	-
UH	-	*22.5*	*23*	*2*	2	5.0
Training	*11*	*42*	*54.5*	*18*	18	45.0
Demos, Workshops, Visitors	*28*	*5*	*29*	*31*	18	45.0
Free pilots	-	*22.5*	-	-	-	-
All users total	***157.5***	***190***	***138***	***83***	**40**	**100.0**
Service and technical development	*100*	*50*	*100*	*50*	30	

AMI CENTRE

In 2017, the total number of used hours (not including maintenance and free pilot hours) reached 963 hours (out of which about 72% during prime time). The biggest single user group from Aalto University, was the Department of Neuroscience and Biomedical Engineering (~31% of the total). Aalto Brain Centre continued to support our users (~5% of the total), although somewhat less than during previous years. We were very happy to see the continuous use of our magnet by the groups from University of Helsinki (~36% of the total) comprising again more than half of the total outside use.

After a slightly poorer year in 2016, we are back on track and almost reached the 1000 paid hours mark, designating a budget balance. Radiographer assistance is still very much needed and extremely important part of our operation as many groups measure only during prime time (Mon–Fri, 9–16) when this service is available. We are looking forward to boosting the usage back to well over the 1000 paid hours mark in the years to come.

	AMI CENTRE (hours used)											**2017**
	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	**2017**	**%**
Aalto users												
NBE (BECS)	*98*	*85*	*84*	*108*	*194*	*50*	*231*	*365.75*	*285*	*67.5*	302	31.4
NBE (BRU)	*622*	*339*	*253*	*227*	*335*	*286*	*185*	*178.25*				
ABC	-	-	-	-	-	-	-	-	*163.5*	*97*	48	5.0
aivoAALTO	-	-	*28*	*252*	*115*	*177*	*201*	*125.5*	-	-	-	-
AMI Centre[1]	*85*	*27*	*46*	*56*	*47*	*92*	*39*	*71.5*	*97.5*	*20*	54	5.6
Others[*]	-	-	-	*7*	*53*	*30*	*3*	*10*	*31*	*7*	6	0.6
Aalto total	***805***	***451***	***411***	***650***	***744***	***635***	***659***	***751***	***591.5***	***191.5***	**410**	**42.6**
Outside users												
UH	*126*	*126*	*172*	*268*	*131*	*339*	*286*	*526.5*	*501.5*	*413*	349.5	36.3
HUS and Clinical Research Institute HUCH Ltd.	*10*	*10*	*4*	*4*	*5*	*82*	*60*	*43*	*109.5*	*77*	117	12.1
Other academic[#]	*7*	*24*	*91*	*10*	*63*	*57*	*61*	*174.5*	*116.5*	*87.5*	84.5	8.8
Others (industry etc.)	*20*	*40*	*47*	*35*	*16*	*3*	-	-	-	-	2	0.2
Outside total	***163***	***200***	***314***	***317***	***215***	***481***	***407***	***744***	***727.5***	***577.5***	**553**	**57.4**
All users total	***968***	***651***	***725***	***967***	***959***	***1116***	***1066***	***1495***	**1319**	**769**	**963**	**100.0**
Radiographer	*577*	*410*	*508*	*663*	*553*	*641*	*647*	*744.5*	*819.5*	*553.5*	*630*	
Radiogr. %	*60%*	*63%*	*70%*	*69%*	*58%*	*57%*	*61%*	*50%*	*62%*	*72%*	*65%*	
Service[1, 2]	*214*	*234*	*218*	*212*	*735*[3]	*180*	*185*	*195*	*228*	*175.5*	*217.5*	
Free pilots[1]	-	-	-	*5*	*13*	*6*	*5*	*10.5*	*25*	*26*	*25*	
Cancellations[4]	*~30*	*~20*	*~5*	*~5*	*32*	*55*	*65*	*180.5*	*127.5*	*77*	*106*	

[1] Not invoiced: 1. AMI Centre's technical development projects 2. Service times 3. Complimentary phantom pilots
[2] Includes: GE/Siemens maintenance (prime time only), AMI maintenance, trainings, visits
[3] Including the 3-month downtime for Scanner change (approx. 575 prime time hours)
[4] Late cancellations (not invoiced), 2017 reasons: 1. Subject cancelled (more than 80%; sickness, no-show, other) 2. Other reasons
[*] In 2017: Department of Electrical Engineering and Automation (6 hrs)
[#] In 2017: University of Jyväskylä (73.5 hrs), National Institute for Health and Welfare (THL; 11 hrs)

MEG CORE

The usage of MEG Core was increased in 2017. The total use of MEG Core was 815 hours (excluding service hours and more than 450 prime-time hours that were reserved for nearby construction work in Otaniemi Campus area, otherwise causing vibrational artefacts in the recordings). Aalto Brain Centre (ABC) supported users and Department of Neuroscience and Biomedical Engineering (NBE) were the largest user groups. We were happy to see the increased use of the facility by outside users and we are looking forward of boosting the usage back to the level of over 1000 hours per year.

	MEG Core (hours used)					**2017**
	2013	*2014*	*2015*	*2016*	**2017**	**%**
Users						
NBE	*950*	*488.5*	*468*	*101*	116.5	14.3
ABC	-	-	*24.5*	*55.5*	358	43.9
HUS collaboration	*265*	*24.5*	*12*	-	-	-
Outside visitors*	*19*	*18*	*27.5*	*6*	109	13.4
Elekta (intro training)	*64*	*188.5*	-	*73.5*	-	-
Elekta (service training)	*135*	*29.5*	*125*	*237*	-	-
Elekta (testing)	*n/a*	*n/a*	*n/a*	*40.5*	3.5	0.4
Courses	-	*4*	*5*	*17*	30	3.7
Visitors	-	*54*	*46*	*29.5*	41	5.0
Method development (free)	*n/a*	*n/a*	*n/a*	*55*	107.5	13.2
Free pilots	-	*200*	*73.5*	*58*	49.5	6.1
All users total	***1433***	***1006***	***781.5***	***673***	**815**	**100.0**
Service (helium refills)	*156*	*207*	*158*	*191*	*655*#	

* In 2017: University of Jyväskylä, University of Helsinki, HYKS Oy

\# Including 462 hours of dedicated hours for nearby Otaniemi Campus construction sites (vibration artefacts)

INCOME AND OPERATING COSTS 2017

In 2017, the total income of Aalto NeuroImaging (788 k€) was below the estimated budget. The income came from user fees (346 k€) and other sources, mainly from basic funding (388 k€). The total expenses were 784 k€ (expenses in MEG Core were 296 k€, AMI Centre 396 k€, and Aalto TMS 92 k€) signifying that the budget was in balance (~3 k€ on the positive side).

AMI Centre, performing best of the three separate units, needed 26% of its budget from ANI basic funding (planned 40%), MEG Core needed more support (under 65%) whereas Aalto TMS was fully supported (approximately 99%) by ANI basic funding. Both AMI Centre and MEG Core improved their situation from the last year. Adding to the cumulative surplus/deficit from the previous years, the cumulative sum is currently -345 k€.

6 Safety, teaching, seminars, visitors, and travel

AALTO TMS

Aalto TMS Laboratory's own safety and user course which is a prerequisite for all TMS measurements at Aalto TMS was organized 2 times during 2017 and was attended by a total of 9 participants. Aalto TMS was part of the organizers of the 5th Science Factory: TMS–EEG summer school 2017 held on 4th–9th of September. The most of the event was organized in Solvalla, Espoo, in which the research engineer, MSc Mikko Nyrhinen, also attended.

Aalto TMS was visited by 30 students from Dutch study association (Technical University of Eindhoven) on 2nd of March. Tapiola upper secondary school psychology students (14 people) visited Aalto TMS and AMI Centre on 2nd of March. Optician students (total of 22 people) from Metropolia University of Applied Sciences visited Aalto TMS, AMI Centre, MEG Core and ABL on 5th of May. 15 students from Ressu's upper secondary school visited the infrastructure (including AMI Centre, MEG Core and Aalto TMS) on 24th of May as well as 22 students from Haukilahti's upper secondary school on 14th of September. Also, students (18 people) from Helsinki upper secondary school of natural sciences visited Aalto TMS and AMI Centre in 2017.

Aalto TMS was also visited by 20 students from NBE's course *Structure and Operation of the Human Brain* and Aalto TMS housed a demonstration of navigated TMS on 21st of November for the course *TRANSMED: Imaging in Science and Medicine* organized by University of Helsinki. The demonstration was attended by 7 students. In addition, several informal visits by researchers to Aalto TMS were hosted.

AMI CENTRE

AMI Centre organizes its own MRI safety course, which is a prerequisite for all MRI scanner users at AMI. It was organized 3 times during 2017 and a total of 21 individuals (8 foreigners) passed it (altogether 540 people have passed it since 2002). The knowhow of our experts in fMRI/MRI is delivered to our user groups by arranging demonstrations of new equipment and magnet use when needed.

AMI personnel hosted numerous formal and informal visits by groups or individuals of students, researchers, science reporters, and television crews. The visitors (approximately 150 people) included, but not limited to, groups from Aalto University, University of Helsinki, Technical University of Eindhoven, Metropolia University of Applied Sciences, Laurea University of Applied Sciences as well as several high school student groups. In addition, AMI Centre's facilities were used in the Aalto University's course *Functional Brain Imaging* (NBE-4210; ~24 students), lectured by Professor Lauri Parkkonen of the Department of Neuroscience and Biomedical Engineering (NBE).

During 2017, the AMI Centre's internal safety committee (whose members were Toni Auranen, Veikko Jousmäki, Tuomas Tolvanen, and Raimo Sepponen) had email exchanges and informal discussions in which safety issues and procedures of testing new devices for the MRI environment were evaluated. Additional scientific talks related to AMI activities were included in the laboratory seminars of NBE and Aalto Brain Centre (ABC).

MEG CORE

In 2017, Elekta Neuromag Introductory courses were carried out abroad. We organized a local 2-day training at the MEG Core. MEG Core personnel also hosted formal and informal visits by groups or individuals of students, and researchers.

7 Aalto NeuroImaging personnel

7.1 Aalto TMS, AMI Centre, MEG Core

DIRECTORS

Veikko Jousmäki, ANI & MEG Director, PhD, Visiting Professor, Senior Scientist (**MEG**)

Synnöve Carlson, TMS Scientific Director, MD, PhD, Professor of Practice (**TMS**)

Toni Auranen, AMI Technical Director, DrTech, Staff Scientist (**AMI**)

OTHER PERSONNEL

Mia Illman, MEG Technologist (**MEG**)

Helge Kainulainen, Technician (**MEG**)

Marita Kattelus, Radiographer (**AMI**)

Mikko Nyrhinen, Laboratory Engineer/NBE PhD Student (**TMS**, part-time basis after July 2017)

Jenny Ruokolainen, Comprehensive School Internship (~2 weeks for **ANI**)

Petteri Räisänen, System Administration/Technical Support (~2 days/week for **ANI**)

Veli-Matti Saarinen, Laboratory Engineer, MSc (**ABL**)

Ronny Schreiber, System Administration/Technical Support (~day/week for **ANI** until February 2017)

Tuomas Tolvanen, Laboratory Engineer, MSc (**AMI**, **MEG**)

Noona Välimaa, Summer Student (2.5 months for **AMI**)

7.2 Users and collaborators of ANI (n = 203)

The persons listed below are either, *authors* in scientific publications and theses where Aalto NeuroImaging is indicated in the byline or where data measured at any part of ANI (Aalto **TMS**, **AMI** Centre, **MEG** Core) were used in 2017 (previous years in parentheses), and/or they are members of research teams collecting data or carrying out research on data collected at ANI; the latter names have been collected from the active research permissions as well as project information and user notifications delivered to ANI in 2017. Also the employees of ANI who are performing measurements are listed here.

The total number of users and collaborators of the Aalto NeuroImaging infrastructure in 2017 (2016, 2015, 2014, 2013) adds up to 203 (208, 212, 214, 220) individual researchers [41 (48, 43, 61, 65) foreigners, 135 (139, 155, 126, 112) individual authors] with AMI Centre affiliating to 190 (180, 172, 174, 189), MEG Core to 50 (57, 67, 76, 51), and Aalto TMS to 6 (4, 12, 10, 5) of them. Out of the total, 90 (98, 113, 112, 113) were affiliated with Aalto University, 78 (64, 52, 45, 51) with University of Helsinki and 28 (26, 20, 20, 10) with HUS/HUCH, some with double or triple affiliations.

Abbreviations: *AU = Aalto University*
UH = University of Helsinki
HUS = Hospital District of Helsinki and Uusimaa
HUCH = Helsinki University Central Hospital

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8 APPENDIX: Aalto Behavioral Laboratory (ABL)

8.1 Introduction

Aalto Behavioral Laboratory (ABL) was established on summer 2015 on the old premises of Behavioral Imaging Laboratory (BIL). For a year and a half ABL has been constantly improved to its current state, while the laboratory has been in full operation.

Laboratory is meant for behavioral measurements; it offers two measurement rooms and versatile devices for subject monitoring, such as EEG, eye tracking, thermal imaging, EMG, EDA, ECG, and accelerometry. Electroencephalography (EEG) measurements are conducted in electrically shielded room where the equipment consists of Brain Products devices, including a 32-ch BrainAmp amplifiers and actiCAP EEG-caps. For eyetracking there are a remote EyeLink 1000 plus (SR-Research Ltd.) eye tracker with a chin rest, which enables recording eye movements up to 2000Hz; and two head mounted Eye Tracking Glasses (SensoMotoric Instruments GmbH) which are for remote measurements. For autonomic responses laboratory has a data logger (ME6000, Mega Electronics Ltd) which can record signals like EMG, EDA and ECG.

For subject monitoring purposes surveillance cameras and voice intercom system are installed in the rooms. The laboratory has systems for visual and audio stimuli, including headphones, earphones, speakers and display monitors. Our stimulus system also includes a thermal stimulator (MSA Thermotest, Somedic SenseLab AB).

8.2 Location, facilities, organization, and mission

ABL offers variety of different stimulus and monitoring devices for versatile experimental setups for one or more subjects at a time. ABL consists of two measurement rooms and a control area. It is located in the 4th floor of the Magnet Building, in the immediate proximity of both AMI Centre and Aalto TMS.

During 2017, ABL was operating under NBE directly. In December 2017, by the decision of the Dean of Aalto University School of Science, ABL was included in Aalto NeuroImaging infrastructure in. Research Engineer, MSc Veli-Matti Saarinen, has been managing the laboratory with the guidance of Aalto NeuroImaging director Veikko Jousmäki. Until the end of 2016 the measuring has been free of charge, but hourly fees were introduced in the beginning of 2017.

8.3 Achievements

SCIENTIFIC PUBLICATIONS IN PRESS

1) Kakouros S, Salminen N, and Räsänen O: **Making predictable unpredictable with style – Behavioral and electrophysiological evidence for the critical role of prosodic expectations in the perception of prominence in speech**. *Neuropsychologia* 2017, Electronic publication ahead of print. (IF 3.197, JuFo: 2, A1, **ABL**)

DOCTORAL THESES

1) Sofoklis Kakouros: **Cognitive and probabilistic basis of prominence perception in speech**. Dissertation for the degree of Doctor of Science in Technology, Aalto University, School of Electrical

Engineering, Department of Signal Processing and Acoustics. Supervisors: Professor Emeritus Unto Laine and Academy Professor Paavo Alku. Advisor Doctor Okko Räsänen. (G5, **ABL**)

MASTERS THESES

1) Irina Jelistratova: **Eye movements during judgements of relative distance and size from images of indoor spaces**. Master's thesis for the degree of Master of Science, Aalto University School of Science. Supervisor: Professor Lauri Parkkonen Advisor: Doctor Linda Henriksson. (G2, **ABL**)

8.4 Technical development

ABL is continuously developed to serve our users with easy measurements. EEG systems were updated: control boxes were upgraded, new actiCAP electrode set and several caps with different sizes were purchased. These improvements enable to measure subjects with various head sizes and more subjects in a row. Thermal Stimulator (MSA Thermal Stimulator, Somedic SenseLab AB), which can produce hot and cold stimuli, was installed in ABL. In addition, forehead rest for stabilizing head was adjusted to fit all subjects. Attachment adapters for the aluminum profile system in the measurement rooms were added.

ANItime (http://anitime.aalto.fi), Aalto NeuroImaging reservation calendar system continued to serve ABL. With ANItime, you can reserve both rooms and loanable devices separately.

8.5 Equipment use and infrastructure funding

In 2017, there were 279 hours of charged measurements in ABL, including both rooms and all loanable devices. The biggest single user was NBE/Aalto (170.5 hours). During 2016, all measurements were free of charge whereas in 2017 all measurements were subject to charge for the first time. Assistance was needed in 35% of measurements, signifying its importance, mainly in the DC-room measurements.

	ABL (hours used in 2017)					**2017**	**2016**
	AC	DC	ETG1	ETG2	IR	**Total**	**Total**
Users							
NBE/Aalto	67	84.5	9.5	9.5	-	**170.5**	**283.5**
Others (Aalto)	-	10.5	-	-	-	**10.5**	**55.5**
Other	29	34.5	34.5	-	-	**98**	**38**
All users total	96	129.5	44	9.5	-	**279**	**453**
Piloting and service times	*43.5*	*76.5*	*29.5*	*20*	-	*169.5*	*321*

AC = normal room
DC = shielded room
ETG1 = Eye Tracking Glasses 1
ETG2 = Eye Tracking Glasses 2
IR = Thermal Camera

8.6 Safety, teaching, seminars, visitors, and travel

There were several groups from different educational levels visiting ABL, including Universities (in and outside Aalto), Universities for Applied Sciences and high schools. There were a total of 217 persons in 12 groups visiting ABL. ABL started its first user training courses in June 2017. There were also other hands-on sessions organized on demand.

Life Science and Technologies (JOIN-E3000) course measurements were held in ABL. Course included 20 measurement sessions in total, with EEG and eyetracker. In total 20 students were attending in two groups. One student group from project course *Biologisten ilmiöiden mittaaminen* (ELEC-A8720), lectured by Professor Markus Turunen, was measuring EEG data at ABL. Course *Structure and Operation of the Human brain* (NBE-E4210; Professor Risto Ilmoniemi) was having demonstration EEG measurements at ABL. In addition, student course *Functional Brain Imaging* (NBE-4210), lecturer Professor Lauri Parkkonen, used ABL as preparation environment for their MEG and fMRI projects.

8.7 Users and collaborators of ABL (n = 26)

The persons listed below are either, authors in scientific publications and theses where Aalto Behavioral Laboratory is indicated in the byline or where data measured at ABL were used in 2017 and/or they are members of research teams collecting data or carrying out research on data collected at ABL in 2017. Also the employees of ABL and ANI who are performing measurements are listed here. The total number of users and collaborators of the Aalto Behavioral Laboratory in 2017 is 26.

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