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Main Goals, Keywords

To study developmental neuropsychology and functional/anatomical brain plasticity of number processing and other cognitive domains in normally achieving and learning disabled children as well as epidemiology, developmental course, outcome and treatment of school developmental disorders. Transfer between basic research and practical application.

number processing, calculation, neuropsychology, brain imaging, brain plasticity, developmental disorders, psychopathology, developmental dyscalculia (DD)

Group Members

1 professor, 2 post doc, 3 postgraduate and 2 undergraduate students

Previous and Current Research (see Figure below)

During the last decade several interrelated projects have focused on

- a) the development and standardization of diagnostic instruments
- b) the development of neurocognitive components of scholastic skills, especially number processing and calculation in typically achieving and learning disabled children, using different neuropsychological and neurobiological methods
- c) the development and evaluation of training methods and implementation for special educational needs.

Development of diagnostic instruments

- Neuropsychological test battery for number processing and calculation in primary school and kindergarten children (ZAREKI 2001, ZAREKI-R 2006, ZAREKI-K 2009)
- Wechsler adult intelligence scale (WAIS III, german version WIE 2007)
- Math anxiety questionnaire (MAF)

Clinical neuropsychology

- Early risks and precursors of developmental dyscalculia (DD)
- Development of SNARC-effects
- Prevalence of DD, dyslexia and comorbidities
- Cross-cultural comparison studies
- Early intervention, epidemiology, long-term outcome and treatment of DD, dyslexia and allied developmental disorders (with Prof. G. Esser, Clinical Psychology, University Potsdam)
- Impact of math anxiety on the development of mathematical skills
- Development and evaluation of adaptive computerized intervention methods for number processing and calculation in children (with Prof. M. Gross, Computer Graphics Lab, ETH Zürich)

Brain Imaging (with Prof. E. Martin, Dr. R. O'Gorman, Dr. K. Kucian)

By means of magnetic resonance imaging (MRI) we investigated neuronal correlates of mathematical reasoning in children with and without DD and healthy adults. Different research questions have been addressed with functional MRI (fMRI), voxel-based morphometry (VBM), diffusion tensor imaging (DTI), cortical thickness (CT) and spectroscopy (MRS):

- Development of neural networks for calculation (fMRI)
- Functional neuronal correlates of DD (fMRI)
- Morphometric neuronal correlates of Dyscalculia (VBM)
- Micro-structural neuronal correlates Dyscalculia (DTI)
- Evaluation of training effects in children with DD (fMRI, VBM, DTI, CT)
- Longterm course of DD (fMRI, VBM, DTI, CT)
- Metabolic differences between children with and without DD (MRS)

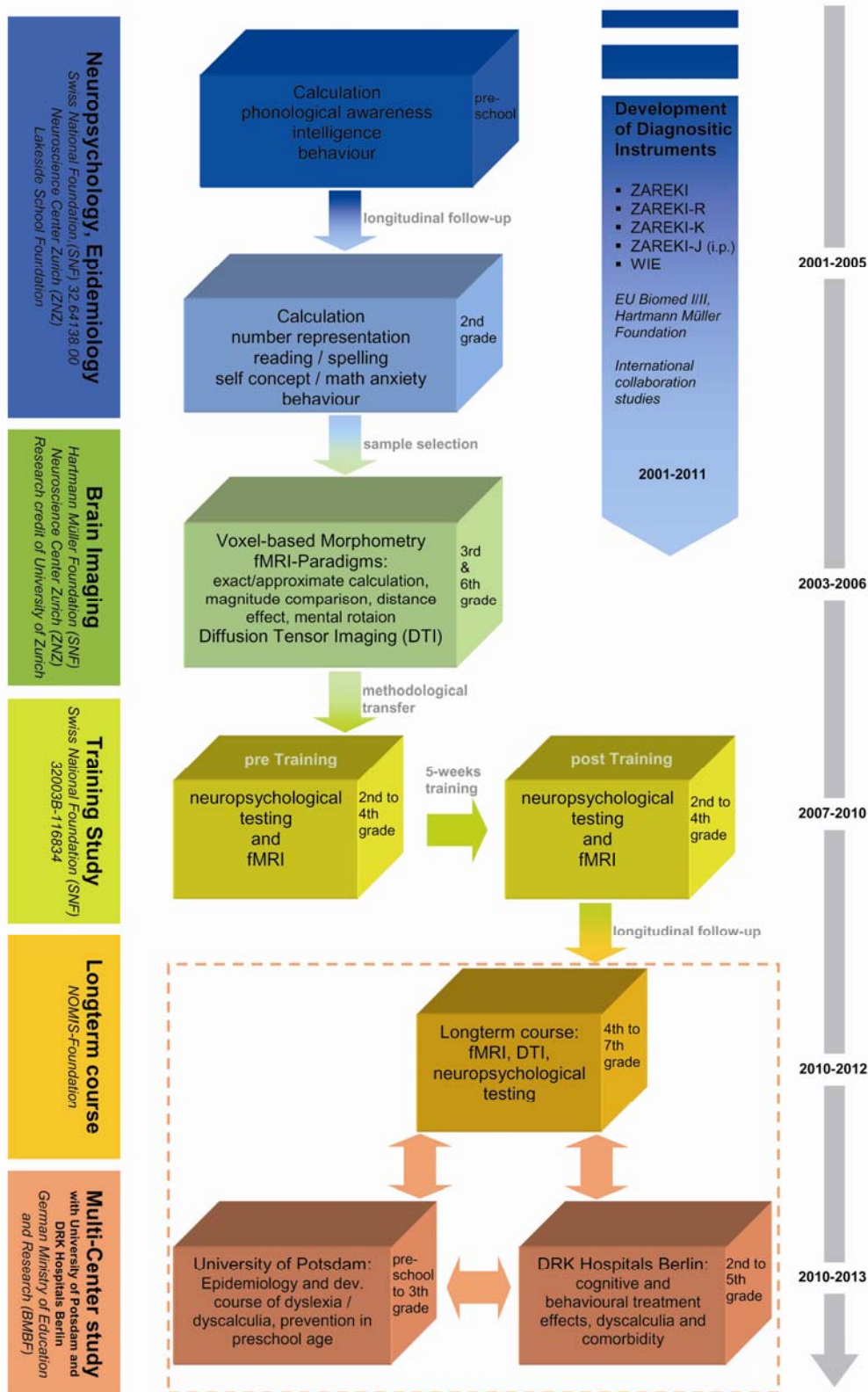


Figure: Research projects (from 2001), methods and funding

Selected Publications

- Kucian, K., Loenneker, T., Dietrich, T., Dosch, M., Martin, E., & von Aster, M. (2006). Impaired neural networks for approximate calculation in dyscalculic children: a functional MRI study. *Behavioral and Brain Functions*, 2, 31.
- von Aster, M., Weinhold Zulauf, M., & Horn, R. (2006). ZAREKI-R (Neuropsychological Test Battery for Number Processing and Calculation in Children), revidierte Version. Frankfurt: Harcourt Test Services.
- von Aster, M., & Shalev, R.S. (2007). Number development and developmental dyscalculia. *Developmental Medicine & Child Neurology*, 49(11), 868-873.
- Rotzer, S., Kucian, K., Martin, E., von Aster, M., Klaver, P., & Loenneker, T. (2008). Optimized voxel-based morphometry in children with developmental dyscalculia. *NeuroImage*, 39(1), 417-422.
- Rotzer, S., Loenneker, T., Kucian, K., Martin, E., Klaver, P., & von Aster, M. (2009). Dysfunctional neural network of spatial working memory contributes to developmental dyscalculia. *Neuropsychologia*, 47(13), 2859-2865.
- Kucian, K., Grond, U., Rotzer, S., Henzi, B., Schonmann, C., Plangger, F., Galli, M., Martin, E. & von Aster, M. (2011). Mental number line training in children with developmental dyscalculia. *NeuroImage*, 57(3): 782-95.
- Kucian, K., Loenneker, T., Martin, E., & von Aster, M. (2011). Non-symbolic numerical distance effect in children with and without developmental dyscalculia: a parametric fMRI study. *Developmental Neuropsychology*, 36(6), 741-762.

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