ANNUAL REPORT OF

AALTO NEUROIMAGING

AALTO UNIVERSITY SCHOOL OF SCIENCE

2018

Composed by personnel of Aalto NeuroImaging

Edited by Toni Auranen

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Director's executive summary

Another year has passed at Aalto NeuroImaging with some positive and negative news. Positive news are related to the positions at Aalto NeuroImaging. Veli-Matti Saarinen and Tuomas Tolvanen have now fixed positions at Aalto NeuroImaging. Congratulations Veli-Matti and Tuomas – it was a long process which finally was accepted at Aalto University. Another positive news is the quality and variety of published papers based on data obtained at Aalto NeuroImaging. 34 publications and 6 PhD theses is an amazing number taking into account the number of researchers in the field.

Negative news is that we haven't been able to increase the usage of Aalto NeuroImaging facilities. As a result, 2018 was financially negative. To my mind, there are two main reasons. The most important one are the pending professorships. It is really amazing that it takes more than a year to fulfill a professorship and in some cases it takes even longer. These processes seem to have several weaknesses and failures due to several reasons. The second reason is that our department does not seem to have a clear strategy about the nearby nor faraway future. Thus any long-term plan to develop functional neuroimaging at Aalto NeuroImaging is rather difficult.

Our 7T fMRI project, proposed originally three years ago, is in hold phase still. There have been some discussions about it but we would really need a clear sign and full support from our Department and School to reignite the project.

In 2018, Aalto NeuroImaging received 50% of the budget from Aalto University School of Science. The support was mainly used to reduce the user fees within NEUROIMAGING infrastructure users. Such a financial support is crucial for the functional neuroimaging 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 contributed financially ANI measurements in 2018. Here, 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 very useful comments and suggestions to improve our infrastructure.

In 2019, we will introduce top-of-the-art, high-speed 3D projectors at AMI Centre and MEG Core. The School of Science will fund 50% of the investment. We will also apply FIRI2019 funding from the Academy of Finland for the MEG system upgrade. We did apply MEG system upgrade from FIRI2018 call but failed in it. 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* (fast tramline) will cause more disturbances in the present MEG Core and, thus, it is time to find another location for the new MEG Core.

Finally, I would like to express my gratitude to our staff and users. Aalto NeuroImaging has survived 6 years in turmoil. Your efforts and contributions have been crucial for our infrastructure.

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 Aalto Behavioral Laboratory (ABL) and 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 and ABL (launch phase in 2015–2017) became officially part of ANI from the beginning of 2018. 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 two meetings in 2018; the appointed chairman of the Steering Board for the three-year period (2017–2019) is Dean Jouko Lampinen and the secretary in 2018 was DrTech Toni Auranen. 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.

1.1 Aalto Behavioral Laboratory

Aalto Behavioral Laboratory (ABL; http://www.aalto.fi/services/aalto-behavioral-laboratory) was established on summer 2015 on the old premises of Behavioral Imaging Laboratory (BIL). Since then, ABL has been constantly improved to its current state, while being in full operation.

Laboratory is designed 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).

1.2 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.

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.

1.3 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 just over 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 parallel transmission for MRI and fMRI, and since 2018, Simultaneous Multi-Slice (SMS) capabilities for fMRI and diffusion tensor imaging (DTI) studies. 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.

1.4 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. AMI Centre, Aalto Behavioral Laboratory and Aalto TMS are located in the Magnet Building (Otakaari 5 I, Espoo, Finland), AMI occupying 350 m^2 in floors 1–3, ABL and TMS both 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. Western Metro Extension has improved the site access for both researchers and volunteers for studies. All four 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.

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, in the immediate proximity of both AMI Centre and Aalto TMS. In December 2017, by the decision of the Dean of Aalto University School of Science, ABL was included in Aalto NeuroImaging infrastructure. Research Engineer, MSc Veli-Matti Saarinen, has been managing the laboratory with the guidance of ANI Director Veikko Jousmäki.

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 whereas MSc Mikko Nyrhinen takes care of the practicalities and development of the 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 2018.

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 **ABL**, **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 2019)

1) Aleandrou A, Saarinen T, Kujala J, and Salmelin R: **Cortical tracking of global and local variations of speech rhythm during connected natural speech perception**. *Journal of Cognitive Neuroscience* 2018, 30(11): 1704–1719. (IF 3.468, JuFo: 2, A1, **MEG**)

2) Bacha-Trams M, Alexandrov Y, Broman E, Glerean E, Kauppila M, Kauttonen J, Ryyppö E, Sams M, and Jääskeläinen I: **A drama movie activates brains of holistic and analytical thinkers differentially**. *Social Cognitive and Affective Neuroscience* 2018, 13(12): 1293–1304. (IF 3.500, JuFo: 2, A1, **AMI**)

3) Gotsopoulos A, Saarimäki H, Glerean E, Jääskeläinen IP, Sams M, Nummenmaa L, and Lampinen J: **Reproducibility of importance extraction methods in neural network based fMRI classification**. *NeuroImage* 2018, 181: 44–54. (IF 5.426, JuFo: 2, A1, **AMI**)

4) Green B, Jääskeläinen I, Sams M, and Rauschecker J: **Distinct brain areas process novel and repeating tone sequences**. *Brain and Language* 2018, 187: 104–114. (IF 2.851, JuFo: 2, A1, **AMI**)

5) Hakala T, Hultén A, Lehtonen M, Lagus K, and Salmelin R: **Information properties of morphologically complex words predict brain activity during reading**. *Human Brain Mapping* 2018, 39(6): 2583–2595. (IF 4.927, JuFo: 2, A1, **AMI**, **MEG**)

6) Halme H-L and Parkkonen L: **Across-subject offline decoding of motor imagery from MEG and EEG**. *Scientific Reports* 2018, 8: 10087. (IF 4.122, JuFo: 1, A1, **MEG**)

7) Häkkinen S and Rinne R: **Intrinsic, stimulus-driven and task-dependent connectivity in human**

auditory cortex. *Brain Structure and Function* 2018, 223: 2113–2127. (IF 4.231, JuFo: 1, A1, **AMI**)

8) Jiang P, Vuontela V, Tokariev M, Lin H, Aronen ET, Ma Y-Y, and Carlson S: **Functional connectivity of intrinsic cognitive networks during resting state and task performance in preadolescent children**. *PLoS ONE* 2018, 13(10): e0205690, DOI: 10.1371/journal.pone.0205690. (IF 2.766, JuFo: 1, A1, **AMI**)

9) 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* 2018, 109: 181–199. (IF 2.888, JuFo: 2, A1, **ABL**)

10) Kaltiainen H, Helle L, Liljeström M, Renvall H, and Forss N: **Theta-band oscillations as an indicator of mild traumatic brain injury**. *Brain Topography* 2018, 31(6): 1037–1046. (IF 2.703, JuFo: 1, A1, **MEG**)

11) Kauttonen J, Hlushchuk Y, Jääskeläinen I, and Tikka P: **Brain mechanisms underlying cue-based memorizing during free viewing of movie Memento**. *NeuroImage* 2018, 172: 313–325. (IF 5.426, JuFo: 2, A1, **AMI**)

12) Kliuchko M, Puoliväli T, Heinonen-Guzejev M, Tervaniemi M, Toiviainen P, Sams M, and Brattico E: **Neuroanatomical substrate of noise sensitivity**. *NeuroImage* 2018, 167: 309–315. (IF 5.426, JuFo: 2, A1, **AMI**)

13) Komulainen E, Heikkilä R, Nummenmaa L, Raij T, Harmer C, Isometsä E, and Ekelund J: **Short-term escitalopram treatment normalizes aberrant self-referential processing in major depressive disorder**. *Journal of Affective Disorders* 2018, 236: 222–229. (IF 3.786, JuFo: 1, A1, **AMI**)

14) Korhonen O, Saarimäki H, Glerean E, Sams M, and Saramäki J: **Consistency of Regions of Interest as nodes of fMRI functional brain networks**. *Network Neuroscience* 2017 (paper not reported in last year's annual report), 1(3): 254–274. (IF n/a, JuFo: 1, A1, **AMI**)

15) Lankinen K, Saari J, Hlushchuk Y, Tikka P, Hari R, and Koskinen M: **Consistency and similarity of MEG- and fMRI-signal time-courses during movie viewing**. *NeuroImage* 2018, 173: 361–369. (IF 5.426, JuFo: 2, A1, **AMI**, **MEG**)

16) Liljeström M, Vartiainen J, Kujala J, and Salmelin R: **Large-scale functional networks connect differently for processing words and symbol strings**. *PLoS ONE* 2018, 13(5): e0196773. (IF 2.766,

JuFo: 1, A1, **AMI**, **MEG**)

17) Moisala M, Salmela V, Carlson S, Salmela-Aro K, Lonka K, Hakkarainen K, and Alho K: **Neural activity patterns between different executive tasks are more similar in adulthood than in adolescence**. *Brain and Behavior* 2018, 8(9): e01063. (IF 2.219, JuFo: 1, A1, **AMI**)

18) Mäkelä N, Stenroos M, Sarvas J, and Ilmoniemi RJ: **Truncated RAP-MUSIC (TRAP-MUSIC) for MEG and EEG source localization**. *NeuroImage* 2018, 167: 73–83. (IF 5.426, JuFo: 2, A1, **MEG**)

19) Mäntylä T, Nummenmaa L, Rikandi E, Lindgren M, Kieseppä T, Hari R, Suvisaari J, and Raij T: **Aberrant cortical integration in first-episode psychosis during natural audiovisual processing**. *Biological Psychiatry* 2018, 84(9): 655–664. (IF 11.982, JuFo: 3, A1, **AMI**)

20) Nurmi T, Henriksson L, and Piitulainen H: **Optimization of proprioceptive stimulation frequency and movement range for fMRI**. *Frontiers in Human Neuroscience* 2018, 12: 477, DOI: 10.3389/fnhum.2018.00477. (IF 2.871, JuFo: 1, A1, **AMI**)

21) Parkkonen E, Laaksonen K, Parkkonen L, and Forss N: **Recovery of the 20 Hz rebound to tactile and proprioceptive stimulation after stroke**. *Neural Plasticity* 2018, 7395798, doi.org/10.1155/2018/7395798. (IF 3.161, JuFo: 1, A1, **MEG**)

22) Piitulainen H, Illman M, Laaksonen K, Jousmäki V, and Forss N: **Reproducibility of corticokinematic coherence**. *NeuroImage* 2018, 179: 596–603. (IF 5.426, JuFo: 2, A1, **MEG**)

23) Raij T, Riekki T, Rikandi E, Mäntylä T, Kieseppä T, and Suvisaari J: **Activation of the motivation-related ventral striatum during delusional experience**. *Translational Psychiatry* 2018, 8: 283. (IF 4.691, JuFo: 1, A1, **AMI**)

24) 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* 2018, 109: 10–18. (IF 2.888, JuFo: 2, A1, **AMI**)

25) Riekki T, Svedholm-Häkkinen AM, and Lindeman M: **Empathizers and systemizers process social information differently**. *Social Neuroscience* 2018, 13(5): 616–627. (IF 2.575, JuFo: 1, A1, **AMI**)

26) Rikandi E, Mäntylä T, Lindgren M, Kieseppä T, Suvisaari J, and Raij T: **Connectivity of the**

precuneus-posterior cingulate cortex with the anterior cingulate cortex-medial prefrontal cortex differs consistently between control subjects and first-episode psychosis patients during a movie stimulus. *Schizophrenia Research* 2018, 199: 235–242. (IF 3.958, JuFo: 2, A1, **AMI**)

27) Saari P, Burunat I, Brattico E, and Toiviainen P: **Decoding musical training from dynamic processing of musical features in the brain**. *Scientific Reports* 2018, 8(1): 708, DOI: 10.1038/s41598-018-19177-5. (IF 4.122, JuFo: 1, A1, **AMI**)

28) Saarimäki H, Ejtehadian LF, Glerean E, Jääskeläinen I, Vuilleumier P, Sams M, and Nummenmaa L: **Distributed affective space represents multiple emotion categories across the human brain**. *Social Cognitive and Affective Neuroscience* 2018, 13(5): 471–482. (IF 3.500, JuFo: 2, A1, **AMI**)

29) 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* 2018, 28(2): 549–560. (IF 6.308, JuFo: 3, A1, **AMI**)

30) Salmi J, Salmela V, Salo E, Mikkola K, Leppämäki S, Tani P, Hokkanen L, Laasonen M, Numminen J, and Alho K: **Out of focus – Brain attention control deficits in adult ADHD**. *Brain Research* 2018, 1692: 12–22. (IF 3.125, JuFo: 1, A1, **ABL**, **AMI**)

31) Salminen NH, Jones SJ, Christianson GB, Marquardt T, and McAlpine D: **A common periodic representation of interaural time differences in mammalian cortex**. *NeuroImage* 2018, 167: 95–103. (IF 5.426, JuFo: 2, A1, **MEG**)

32) Tikka P, Kauttonen J, and Hlushchuk Y: **Narrative comprehension beyond language: Common brain networks activated by a movie and its script**. *PLoS ONE* 2018, 13(7): e0200134. (IF 2.766, JuFo: 1, A1, **AMI**)

33) Zetter R, Iivanainen J, Stenroos M and Parkkonen L: **Requirements for coregistration accuracy in on-scalp MEG**. *Brain Topography* 2018, 31(6): 931–948. (IF 2.703, JuFo: 1, A1, **MEG**)

34) Zubarev I and Parkkonen L: **Evidence for a general performance-monitoring system in the human brain**. *Human Brain Mapping* 2018, 39(11): 4322–4333. (IF 4.927, JuFo: 2, A1, **MEG**)

IN PRESS (situation in the beginning of January 2019)

1) Alexandrou A, Saarinen T, Kujala J, and Salmelin R: **Cortical entrainment: what we can learn from studying naturalistic speech perception**. *Language, Cognition and Neuroscience* 2018,

Electronic publication ahead of print. (IF n/a, JuFo: 1, A1, **MEG**)

2) Leppäaho E, Renvall H, Salmela E, Kere J, Salmelin R, and Kaski S: **Discovering modes of MEG spectral power with genetic associations**. *Human Brain Mapping* 2018, Electronic publication ahead of print. (IF 4.927, JuFo: 2, A1, **MEG**)

3) Ruotsalainen I, Renvall V, Gorbach T, Syväoja HJ, Tammelin TH, Karvanen J, and Parviainen T: **Aerobic fitness, but not physical activity, is associated with grey matter volume in adolescents**. *Behavioural Brain Research* 2018, Electronic publication ahead of print. (IF 3.173, JuFo: 1, A1, **AMI**)

4) Wikman P and Rinne T: **Interaction of the effects associated with auditory-motor integration and attention-engaging listening tasks**. *Neuropsychologia* 2018, Electronic publication ahead of print. (IF 2.888, JuFo: 2, A1, **AMI**)

PUBLIC / UNDER REVIEW (situation in the beginning of January 2019)

5) Hultén A, van Vliet M, Lammi L, Kivisaari S, Lindh-Knuutila T, Faisal A, and Salmelin R: **Cracking the problem of neural representations of abstract words: grounding word meanings in language itself**. *bioRxiv* 2018, DOI: 10.1101/391052. Under review. (IF n/a, JuFo: n/a, A1, **AMI**, **MEG**)

6) Kivisaari S, van Vliet M, Hultén A, Lindh-Knuutila T, Faisal A, and Salmelin R: **Reconstructing meaning from bits of information**. *bioRxiv* 2018, DOI: 10.1101/ 401380. Under review. (IF n/a, JuFo: n/a, A1, **AMI**)

3.2 Other scientific publications and influence in meetings and conferences

ORAL PRESENTATIONS, INVITED TALKS AND POSTERS

Our users produce 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 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) Anna Alexandrou: **Neurophysiological correlates of producing and perceiving natural connected speech**. Dissertation for the degree of Doctor of Science (Technology), Aalto University School of Science, Department of Neuroscience and Biomedical Engineering, 2018. Supervisor: Professor Riitta Salmelin. (G5, **AMI**, **MEG**)

2) Juha Gogulski: **Prefrontal control of the tactile sense**. 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, 2018. Supervisors: Professor Synnöve Carlson (University of Helsinki and Aalto University) and Professor Antti Pertovaara (University of Helsinki) . (G5, **TMS**, **AMI**)

3) Suvi Häkkinen: **Functional organization of human auditory cortex during active auditory tasks**. Dissertation for the degree of Doctor of Philosophy, University of Helsinki, Faculty of Medicine, Department of Psychology and Logopedics, 2018. Supervisors: Dr. Teemu Rinne (University of Turku) and Associate Professor Christopher Stecker (Vanderbilt University, TN, USA). (G5, **AMI**)

4) Kaisu Lankinen: **Dynamics of cortical brain activity during movie viewing**. Dissertation for the degree of Doctor of Science (Technology), Aalto University School of Science, Department of Neuroscience and Biomedical Engineering, 2018. Supervisor: Professor Lauri Parkkonen. (G5, **AMI**, **MEG**)

5) Eemeli Leppäaho: **Bayesian multi-view factor models for drug response and brain imaging studies**. Dissertation for the degree of Doctor of Science (Technology), Aalto University School of Science, Department of Computer Science, 2018. Supervisor: Professor Samuel Kaski. (G5, **MEG**)

6) Niko Mäkelä: **Locating functional brain areas with magnetic stimulation and electrophysiological neuroimaging**. Dissertation for the degree of Doctor of Science (Technology), Aalto University School of Science, Department of Neuroscience and Biomedical Engineering, 2018. Supervisor: Professor Risto Ilmoniemi. (G5, **MEG**)

7) Juulia Suvilehto: **Maintaining social bonds via touching: A cross-cultural study**. Dissertation for the degree of Doctor of Science (Technology), Aalto University School of Science, Department of Neuroscience and Biomedical Engineering, 2018. Supervisor: Professor Mikko Sams. (G5, **AMI**)

MASTERS THESES

1) Minea Jokivuolle: **Including head movement in magnetoencephalographic source estimation**. Master's thesis for the degree of Master of Science, Aalto University School of Science. Supervisor: Dr. Matti Stenroos. (G2, **MEG**)

2) Mirva Kallio: **Activity in somatosensory cortices during stroke recovery**. Master's thesis for the degree of Master of Science, Aalto University School of Science. Supervisor: Professor Lauri Parkkonen. (G2, **MEG**)

3) Mostafa Metwaly: **Intersubject correlation of brain activity in ADHD participants at the "cocktail party" environment**. Master's thesis for the degree of Master of Arts, University of Helsinki. Supervisor: Professor Juha Voipio (G2, **AMI**)

4) Peter Palo-oja: **Exploring white matter structural anomalies underlying dyslexia – A diffusion tensor imaging study**. Master's thesis for the degree of Master of Arts, University of Helsinki. Supervisor: Professor Teija Kujala. (G2, **AMI**)

5) Manu Sutela: **Measuring the integration of sensorimotor information during hand movement**. Master's thesis for the degree of Master of Science, Aalto University School of Science. Supervisor: Professor Lauri Parkkonen. (G2, **MEG**)

6) Anna Äimälä: **Similarity of word associations studied with latent semantic analysis to reveal intergroup social bias**. Master's thesis for the degree of Master of Science, Aalto University School of Science. Supervisor: Professor Iiro Jääskeläinen. (G2, **ABL**)

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 reported 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 detailed summary of the publications 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 2018	**34**	**6**	**7**	**6**
ABL used in	*2*	*0*	*0*	*1*
TMS used in	*0*	*0*	*1*	*0*
AMI used in	*24*	*4*	*5*	*2*
MEG used in	*12*	*3*	*4*	*3*
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. 'In-press' includes also publicly submitted under-review manuscripts (such as ones in *bioRxiv*).

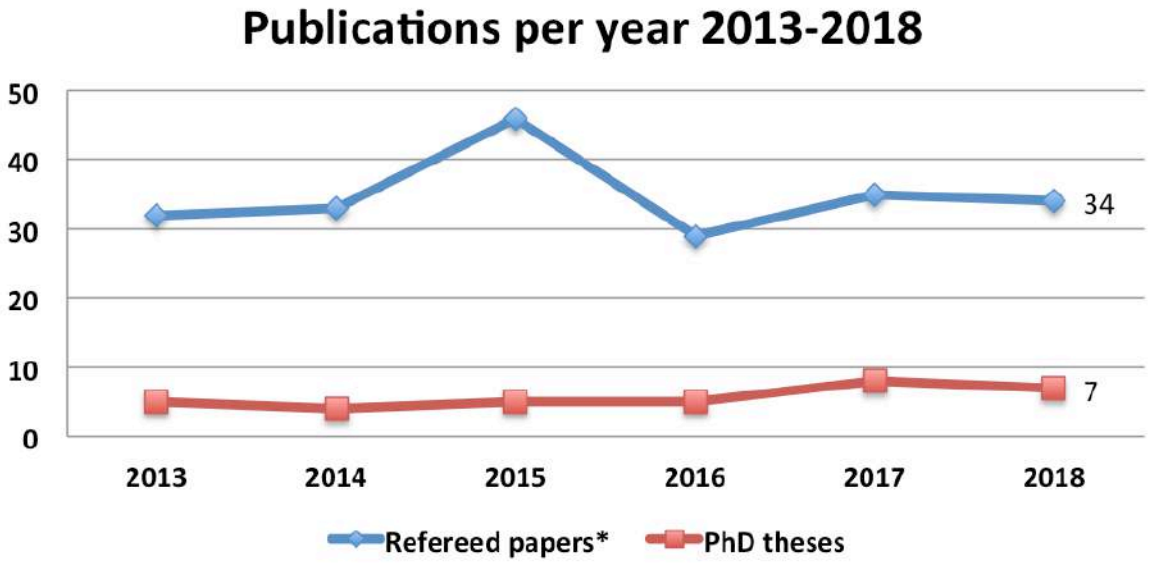

Figure 1 Total number of publications and doctoral theses (2013–2018) where data gathered at the Aalto NeuroImaging –infrastructure were used. *Including refereed conference proceedings papers and book chapters

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, we describe some key projects and advances made in 2018. Many of these projects are direct collaboration with our users and, therefore, they often interact with academically funded research projects resulting in achievements listed in the previous chapter.

AALTO BEHAVIORAL LABORATORY

ABL is continuously developed to serve our users with easy measurements. EEG system now includes option for passive electrodes, which enables extra EOG channels. Thermal camera can now be synchronized with the stimulus system; synchronization is based on custom-made trigger cable. Video triggering has also been developed further.

AALTO TMS

Improving of Aalto TMS laboratory's facilities continued in the year 2018. Aalto TMS operates closely with other ANI units and NBE researchers in developing novel equipment setups that aim to enable consecutive and concurrent TMS and functional magnetic resonance imaging (fMRI), for example. Aalto TMS aims to continue taking part in novel scientific projects within the department.

AMI CENTRE

In 2018, one major update to the scanner was purchased. This included both hardware updates (high-end reconstruction computer and console computer upgrade) and software updates (from VD13C to VE11C) in August. Most importantly, we now have Simultaneous Multi-Slice (SMS) EPI, which enables accelerated imaging for diffusion-weighted (DWI/DTI) and BOLD fMRI imaging. The imaging time can be drastically reduced and/or images can be acquired with higher spatial resolution.

Our summer worker, Emi Iizuka, worked on a project where she will create a manual to our new users for pinpointing the potential pitfalls in conducting an fMRI study. This will help the new users to start their studies smoothly at AMI Centre. After the summer, Emi continued working on her Master's Thesis in a project where standard EPI imaging is compared to different combinations of SMS EPI imaging. This will provide vital first-hand insight to us and our users in using SMS EPI.

The development and building of a custom-made 48-channel head coil to be used at AMI Centre for undisclosed purposes (Professor Fa-Hsuan Lin's funding) has unfortunately been delayed due to various reasons. However, in addition to using the Inverse Imaging (InI) at AMI Centre (in collaboration with Professor Fa-Hsuan Lin from the National Taiwan University) there are definitive plans to add MREG (Magnetic Resonance Encephalography; developed by Dr. Pierre LeVan from University Medical Center Freiburg, Germany) to our repertoire of methods in collaboration with Professor Lauri Parkkonen from NBE and Associate Professor Vesa Kiviniemi from University of Oulu and Oulu University Hospital. This will further shift our focus towards fast fMRI imaging methods.

Measurements of combined EEG–fMRI, eye-tracking, and other physiological signals can routinely be performed in AMI Centre. 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.

Further on in 2019, 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

We have continued the collaboration with MEGIN, previously known as Elekta Oy, to train MEG users and develop new products for MEG. In 2018, we organized one MEG Introductory Course at MEG Core and contributed to projects dealing with audio hearing threshold system (Crimson 3) and e-Prime software. Both projects were carried out mainly by Tuomas Tolvanen. We also developed intermittent photic stimulator for MEG further, presented the ideas behind it at Business Finland pitching, filed an invention disclosure and provisional application on the technology.

MEG Core is still trying to find another, magnetically more silent locations to avoid magnetic artefacts due to continuous construction work close to the present location and *Raidejokeri* tramline expected to start its operation in 2024. The FIRI2018 plan for the system upgrade was not successful and now we aim at FIRI2019.

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.

DESIGNING NEW STIMULATORS AND MONITORING DEVICES

Throughout its operation, members of the Aalto NeuroImaging infrastructure and its predecessors have taken part in developing new stimulators and monitoring devices to be used in neuroscience and behavioral studies. The preliminary work is often done in collaboration and does not produce data or papers directly affiliated with ANI, although many ideas are conceived and further boosted by ANI personnel. The achievements affiliated to such development work are listed here. In addition to publications, there is a provisional application "A DEVICE AND METHOD FOR VISUAL STIMULATION" based on IPID1976/Veikko Jousmäki at Aalto University June 14th, 2018.

1) Marty B, Bourguignon M, Jousmäki V, Wens V, Goldman S, and de Tiège X: **Movement kinematics dynamically modulates the rolandic ~20-Hz rhythm during goal-directed executed and observed hand actions**. *Brain Topography* 2018, 31(4): 566–576.

2) Marty B, Wens V, Bourguignon M, Naeije G, Goldman S, Jousmäki V, and de Tiège X: **Neuromagnetic cerebellar activity entrains to the kinematics of executed finger movements**. *Cerebellum* 2018, 17(5): 531–539.

3) Lolli V, Rovai A, Trotta N, Bourguignon M, Goldman S, Sadeghi N, Jousmäki V, and de Tiège X: **MRI-compatible pneumatic stimulator for sensorimotor mapping**. *Journal of Neuroscience Methods* 2018, Electronic publication ahead of print.

4) de Tiège X, Bourguignon M, Piitulainen H, and Jousmäki V: **Functional sensorimotor MEG mapping: An update of the current state of clinical research and practice**. 2018, Accepted for publication.

5 Equipment use and infrastructure funding

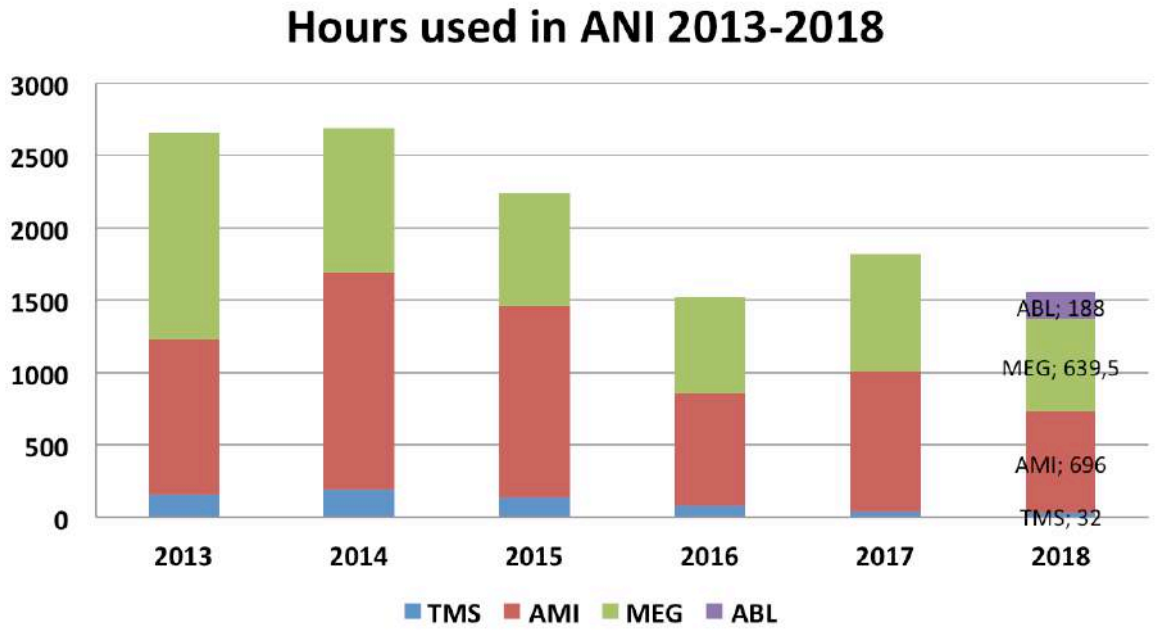

Figure 2 Total number of used hours of the Aalto NeuroImaging –infrastructure during 2013–2018. The numbers do not include service hours, but they include non-invoiced hours for scientific internal development, teaching purposes and similar use.

AALTO TMS

Total number of invoiced hours in 2018 was 4. A total of 6 hours was used to user and safety training. A total of 14 hours was used to demonstrate the laboratory to various interested parties. In addition, a total of approximately 25 hours were used to technical development.

	AALTO TMS (hours used)						**2018**
	2013	*2014*	*2015*	*2016*	*2017*	**2018**	**%**
Users							
NBE (previously BRU)	*118.5*	*98*	-	-	*2*	2	6.2
ABC	-	-	*31.5*	*32*	-	-	-
UH	-	*22.5*	*23*	*2*	*2*	2	6.2
Training	*11*	*42*	*54.5*	*18*	*18*	12	37.5
Demos, Workshops, Visitors	*28*	*5*	*29*	*31*	*18*	14	43.8
Free pilots	-	*22.5*	-	-	-	2	6.2
All users total	***157.5***	***190***	***138***	***83***	***40***	**32**	**100.0**
Service and technical development	*100*	*50*	*100*	*50*	*30*	25	

AALTO BEHAVIORAL LABORATORY

In 2018, there were 188 hours of charged measurements in ABL, including both rooms and all loanable devices. The biggest single user was NBE from Aalto University (125 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 18% of measurements, all of them in the DC-room measurements.

	ABL (hours used in 2018)					**2018**	**2017**	**2016**
	AC	DC	ETG1	ETG2	IR	**Total**	**Total**	**Total**
Users								
NBE (Aalto)	42	83	-	-	-	**125**	**170.5**	**283.5**
Others (Aalto)	-	61.5	-	-	1.5	**63**	**10.5**	**55.5**
Other	-	-	-	-	-	**-**	**98**	**38**
All users total	42	144.5	-	-	1.5	**188**	**279**	**377**
Piloting and service times	*81*	*160.5*	*24.5*	*22.5*	*-*	*288.5*	*169.5*	*321*

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

MEG CORE

The usage of MEG Core dropped slightly in 2018. The total use of MEG Core was 639.5 hours (excluding service hours and more than 500 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) was the largest single user group. We are hoping to boost the usage back to the level of over 1000 hours per year in the future.

	MEG Core (hours used)						**2018**
	2013	*2014*	*2015*	*2016*	*2017*	**2018**	**%**
Users							
NBE	*950*	*488.5*	*468*	*101*	*116.5*	218	34.1
ABC	-	-	*24.5*	*55.5*	*358*	80.5	12.6
Others (Aalto)*	-	-	-	-	-	61	9.5
HUS collaboration	*265*	*24.5*	*12*	-	-	-	-
Outside visitors**	*19*	*18*	*27.5*	*6*	*109*	70.5	11.0
Elekta (intro training)	*64*	*188.5*	-	*73.5*	-	34.5	5.4
Elekta (service training)	*135*	*29.5*	*125*	*237*	-	-	-
Elekta (testing)	*n/a*	*n/a*	*n/a*	*40.5*	*3.5*	-	-
Courses	-	*4*	*5*	*17*	*30*	20	3.1
Visitors	-	*54*	*46*	*29.5*	*41*	29	4.5
Method development (free)	*n/a*	*n/a*	*n/a*	*55*	*107.5*	123.5	19.3
Free pilots	-	*200*	*73.5*	*58*	*49.5*	2.5	0.4
All users total	***1433***	***1006***	***781.5***	***673***	***815***	**639.5**	**100.0**
Service (helium refills)	*156*	*207*	*158*	*191*	*655*	667.5#	

* In 2018: Department of Signal Processing and Acoustics
** In 2018: University of Jyväskylä, University of Helsinki, HYKS Oy
\# Including 531 hours of dedicated hours for nearby Otaniemi Campus construction sites (vibration artefacts; 462 in 2017)

AMI CENTRE

In 2018, the total number of used hours (not including maintenance and free pilot hours) reached just under 700 hours (out of which about 75% during prime time). The biggest single user group from Aalto University, was the Department of Neuroscience and Biomedical Engineering (~45% of the total). Aalto Brain Centre support was used less than during previous years. Unfortunately, the outside use dropped heavily in 2018, reaching only about 300 hours.

Radiographer assistance is 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. After a poorer year, we are looking forward to boosting the usage closer to the 1000 paid hours mark in the years to come.

	AMI Centre (hours used)											**2018**
	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	**2018**	**%**
Aalto users												
NBE (BECS)	*85*	*84*	*108*	*194*	*50*	*231*	*365.75*	*285*	*67.5*	*302*	310.5	44.6
NBE (BRU)	*339*	*253*	*227*	*335*	*286*	*185*	*178.25*					
ABC	-	-	-	-	-	-	-	*163.5*	*97*	*48*	10.5	1.5
aivoAALTO	-	*28*	*252*	*115*	*177*	*201*	*125.5*	-	-	-	-	-
AMI Centre[1]	*27*	*46*	*56*	*47*	*92*	*39*	*71.5*	*97.5*	*20*	*54*	58.5	8.4
Others[*]	-	-	*7*	*53*	*30*	*3*	*10*	*31*	*7*	*6*	22	3.2
Aalto total	***451***	***411***	***650***	***744***	***635***	***659***	***751***	***591.5***	***191.5***	***410***	**401.5**	**57.7**
Outside users												
UH	*126*	*172*	*268*	*131*	*339*	*286*	*526.5*	*501.5*	*413*	*349.5*	226.5	32.5
HUS and Clinical Research Institute HUCH Ltd.	*10*	*4*	*4*	*5*	*82*	*60*	*43*	*109.5*	*77*	*117*	31.5	4.5
Other academic[#]	*24*	*91*	*10*	*63*	*57*	*61*	*174.5*	*116.5*	*87.5*	*84.5*	34.5	5.0
Other (industry etc.)	*40*	*47*	*35*	*16*	*3*	-	-	-	-	*2*	2	0.3
Outside total	***200***	***314***	***317***	***215***	***481***	***407***	***744***	***727.5***	***577.5***	***553***	**294.5**	**42.3**
All users total	***651***	***725***	***967***	***959***	***1116***	***1066***	***1495***	***1319***	***769***	***963***	**696**	**100.0**
Radiographer	*410*	*508*	*663*	*553*	*641*	*647*	*744.5*	*819.5*	*553.5*	*630*	457.5	
Radiographer %	*63%*	*70%*	*69%*	*58%*	*57%*	*61%*	*50%*	*62%*	*72%*	*65%*	66%	
Service[1, 2]	*234*	*218*	*212*	*735*[3]	*180*	*185*	*195*	*228*	*175.5*	*217.5*	334.5	
Free pilots[1]	-	-	*5*	*13*	*6*	*5*	*10.5*	*25*	*26*	*25*	8.5	
Cancellations[4]	*~20*	*~5*	*~5*	*32*	*55*	*65*	*180.5*	*127.5*	*77*	*106*	81	

[*] In 2018: Department of Economics (22 hrs)
[#] In 2018: Metropolia University of Applied Sciences (18.5 hrs), University of Jyväskylä (10.5 hrs), University of Tampere (5.5 hrs)
[1] Not invoiced: 1. AMI Centre's technical development projects 2. Service times 3. Complimentary phantom pilots
[2] Includes: Manufacturer's maintenance/service (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), 2018 reasons: 1. Subject cancelled (more than 60%; sickness, no-show, other) 2. Technical problems (approx. 20%) 3. Other reasons

INCOME AND OPERATING COSTS 2018

In 2018, the total income of Aalto NeuroImaging (740 k€) was below to the estimated budget. The income came from user fees (253 k€), other external sources (28 k€) and basic funding (459 k€). The total expenses were 852 k€ showing that the budget was 112 k€ on the negative side.

6 Safety, teaching, seminars, visitors, and travel

Aalto NeuroImaging personnel regularly hosts formal and informal visits by groups or individuals of students, researchers, science reporters, television crews or other interested parties. In 2018, the total number of visitors to our laboratories (ABL, TMS, AMI and/or MEG) reached **approximately 400 people** in 2018. The visitors included, but not limited to, groups from Aalto University, University of Helsinki, and Metropolia University of Applied Sciences, ICPS 2018 participants, RAI 2018 evaluators, as well as a very large number of university and high school student groups.

At the end of 2018, DrTech Toni Auranen launched an ANI internal Journal Club (twice a month), in which interesting topics related to ANI activities are covered by ANI personnel and collaborating visitors from *e.g.,* NBE. Additional scientific talks related to ANI activities were included in the laboratory seminars of NBE and Aalto Brain Centre (ABC).

AALTO BEHAVIORAL LABORATORY

There were several groups from different educational levels visiting ABL, including Universities (in and outside Aalto), Universities for Applied Sciences and high schools. For example a group of 15 persons from Aalto Juniors was visiting ABL during their sports game-camp. There were a total of 341 persons in 14 groups visiting ABL in 2018. ABL had two sets of training sessions in which training was given for all devices. There were also other hands-on sessions organized on demand.

Life Science and Technologies (JOIN-E3000) course measurements were acquired in ABL. The course included a total of 10 measurement sessions with EEG and eye-tracker. Course *Structure and Operation of the Human brain* (NBE-E4210; Professor Risto Ilmoniemi) was having EEG demonstrations at ABL. Professor Lauri Parkkonen, the lecturer of *Functional Brain Imaging* (NBE-4210), used ABL as preparation environment for the course's MEG and fMRI projects.

AALTO TMS

Aalto TMS Laboratory's own safety and user course which is a prerequisite for all TMS measurements at Aalto TMS was organized 1 time during 2018 and was attended by a total of 4 participants. Aalto TMS was part of the organizers of 6th Science Factory: TMS–EEG Workshop Summer School, held on 18th–23rd of May 2018. The event was organized in Solvalla and Otaniemi.

Aalto TMS housed a demonstration of navigated TMS on 20th of November for the course *TRANSMED: Imaging in Science and Medicine* organized by University of Helsinki. The demonstration was attended by 4 students. Aalto TMS had a TET-trainee Samuli Sipponen working in the laboratory and getting familiar to the laboratory's facilities during 29th of January and 2nd of February. Samuli also worked for ABL, AMI and MEG during his trainee period.

AMI CENTRE

AMI Centre organizes its own MRI safety course, which is a prerequisite for all MRI scanner users at AMI. It was organized 4 times during 2018 and a total of 21 individuals (6 foreigners) passed it (altogether 561 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.

In addition, AMI Centre's facilities were used in the Aalto University's course *Functional Brain Imaging* (NBE-4210), lectured by Professor Lauri Parkkonen of the Department of Neuroscience and

Biomedical Engineering (NBE), as well as for practical training of the radiographer students of Metropolia University of Applied Sciences by their own staff.

During January 29th–31st, 2018, DrTech Toni Auranen attended a Siemens' MRI Safety Seminar (lectured by Dr. Emanuel Kanal) in Copenhagen, Denmark and at the end of August, he visited Oulu University Hospital for one day to participate in MREG workshop.

Furthermore in 2018, the AMI Centre's internal safety committee (whose members were Toni Auranen, Veikko Jousmäki, Tuomas Tolvanen, and Raimo Sepponen) had informal discussions in which safety issues and procedures of testing new devices for the MRI environment were evaluated.

MEG CORE

In 2018, we organized a 5-day *MEGIN Introductory Course* training with 10 trainees at the MEG Core. We also hosted formal and informal visits by groups or individuals of students, and researchers.

7 Aalto NeuroImaging personnel

7.1 Aalto Behavioral Laboratory, 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

Emi Iizuka, Summer Student (3.5 months at **AMI**) / MSc Student (17th Sep onwards at **AMI**, 80%)

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

Helge Kainulainen, Technician (**MEG**)

Marita Kattelus, Radiographer (**AMI**)

Mikko Nyrhinen, Laboratory Engineer (**TMS**, part-time) / PhD Student at NBE

Petteri Räisänen, System Administration/Technical Support (**ANI**, part-time)

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

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

7.2 Users and collaborators of ANI (194 individuals)

The persons listed in this chapter 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 (**ABL**, Aalto **TMS**, **AMI** Centre, **MEG** Core) were used in 2018, 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 2018. 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 2018 adds up to **194 individual researchers** (118 individual authors and 40 foreigners) with AMI Centre affiliating to **148**, MEG Core to **67**, ABL to **35** and Aalto TMS to **3** of them. Out of the total, 99 were affiliated with Aalto University, 58 with University of Helsinki and 17 with Helsinki University Hospital and Hospital District of Helsinki and Uusimaa, some with double or triple affiliations.

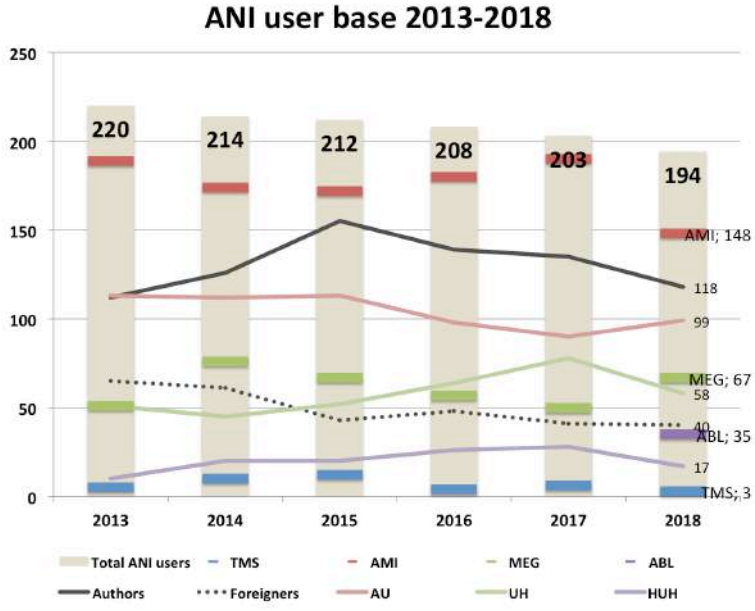

Figure 3 Aalto NeuroImaging user base in 2013–2018.

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

Aksiuto, A (**ABL**, **AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Alexandrou, A (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Alexandrov, Y (**AMI**, *author*)
Laboratory of Neural Bases of Mind, Institute of Psychology, Russian Academy of Sciences, Moscow, Russia
Department of Psychology, National Research University Higher School of Economics, Moscow, Russia

Alho, J (**AMI**)
UH, Helsinki, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Alho, K (**ABL**, **AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland
Swedish Collegium for Advanced Study, Uppsala, Sweden

Aronen, ET (**AMI**, *author*)
Child Psychiatry, Children's Hospital, UH and HUCH, Helsinki, Finland
Pediatric Research Center, Laboratory of Developmental Psychopathology, UH and HUCH, Helsinki, Finland

Auranen, T (**AMI**)
AMI Centre, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Aydogan DB (**AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Bacha-Trams, M (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Barros, DH (**AMI**, **MEG**)
Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

Becken, M (**ABL**)
Baltic Film Media, Arts and Communication School, Tallinn University, Estonia

Brattico, E (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland
Center for Music in the Brain, Department of Clinical Medicine, Aarhus University & The Royal Academy of Music Aarhus/Aalborg, Aarhus, Denmark

Broman, E (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Burunat, I (**AMI**, *author*)
Department of Music, University of Jyväskylä, Jyväskylä, Finland
Department of Mathematical Information Technology, University of Jyväskylä, Jyväskylä, Finland

Carlson, S (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Neuroscience Unit, Department of Physiology, Faculty of Medicine, UH, Helsinki, Finland

Christianson, GB (**MEG**, *author*)
UCL Ear Institute, 332 Gray's Inn Road, London, WC1X 8EE, UK

Ejtehadian, LF (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Ekelund, J (**AMI**, *author*)
Psychiatry, UH and HUCH, Helsinki, Finland
Department of Psychiatry, Vaasa Hospital District, Vaasa, Finland

Faisal, A (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Forss, NH (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Departments of Clinical Neurosciences and Neurology, UH and HUCH, Helsinki, Finland

Green, B (**AMI**, *author*)
Laboratory of Integrative Neuroscience and Cognition, Interdisciplinary Program in Neuroscience, Georgetown University Medical Center, Washington DC, USA

Glerean, E (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Department of Computer Science, School of Science, AU, Espoo, Finland

Gogulski, J (**AMI**, **TMS**, *author*)
Neuroscience Unit, Department of Physiology, Faculty of Medicine, UH, Finland

Gorbach, T (**AMI**)
Umeå School of Business, Economics and Statistics, Umeå University, Umeå, Sweden
Department of Mathematics and Statistics, University of Jyväskylä, Jyväskylä, Finland

Gotsopoulos, A (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Haapasalmi, P (**AMI**)
Metropolia University of Applied Sciences, Finland

Hakala, T (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Hakkarainen, K (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Hakonen, M (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Halko, M-L (**AMI**)
HECER/Department of Political and Economic Studies, UH, Helsinki, Finland.
Department of Economics, School of Business, AU, Espoo, Finland

Halme, H-L (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Radiology Unit, HUS Medical Imaging Center, HUCH, Helsinki, Finland

Hari, R (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Department of Art, School of Arts, Design and Architecture, AU, Espoo, Finland

Harmer, C (**AMI**, *author*)
University Department of Psychiatry, Oxford, UK

Havu, M (**ABL**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Heikkilä, R (**AMI**, *author*)
Psychiatry, UH and HUCH, Helsinki, Finland

Heinonen-Guzejev, M (**AMI**, *author*)
Department of Public Health, Faculty of Medicine, UH, Helsinki, Finland

Helle, L (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Elekta Oy, P.O. Box 34, 00531, Helsinki, Finland

Henriksson, L (**ABL**, **AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Himberg, T (**ABL**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Hlushchuk, Y (**AMI**, **MEG**, *author*)

NeuroLab, Laurea University of Applied Sciences, Espoo, Finland

Hokkanen, L (**ABL**, **AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Hultén, A (**ABL**, **AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Huovilainen, T (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Hyvärinen, A (**MEG**)
Gatsby Computational Neuroscience Unit, University College London, United Kingdom
Department of Computer Science, UH, Helsinki, Finland

Häkkinen, S (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Iivanainen, J (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Iizuka, E (**AMI**)
AMI Centre, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Illman, M (**AMI**, **MEG**, *author*)
MEG Core, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Ilmoniemi, R (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Industry (**AMI**)
1 undisclosed individuals

Isometsä, E (**AMI**, *author*)
Psychiatry, UH and HUCH, Helsinki, Finland
Finland National Institute of Health and Welfare, Helsinki, Finland

Jaatela, J (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Jiang, P (**AMI**, *author*)
Department of Physiology, Faculty of Medicine, UH, Helsinki, Finland

Jokivuolle, M (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Jones, SJ (**MEG**, *author*)
UCL Ear Institute, 332 Gray's Inn Road, London, WC1X 8EE, UK

Jousmäki, V (**MEG**, *author*)
MEG Core, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Jääskeläinen, IP (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kakouros, S (**ABL**, *author*)
Department of Signal Processing and Acoustics Electrical engineering, School of Electrical Engineering, AU, Espoo, Finland

Karvanen, J (**AMI**)
Department of Mathematics and Statistics, University of Jyväskylä, Jyväskylä, Finland

Kattelus, M (**AMI**)
AMI Centre, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kaukinen, C (**ABL**, **MEG**)
UH, Helsinki, Finland

Kauppila, M (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kauttonen, J (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kallio, M (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kaltiainen, H (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Department of Neurology, Lohja District Hospital, Lohja, Finland
Clinical Neurosciences and Department of Neurology, UH and HUCH, Helsinki, Finland

Kaprio, J (**AMI**)
Department of Public Health, Faculty of Medicine and Institute for Molecular Medicine FIMM, HiLIFE, UH, Helsinki, Finland

Kaski, S (**MEG**)
Department of Computer Science, Helsinki Institute for Information Technology HIIT, AU, Finland

Kere, J (**MEG**)
Molecular Neurology Research Program, UH, Folkhälsan Institute of Genetics, Helsinki, Finland
Department of Biosciences and Nutrition, Karolinska Institutet, Huddinge, Sweden
School of Basic and Medical Biosciences, King's College London, Guy's Hospital, London, UK

Ketomäki, J (**ABL**)
Department of Electrical Engineering and Automation, AU, Espoo, Finland

Kieseppä, T (**AMI**, *author*)
Department of Psychiatry, UH and HUCH, Helsinki, Finland

Kivisaari, S (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kliuchko, M (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Komulainen, E (**AMI**, *author*)
Psychiatry, UH and HUCH, Helsinki, Finland

Kondinska, A (**ABL**)
Baltic Film Media, Arts and Communication School, Tallinn University, Estonia

Korhonen, J (**AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Korhonen, O (**AMI**, *author*)
Department of Computer Science, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Koskinen, M (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Department of Physiology, Faculty of Medicine, UH, Helsinki, Finland

Kujala, J (**ABL**, **AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Kurki, I (**ABL**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Kurmanaviciute, D (**ABL**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Laaksonen, K (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Laasonen, M (**ABL**, **AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland
Department of Psychology, University of Turku, Finland
Department of Phoniatrics, HUH, Finland

Lagus, K (**AMI**, **MEG**, *author*)
Department of Political and Economic Studies, UH, Helsinki, Finland

Lahti, T (**AMI**)
Hanken School of Economics, Helsinki, Finland

Lammi, L (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Lampinen, J (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Department of Computer Science, School of Science, AU, Espoo, Finland

Lankinen, K (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Lapinkero, H-M (**AMI**)
Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

Lehtonen, M (**AMI**, **MEG**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Leminen, A (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Leminen, M (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Leppäaho, E (**MEG**, *author*)
Department of Computer Science, Helsinki Institute for Information Technology HIIT, AU, Finland

Leppämäki, S (**ABL**, **AMI**, *author*)
Department of Psychiatry, HUH, Finland

Liljeström, M (**ABL**, **AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Lin, H (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Lindeman, M (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Lindgren, M (**AMI**, *author*)
Mental Health Unit, National Institute for Health and Welfare
UH and HUH, Helsinki, Finland

Lindh-Knuutila, T (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Liu, K (**ABL**)
Department of Applied Physics, School of Science, AU, Espoo, Finland

Lonka, K (**AMI**, *author*)
Department of Teacher Education, UH, Helsinki, Finland

Ma, Y-Y (**AMI**, *author*)
Life Science and Technology, Kunming University of Science and Technology, Kunming, China

Marquardt, T (**MEG**, *author*)
UCL Ear Institute, 332 Gray's Inn Road, London, WC1X 8EE, UK

Maunula, S (**AMI**)
Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

McAlpine, D (**MEG**, *author*)
UCL Ear Institute, 332 Gray's Inn Road, London, WC1X 8EE, UK
Dept of Linguistics, Australian Hearing Hub, Macquarie University, Sydney, Australia

Metwaly, M (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Mikkola, K (**ABL**, **AMI**, *author*)

Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Moisala, M (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland
Department of Teacher Education, UH, Helsinki, Finland

Muukkonen, I (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Mäkelä, N (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Mäntylä, T (**AMI**, *author*)
National Institute for Health and Welfare, Helsinki, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Nieminen, J (**AMI**, **TMS**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Nora, A (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Nummenmaa, L (**AMI**, *author*)
Turku PET Centre and Department of Psychology, University of Turku, Turku, Finland

Numminen, J (**ABL**, **AMI**, *author*)
Helsinki Medical Imaging Centre at Töölö Hospital, HUH, Finland

Nurmi, P (**ABL**, **AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Nurmi, T (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Nyrhinen, M (**AMI**, **TMS**)
Aalto TMS Laboratory, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Olkkonen, M (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland
Department of Psychology, Durham University, Durham, UK

Paetau, R (**MEG**)
Children's Hospital, Department of Neurology, HUCH, Helsinki, Finland
BioMag Laboratory, HUS Medical Imaging Center, HUCH, Helsinki, Finland

Palo-oja, P (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Parkkonen, E (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Parkkonen, L (**ABL**, **AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Parviainen, T (**AMI**, **MEG**)
Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

Piitulainen, H (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Punamäki-Gitai, R-L (**AMI**)
School of Social Sciences and Humanities, Faculty of Social Sciences, University of Tampere, Finland

Puoliväli, T (**AMI**, *author*)
Department of Mathematical Information Technology, University of Jyväskylä, Jyväskylä, Finland

Raij, TT (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Psychiatry, UH and HUCH, Helsinki, Finland

Rauschecker, J (**AMI**, *author*)

Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Laboratory of Integrative Neuroscience and Cognition, Interdisciplinary Program in Neuroscience, Georgetown University Medical Center, Washington DC, USA
Institute for Advanced Study, TUM, Munich, Germany

Remes, L (**ABL**)
Department of Electrical Engineering and Automation, AU, Espoo, Finland

Renvall, HM (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Clinical Neurosciences, Neurology, UH and Department of Neurology, HUCH, Helsinki, Finland
BioMag Laboratory, HUS Medical Imaging Center, HUCH, Helsinki, Finland
Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, the Netherlands

Renvall, V (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Riekki, T (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Rikandi, E (**AMI**, *author*)
Mental Health Unit, National Institute for Health and Welfare, Helsinki, Finland

Rinne, R (**AMI**)
UH and HUCH, Helsinki, Finland

Rinne, T (**AMI**, *author*)
Department of Psychology and Logopedics, UH, Helsinki, Finland

Ruotsalainen, I (**AMI**)
Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

Ryyppö, E (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Räsänen, O (**ABL**, *author*)
Department of Signal Processing and Acoustics Electrical engineering, School of Electrical Engineering, AU, Espoo, Finland

Saarela, T (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Saari, J (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Saari, P (**AMI**, *author*)
Department of Music, Art, and Culture Studies, University of Jyväskylä, Jyväskylä, Finland

Saarimäki, H (**ABL**, **AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Saarinen, T (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Saarinen, V-M (**ABL**)
Aalto Behavioral Laboratory, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Sahari, E (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Salo, E (**ABL**, **AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Salmela, E (**MEG**)
Department of Biosciences, UH, Helsinki, Finland

Salmela, V (**ABL**, **AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Salmela-Aro, K (**AMI**, *author*)

Department of Psychology, University of Jyväskylä, Jyväskylä, Finland
School of Education, University of California, Irvine, USA

Salmelin, R (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Salminen, N (**ABL**, **MEG**, *author*)
Department of Signal Processing and Acoustics Electrical engineering, School of Electrical Engineering, AU, Espoo, Finland

Salmitaival (née Salmi), J (**ABL**, **AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland
Faculty of Arts, Psychology and Theology, Åbo Akademi University, Turku, Finland

Sams, M (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Saramäki, J (**AMI**, *author*)
Department of Computer Science, School of Science, AU, Espoo, Finland

Saranpää, A (**ABL**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Sarvas, J (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Silvanto, J (**AMI**)
Department of Psychology, Faculty of Science and Technology, University of Westminster, London, UK

Sinisalo, H (**AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Stenroos, M (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Souza, VH (**AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Sutela, M (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Suvilehto, J (**AMI**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Suvisaari, J (**AMI**, *author*)
Mental Health Unit, National Institute for Health and Welfare, Helsinki, Finland

Svedhom-Häkkinen, AM (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Syväoja, HJ (**AMI**)
LIKES Research Centre for Physical Activity and Health, Jyväskylä, Finland

Szita, K (**ABL**)
University of Gothenburg, Gothenburg, Sweden
AU, Espoo, Finland

Tammelin, TH (**AMI**)
LIKES Research Centre for Physical Activity and Health, Jyväskylä, Finland

Tani, P (**ABL**, **AMI**, *author*)
Department of Psychiatry, HUH, Finland

Tervaniemi, M (**AMI**, *author*)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Thiede, A (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Tikka, P (**ABL**, **AMI**, **MEG**, *author*)
Baltic Film Media, Arts and Communication School, Tallinn University, Estonia

Toiviainen, P (**AMI**, *author*)
Department of Music, University of Jyväskylä, Jyväskylä, Finland

Tokariev, M (**AMI**, *author*)
Neuroscience Unit, Department of Physiology, Faculty of Medicine, UH, Helsinki, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Tolvanen, T (**AMI**, **MEG**)
AMI Centre, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
MEG Core, Aalto NeuroImaging, School of Science, AU, Espoo, Finland
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Törnroos, S (**AMI**)
Metropolia University of Applied Sciences, Finland

Urjansson, M (**AMI**)
Department of Public Health, Faculty of Medicine, UH, Helsinki, Finland

Vahermaa, V (**AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Vallinoja, J (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

van Vliet, M (**AMI**, **MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Vartiainen, J (**AMI**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Verwoert, M (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Virtanen, L (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Volynets, S (**AMI**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Vuilleumier, P (**AMI**, *author*)
Department of Neuroscience, University Medical Center of Geneva, Switzerland
Swiss Center for Affective Sciences, Campus Biotech, University of Geneva, Switzerland

Vuontela, V (**AMI**, *author*)
Neuroscience Unit, Department of Physiology, Faculty of Medicine, UH, Finland

Vuorikoski, S (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Vähämaa, J (**AMI**)
Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

Wikman, P (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Ylinen, A (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Zetter, R (**MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Zhigalov, A (**MEG**)
Department of Neuroscience and Biomedical Engineering, School of Science, AU, Espoo, Finland

Zubarev, I (**ABL**, **MEG**, *author*)
Department of Neuroscience and Biomedical Engineering, AU, Espoo, Finland

Åkerla, A (**AMI**)
Department of Psychology and Logopedics, Faculty of Medicine, UH, Helsinki, Finland

Äimälä, A (**ABL**, *author*)
Department of Neuroscience and Biomedical Engineering, AU, Espoo, Finland

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