Multilingual multidisciplinary studies on brain and language (MMSBL)

an ESF Scientific Network

Neurolinguistics, the scientific study of how language is organised at the neuronal level, has been revolutionised in the last 15 years by the application of emerging neuroimaging techniques. This has enabled the classical approach of studying brain/language interaction through brain-damaged individuals to be extended to "normal" people without any aphasia (loss of communication ability through damage to the central nervous system). In the past it was only possible to make educated guesses and confirm these in a post mortem. Imaging has now made it possible to locate active brain areas in brain-damaged and normal individuals with good accuracy, identified by changes in blood flow and blood oxygenation, and also in real time, via changes of electric and magnetic fields. The new insights and alternative ways of testing and refining cognitive models provided by modern neuroimaging, have exacerbated problems of interdisciplinary communication, particularly between the neuroimaging and cognitive language modelling communities. This Network is very timely in bringing together European experts in these two fields, with the goal of creating a unified methodology for brain/language studies across European countries and languages.

The traditional aphasiological model of brain/language study, in which data from brain-damaged individuals is used to gain insight into how a particular part of the brain affects performance, is still valid and widely used. It led to the development of functional and anatomical diagrams explaining comprehension and production of both spoken and written language.

Such work is now being extended and reinforced by functional neuroimaging, which allows neurolinguistic functions to be studied directly as they are happening. Neurological imaging took off in 1988 with a seminal paper by Petersen and colleagues in St. Louis, USA, describing the first application of positron tomographic techniques to isolate brain activities during single word processing. Changes of regional cerebral blood flow were used as an index of altered synaptic activity. Cognitive processes were derived from such an index via a subtraction approach still used today.

Since the Petersen paper, many experiments have been conducted using increasingly sophisticated and accurate PET techniques, along with more refined methods for deriving the underlying cognitive processes. But PET continues to be handicapped through being invasive, exposing individuals to radiation.

However in the last 10 years a new non-invasive approach based on functional magnetic resonance (fMRI) has enabled a larger number of scientists to perform functional anatomical language experiments. FMRI exploits the fact that the magnetic field created by haemoglobin in the blood is different when carrying oxygen than when it is not. Active brain regions receive more blood and so have more oxygenated haemoglobin, which can be detected as changes in the brain's magnetic field and picked up by fMRI scanners.

At the same time, another non-invasive technique, magnetoencephalography (MEG) has improved significantly the ability to resolve temporal dynamics, enabling changes in brain activity over time to be tracked at a much finer level of detail.

With such techniques delivering increasing volumes of data, this Network is timely in allowing the overall experimental approach used in applying imaging to neurological research to be re-assessed. It is also time to take stock of progress achieved so far in the field of language processing in order to set priorities for the future and determine possible clinical programmes. Issues that have never been addressed systematically before, such as anatomy of reading and bi-lingualism, are being tackled by a number of studies within this Network. It is also helping to extend physiological investigations into firm clinical tests, as in the case of pre-surgical assessment of language-brain interactions to prevent or minimise post-surgical aphasia. To achieve these goals, the Network is bringing together experts in brain physiology, neurolinguistics, neuropsychology, and clinical aphasiology.

The Network's conclusions will therefore be highly relevant not only for basic neuroscientific research but also for assessment and treatment of acquired language impairments. There should be an even stronger focus on clinical and therapeutic applications in an extensive follow up programme to be defined later in the three year Network, which runs from 2003 to 2006. Indeed the wider objective is to establish an ongoing European platform for the study of brain and language relationships of all kinds.

This Network was approved by the ESF Network Group in May 2003 for a three-year period

Steering Committee

Professor Ria De Bleser (Chair)
University of Potsdam
Neurolinguistics Department
PF 601553
14415 Potsdam
Germany
Tel: +49 331 9772 933
Fax: +49 331 9772 095
Email: debleser@ling.uni-potsdam.de

Professor Roelien Bastiaanse
University of Groningen
Department of Linguistics
PO Box 716
9700 AS Groningen
Netherlands
Tel: +31 503 635 558
Fax: +31 503 636 855
Email: y.r.m.bastiaanse@let.rug.nl

Professor Stefano F. Cappa
Università Vita-Salute San Raffaele
DIBIT
Via Olgettina 58
20132 Milan
Italy
Tel: +39 02 2643 4887 (secr 4784)
Fax: +39 02 2643 4892
Email: Cappa.stefano@hsr.it

Professor Alfonso Caramazza
Harvard University
Department of Psychology
33 Kirkland Street
Cambridge MA02138
United States
Tel: +1 617 495 3867
Fax: +1 617 496 6262
Email: caram@wjh.harvard.edu

Dr. Jean-Francois Demonet
INSERM U455
Service de Neurologie
CHU Purpan
31059 Toulouse cedex 2
France
Tel: +33 5 61 77 95 11/19
Fax: +33 5 61 49 95 24
Email: demonet@purpan.inserm.fr
demont@purpan.inserm.fr

Professor David Howard
University of Newcastle
School of Education, Communication and Language Sciences
Newcastle-upon-Tyne NE1 7RU
United Kingdom
Tel: +44 191 222 7451
Fax: +44 191 222 6518
Email: david.howard@ncl.ac.uk

Professor Matti Laine
Department of Psychology
Åbo Akademi
Domkyrkotorget 3
20500 Åbo
Finland
Tel: +358 2 2153 442
Fax +358 2 2154 833
Email: matti.laine@abo.fi

Professor Claudio Luzzatti
Università degli Studi Milano-Bicocca
Dipartimento di Psicologia
Piazza dell'Ateneo Nuovo 1
20126 Milano
Italy
Tel: +39 026 448 6743
Fax: +39 026 448 6705
Email: claudio.luzzatti@unimib.it

Professor John C. Marshall
Neuropsychology Unit
Radcliffe Infirmary
Woodstock Road
Oxford OX2 6HE
United Kingdom
Tel: +44 1865 727 346
Fax: +44 1865 556 164
Email: john.marshall@clinical-neurology.ox.ac.uk

Professor David Poeppel
CNL Lab
1401 Marie Mount Hall
University Maryland
College Park MD 20742
United States
Tel: +1 301 405 1016
Fax: +1 301 314 5052
Email: dpoeppel@deans.umd.edu

Professor Riitta Salmelin
Brain Research Unit
Low Temperature Laboratory
Helsinki University of Technology
PO Box 2200
02015 Helsinki
Finland
Tel: +358 9 451 2950
Fax: +358 9 451 2969
Email: riitta@neuro.hut.fi

Cynthia K. Thompson
Communication Sciences and Disorders
Northwestern University
633 Clark Street
Evanston IL 60208
United States
Tel: +1 847 491 5073
Fax: +1 847 467 1418
Email: ckthom@northwestern.edu

Professor Cornelius Weiller
Universitätsklinikum
Hamburg-Eppendorf
Martinistraße 52
20246 Hamburg
Germany
Tel: +49 40 42803 3770
Fax: +49 40 42803 6721
Email: weiller@uke.uni-hamburg.de

ESF Liaison

Science:
Dr. Hui Wang

Administration:
Ms. Nathalie Geyer
Tel: +33 (0)3 88 76 71 48
Fax: +33 (0)3 88 37 05 32
Email: ngeyer@esf.org

www.esf.org/mmsbl

The European Science Foundation acts as a catalyst for the development of science by bringing together leading scientists and funding agencies to debate, plan and implement pan-European initiatives.

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the Networks Secretariat
Tel: +33 (0)3 88 76 71 46 - Fax: +33 (0)3 88 37 05 32 - Email: networks@esf.org