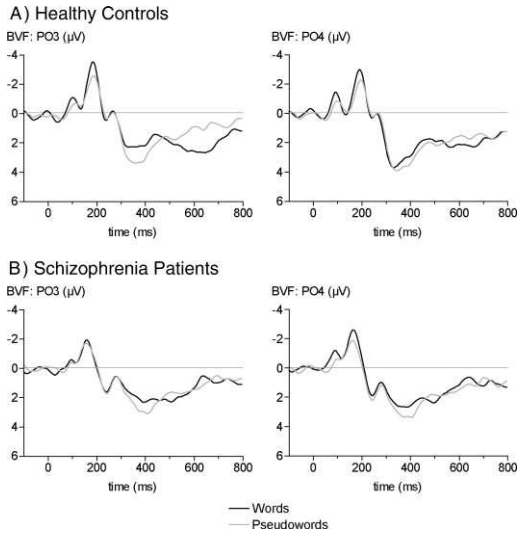
Areas of Research

- Neuroimaging (EEG, MEG, fMRI) of language
- Functional lateralisation in the healthy brain and in neuropsychiatric disorders
- Aphasia Therapy, Neurorehabilitation and cortical reorganisation after stroke
- Poststroke depression
- Cognitive and motor processing in autism spectrum disorders

Neuroimaging (EEG, MEG, fMRI) of language and Functional lateralisation in the healthy brain and in neuropsychiatric disorders

The neuropsychology and neurophysiology of language is one of my major research areas. Of particular interest to me is the functional connection of the two cerebral hemispheres when processing specific word categories. Neuroimaging data have shown that patterns of brain activation are strongly dependent on the semantic content of words. For example, action-related words elicit brain activation in language areas of the brain and in the motor cortex in both hemispheres. In contrast, function words without semantic content are strongly lateralised to the left hemisphere. We are investigating under which experimental conditions the two hemispheres exchange information and co-activate interhemispheric neuronal networks. In this context, I have developed a neurobiological model of how the two hemispheres interact during higher cognitive processing.
There is evidence that in some psychiatric conditions (e.g. in schizophrenia, autism spectrum disorders, etc.), the functional connection within or across the two cerebral hemispheres might be impaired, which could be the underlying neurobiological cause of specific clinical or cognitive symptoms. For example, our research findings indicate that patients with a diagnosis of schizophrenia might have weaker functional connections between the two cerebral hemispheres than healthy controls.



Grand average ERP waveforms for words and pseudowords in healthy controls (A) and schizophrenia patients (B) after bilateral (BVF) stimulation.
from Mohr et al. (2008) Neuroimage

Selected publications:

Moseley, R., Carota, F., Hauk, O., **Mohr, B**., Pulvermüller, F. 2012. A Role for the Motor System in Binding Abstract Emotional Meaning. *Cerebral Cortex*, 22, 1634-1647.

Pulvermüller, F., Kherif, F., Hauk, O., **Mohr, B**., Nimmo-Smith, I. 2009. Cortical cell assemblies for lexical and category-specific semantic processing as revealed by fMRI cluster analysis. *Human Brain Mapping*, 30 (12), 3837-3850.

Mohr, B., Pulvermüller, F., Rockstroh, B., Endrass, T. 2008: Hemispheric cooperation –A crucial factor in schizophrenia? Neurophysiological evidence. Neuro*image*, 41, *1102-1110***.**

Mohr, B., Endrass, T., Pulvermüller, F., 2007: Neurophysiological correlates of the bilateral redundancy gain for words: An ERP study. *Neuropsychologia*, 45, 2114-2124.

Mohr, B., Pulvermüller, F., Cohen, R., Rockstroh, B., 2000. Interhemispheric cooperation during word processing: Evidence for callosal transfer dysfunction in schizophrenic patients. *Schizophrenia Research* ,46, 231-239.

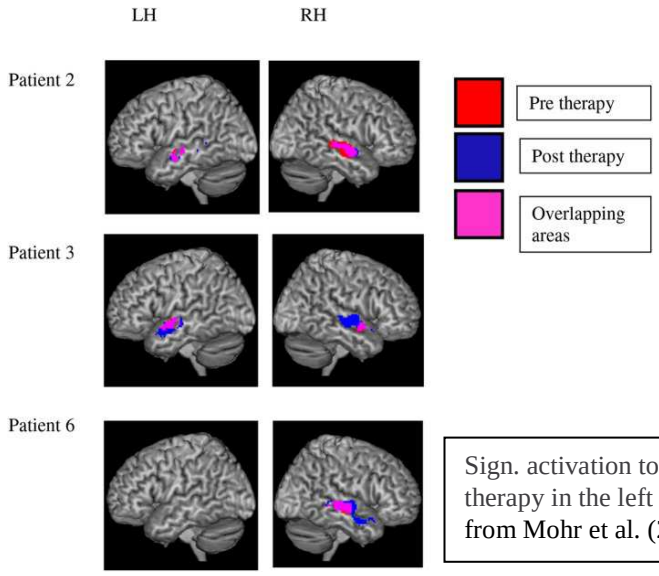
Aphasia therapy, Neurorehabilitation and Cortical Reorganisation after stroke

Post Stroke Depression

Intensive language action therapy (Constraint-induced aphasia therapy) in chronic post stroke aphasia

My main clinical research focus is on the neurorehabilitation and functional restitution of language in aphasia patients.
We have developed a new method for treating language and communication problems in stroke patients with chronic aphasia. This relatively new method is called **Intensive Language Action Therapy (ILAT),** formerly also known under the name **Constraint-Induced Aphasia Therapy (CIAT).** ILAT is based on principles from neuroscience: Learning is best when we repeatedly practice the skills we want to learn and is accomplished when nerve cells frequently fire together. The more frequently nerve cells are co-activated, the better we learn. For this reason, language training is performed in a very intensive manner**,** usually 3-4 hours per day for a period of two weeks.
We also know from neuroscience that the brain systems for language and action are interconnected. Thus, hearing a word may automatically activate the motor system and performing actions may help us to understand words. Therefore, in ILAT, language is practiced in the context of actions and everyday life communication. In so-called *language games*, participants exercise basic and more advanced language skills such as *making a*

request, asking and answering questions etc. ILAT is usually delivered in a group setting of three patients and one therapist. Randomised clinical trials showed that ILAT leads to significant language improvements, even in patients with chronic aphasia several years after stroke onset.
Moreover, neuroimaging data demonstrate that brain reorganisation occurs after only two weeks of ILAT and correlates with language improvement.



Sign. activation to speech vs. SCN before and after therapy in the left and right hemisphere of three patients. from Mohr et al. (2014) Front Hum Neurosci.

Post stroke depression in chronic aphasia

Post-stroke depression (PSD) is among the most frequent neuropsychiatric consequences of stroke, affecting nearly one third of stroke sufferers. Negative consequences of depression include increased morbidity, mortality and poorer functional recovery. So far, the causes of PSD are largely unknown and translational research on PSD is rather limited.

The aim of our research is to investigate a variety of neuropsychological, biological and social factors that contribute to PSD in patients with chronic aphasia. Moreover, the effects of therapeutic interventions in this patient group is currently under investigation.

Both research projects are conducted in close collaboration with researchers at the Freie Universität Berlin.

Selected publications:

Mohr, B., Difrancesco, S., Harrington, K., Evans, S., Pulvermüller, F. 2014. Increase of right-hemispheric activation after intensive language action therapy (ILAT) in chronic aphasia: fMRI evidence from auditory semantic processing. *Frontiers in Human Neuroscience*, 14, doi: 10.3389/fnhum.2014.00919.

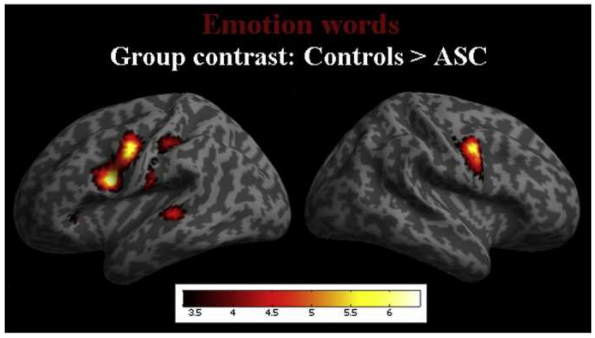
MacGregor, L., Difrancesco, S., Pulvermüller, F., Shtyrov, Y., **Mohr, B**. 2014. Ultra-rapid access to words in chronic aphasia: The effects of intensive language

action therapy (ILAT) *Brain Topography*, doi 10.1007/s10548-014-0398-y
Difrancesco, S., Pulvermüller, F., **Mohr, B**. 2012. Intensive Language Action Therapy (ILAT): The methods. *Aphasiology*, 26 (11), 1317-1351.
Pulvermüller, F., Hauk, O., Zohsel, K., Neininger, B. & **Mohr, B.** 2005: Therapy-related reorganization of language in both hemispheres of patients with chronic aphasia. *Neuroimage*, 28, 481-489.
Pulvermüller, F., Genkinger, B., Elbert, T., **Mohr, B.,** Rockstroh, B., Koebbel, P., Taub, E. 2001. Constraint-induced therapy of chronic aphasia following stroke. *Stroke*, 32, 1621-1626.

Cognitive and motor processing in Autism Spectrum Disorders

Autism spectrum disorders (ASD) are neurodevelopmental disorders associated with deficits in language, sensory perception, motor skills and social interaction. This clinical condition often leads to chronic and devastating impairments in daily life. However, the underlying cause of ASD is still unknown. Our research aims at investigating the neuropsychological, neurophysiological and motor correlates of action-semantic processing in autism spectrum disorders (ASD) in order to gain insight into the neuronal mechanisms underlying this condition. Neuropsychological profiles and electrophysiological signs will be mapped on to clinical symptoms in order to identify specific markers that are of diagnostic and prognostic value.
Our previous findings indicate that individuals with ASD show reduced brain activation in the motor cortex and in limbic brain structures specifically when processing emotion words. This hypoactivity does not occur in brain areas unrelated to emotion processing and correlates with severity of clinical symptoms. The data suggest that sensory-motor deficits may help to explain problems in emotion processing and other clinical symptoms in ASD.

This research is conducted in close cooperation with researchers at the Department of Psychiatry and the Autism Research Centre, University of Cambridge, UK.



Statistical group contrast (controls > ASD) for emotion words (red).
from Moseley et al. (2015) Neuroimage

Selected publications:

Moseley, R., Shtyrov, Y., **Mohr, B**., Lombardo, M.V., Baron-Cohen, S., Pulvermüller, F. 2015. Lost for emotion words: What motor and limbic brain activations reveal about autism and about semantics in general. *Neuroimage*, 104, 413-422.

Moseley R., Pulvermüller F., **Mohr B**., Lombardo M., Baron-Cohen S., Shtyrov Y. 2014. Brain Routes for Reading in Adults With and Without Autism: EMEG Evidence. Journal of Autism and Developmental Disorders, 44, 137-153.

Ludlow, A., **Mohr, B**., Whitmore, A., Garagnani, M., Pulvermüller, F., Gutierrez, R. 2014. Auditory processing and sensory behaviours in children with Autism Spectrum Disorders as revealed by mismatch negativity. *Brain and Cognition*, 86, 55-63.

Moseley, R. L., **Mohr, B**., Lombardo, M. V., Baron-Cohen, S., Pulvermüller, F. 2013. Action-semantic deficit in autism: behavioural and brain manifestation. Frontiers in Human Neuroscience, 7, doi:10.3389/fnhum.2013.00725

Information for students:

For prospective BSc, MSc and PhD students, there is the possibility to undertake research in any of these research areas. For more information, please contact me at:

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