ZENTRUM FÜR KOGNITIONSWISSENSCHAFTEN
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What happens in our brains when we watch TV, or play a video game? How do we learn to discriminate between different car brands, and why our perception sometimes differs markedly from the ‘real’ world, as in (visual) illusions? How do ‘colour-blind’ patients perceive the world, or those who cannot identify objects after a stroke in spite of ‘seeing’ them clearly? To what extent can patients steer a wheelchair by means of their brainwaves? How can the slow ‘wetware’ of our brains beat even the most advanced computers when finding objects in natural environments? What influence on cognition do drugs have, and how can we describe all these functions mathematically? These are questions we are investigating in the centre for cognitive research (ZKW) and this brochure testifies our approach to Neuroscience.

It is possible to understand the brain on different levels of complexity – from the function of isolated nerve membranes, over that of single neurons on a molecular level, up to the systemic level of neuronal populations. A bit against the ‘Zeitgeist’, we in Bremen focus on the systemic level – without ignoring the more elementary levels.

The members of the ZKW are collaborating to solve the puzzles of human and animal behaviour by studying the neuronal populations underlying this behaviour. The methods applied range from recording the electrical activity in single neurons or neuronal populations (via EEG) to functional magnetic resonance imaging (fMRI) that clearly represents the structure and function of the living brain. They include the anatomy and histology of the brain, the effects of neurotransmitters as well as the study of behaviour – with an emphasis on perception – and study the effects of transcranial magnetic stimulation (TMS). A strong emphasis is on the theoretical background of brain function, both through modelling (Neurophysics) and meta-analysis (Neurophilosophy). Last but not least are we trying to translate our results to medical and technical applications, as in the brain-computer interface and in constructing robots (for more details, consult our quarterly Newsletter on the ZKW homepage).

So in case you should be interested in how brains work and how we in Bremen study them: browse through this brochure. It’s your choice.

Best regards

Manfred Fahle
### Table of Contents

<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 – 7</td>
<td>Profile of the ZKW</td>
</tr>
<tr>
<td>8</td>
<td>Highlights of research from Main Groups of ZKW members</td>
</tr>
<tr>
<td>8 – 13</td>
<td>Focus on the Brain – Highlights from current research projects</td>
</tr>
<tr>
<td>14</td>
<td>Main Groups of the ZKW and their research</td>
</tr>
<tr>
<td>14 – 17</td>
<td>Prof. Dr. Canan Basar-Eroglu</td>
</tr>
<tr>
<td>18 – 21</td>
<td>Prof. Dr. Manfred Fahle</td>
</tr>
<tr>
<td>22 – 25</td>
<td>Prof. Dr. Axel Gräser</td>
</tr>
<tr>
<td>26 – 29</td>
<td>Prof. Dr. Dr. Manfred Herrmann</td>
</tr>
<tr>
<td>30 – 33</td>
<td>Prof. Dr. Ottheim Herzog</td>
</tr>
<tr>
<td>34 – 37</td>
<td>Prof. Dr. Michael Koch</td>
</tr>
<tr>
<td>38 – 41</td>
<td>Prof. Dr. Andreas Kreiter</td>
</tr>
<tr>
<td>42 – 45</td>
<td>Prof. Dr. Klaus Pawelzik</td>
</tr>
<tr>
<td>46 – 49</td>
<td>Prof. Dr. Dr. Gerhard Roth / Prof. Dr. Ursula Dicke / PD Dr. Dr. Gerhard Schlosler</td>
</tr>
<tr>
<td>50 – 54</td>
<td>Prof. Dr. Manfred Stöckler / Dr. Meinard Kuhlmann</td>
</tr>
<tr>
<td>55</td>
<td>Further departments of the ZKW and their research</td>
</tr>
<tr>
<td>56 – 59</td>
<td>Prof. Dr. med. Hans-Jochen Heinze</td>
</tr>
<tr>
<td>60 – 63</td>
<td>Prof. Dr. Claus Hilgetag</td>
</tr>
<tr>
<td>64 – 68</td>
<td>Dr. Dorothea Brückner / Prof. Dr. Thomas Hofmeister</td>
</tr>
<tr>
<td>69</td>
<td>Teaching and promotion of young researchers</td>
</tr>
<tr>
<td>70 – 73</td>
<td>Master of Neuroscience</td>
</tr>
<tr>
<td>74 – 75</td>
<td>Center for Advanced Imaging (CAI)</td>
</tr>
<tr>
<td>76 – 79</td>
<td>Bernstein Group for Computational Neuroscience Bremen</td>
</tr>
<tr>
<td>80</td>
<td>Cognium</td>
</tr>
<tr>
<td>81</td>
<td>Scientific Life</td>
</tr>
<tr>
<td>82 – 83</td>
<td>Academic appointments and activities outside Bremen University</td>
</tr>
<tr>
<td>84</td>
<td>Development of personnel</td>
</tr>
<tr>
<td>85</td>
<td>Grants from 2002-2007</td>
</tr>
<tr>
<td>86</td>
<td>Special awards for personnel of the main groups of the ZKW</td>
</tr>
<tr>
<td>87</td>
<td>Meetings and other activities</td>
</tr>
<tr>
<td>88 – 89</td>
<td>Partners of collaborations</td>
</tr>
<tr>
<td>90</td>
<td>Public relations</td>
</tr>
<tr>
<td>91</td>
<td>Contact/Editing/Coordination</td>
</tr>
</tbody>
</table>
Cognitive functions like perception, memory and behavior emerge from interactions of nerve cells in the brain. The processes in the brain that allow us to see, to remember or to perform appropriate actions are investigated by many different scientific fields ranging from physics, chemistry, biology, psychology, computer science, engineering to philosophy. Since the underlying processes interact on many spatial and temporal scales substantial progress in the endeavor of understanding brain functions will rely on close cooperation that includes several disciplines.

The Center for Cognitive Studies at the University Bremen encompasses basic and applied research groups in all the relevant fields: In Theoretical Neuroscience (Prof. Pawelzik, Prof. Bornholdt) mathematical models of neuronal systems are analysed and emerging properties of networks are studied in large scale computer simulations. In Neuropharmacology (Prof. Koch) the influence of various drugs and neuroactive substances on neuronal and synaptic activities as well as on behaviour are studied. In Neurophysiology (Prof. Kreiter, Prof. Roth, Prof. Dicke) neuronal activities are related to cognitive functions including attention and learning. In Neurology (Prof. Schwendemann) mental and neurological disorders are related to neuronal mechanisms. In Psychophysics (Prof. Fahle) experiments on perception and behavior are performed to reveal constraints on the underlying neuronal processes. In Neropsychology and Behavioral Neurobiology (Prof. Herrmann) and Cognitive Psychology (Prof. Basar-Eroglu) psychological phenomena are linked to physiological correlates of neuronal activities.

In Neuroinformatics (Prof. Hilgetag, Prof. Herzog) modern methods from computer science are used to analyse experimental data. In Engineering (Prof. Gräser) new approaches are used for the development of neuro-prosthesis. Last, but not least in Philosophy of Science (Prof. Stöckler) fundamental conceptual issues and the scope of current research in neuroscience are analysed.

This rich scientific environment of the Center for Cognitive Sciences promotes vivid interactions among researchers from the different groups that are documented in many joint projects being funded by the German research foundations (e.g. DFG, BMBF, VW) and the European Union as well as in many publications in highly ranked journals.

Since May 2008 a new building named ‘Cognium’ accommodates several core-laboratories. It also hosts a nuclear resonance imaging facility that is shared among all groups. Furthermore it serves as the physical center of the ZKW to catalyse interactions, organize workshops and to bundle teaching in the field of cognitive science. Here a Master Program ‘Neuroscience’ has been established and will start in autumn 2008. It will offer students acquisition of skills from a uniquely wide combination of scientific areas.

Common research aim of the centre is bridging the gaps between basic processes from single neurons and synapses via small networks to cognitive functions. Unravelling the neuronal mechanisms on the respective scales will provide important insights not only into the functioning but also into various malfunctions leading to neurological and psychiatric disorders, will contribute to novel diagnostic and therapeutic methods (e.g. neuroprosthesis), lead to new methods of data analysis (machine learning, neural networks) and last not least has a large potential to contribute to systems designs that emulate cognitive functions (as in robots that learn to behave successfully in their environments).
Highlights of research

Scientists in the ZKW collaborate on fundamental questions about the functioning of the brain, which have direct implications for everyday life: new insights from their research span from the development of innovative solutions for treating brain diseases to novel concepts being introduced in the social sciences. In the following, we will have a glance on the highlights of the broad research spectrum in the Center for Cognitive Sciences.

A central topic in brain research is to understand learning processes – virtually none of the higher brain functions could be realized without previously acquired knowledge or training. Prof. Dr. Manfred Fahle in the Institute for Human Neurobiology studies the role of perceptual learning combining psychophysical techniques with multi-channel recordings (similar to EEG) and functional Magnetic Resonance Imaging (fMRI). These investigations quantify how perception is improved by training, and reveal how neural activity and blood circulation in the brain change during this process. Surprisingly, perceptual learning turns out to be still possible in aged subjects – especially when the training method is tailored to a specific deficit, making this finding important for the rehabilitation of stroke patients. Reliable and correct feedback have a high impact on learning success, which confirm the necessity of a consistent evaluation of performance in school also from the viewpoint of the natural sciences.

On a molecular level, learning and adaptation is tightly linked to plastic changes in the nervous system being mediated or catalyzed through the presence of neurotransmitters. These changes are most pronounced during puberty, and consequently also very vulnerable during this critical period in life. In fact, experiments in the group of Prof. Dr. Michael Koch in the Department of Neuropharmacology investigating the influence of alcohol or cannabis on the developing brain show disquieting results: Complex behavioural tests establish neurobehavioural changes in young rats which are hardly or not at all curable. The warning to chronic cannabis use during early stages of development cannot be more alarming.

While learning accumulates additional information and context important to interpret or to handle a specific situation in life, other mechanisms in the brain actually seek to reduce the abundant, neverending stream of input from our sensory system to focus on the important information contained within. Attention, which is seen as a door to consciousness, is one of these mechanisms which direct and change the flow of information. As policeman interrogating witnesses know only too well, human observers are virtually blind for almost all aspects of a visual scene, unless their attention is directed to a specific feature, as e.g. the color of a car in a typical busy city scene. In the Institute for Theoretical Neurobiology, Prof. Dr. Andreas Kreiter and his group investigate how attention influences the spiking activity patterns of nerve cells in different brain areas. Hereby the researchers focus on collective phenomena responsible for the gating of information flow depending on the behavioural task, finding that oscillatory activity

Alcohol and drugs are dangerous, especially for the developing brain
in the Gamma range is enhanced when these neurons process attended stimuli, and suppressed otherwise. In cooperation with the Department of Theoretical Neurophysics, application of methods from machine learning determines the features in this data which carry stimulus- and task-relevant information, thus coming a step further in understanding the neural code.

But animals and humans not only use this passive form of selecting the data they need: in addition, they move around, interact with their environment, and are thus able to actively gather information which is missing or beneficial for survival. In cooperation with the Bernstein Centers for Computational Neuroscience (BCCNs), Prof. Dr. Klaus Pawelzik in the Institute for Theoretical Physics investigates principles of learning in such closed-loop systems. Simulations with robots (autonomous agents) reveal the surprising result that maximization of the reward leads to non-optimal behaviour: the agents become ‘blind’ for changes or even opportunities outside their well-explored, but narrow world. Thus curiosity and exploration appears to be more and more an elementary principle of successful learning, because it serves in addition to maximize the gain of information. Research in this field will soon explain the basic principles of how subjects learn to understand their environment and to gain independence, by autonomously selecting the informatizing they need without always requiring a teacher supervising their efforts.

Like selection of appropriate information implies ignoring irrelevant data, acting successfully requires suppression of wrong decisions: Prof. Dr. Manfred Herrmann in the Department for Neuropsychology and Behavioural Neurophysiology employs functional MRI, MEG and EEG recordings to locate the source of this important inhibitory mechanism. An unexpected finding is that this source is distributed over many different brain areas whose concerted actions are responsible for correct behavioural decisions. Studying the temporal dynamics of this process uncovers that many alternative decisions are ruled out by our brain even before we become conscious about this selection process. Especially at these early stages in the decision process it is strongly influenced by emotions. Success turns out to be only to a lesser extent the sum of correct decisions, but rather resulting from an effective suppression of faulty decisions that are recalled from our emotional memory. These findings provide a novel view on the role of emotions, which are often regarded as counterproductive to “normal”, rational reasoning. Supporting this viewpoint, detailed research in the Institute for Behavioural Physiology and Developmental Neurobiology by Prof. Dr. Dr. Gerhard Roth and Prof. Dr. Ursula Dicke on the limbic system of amphibians has demonstrated that emotions may be regarded as a memory for situations in which certain decisions led to success or to failure. This memory becomes perceptible as positive or negative emotions when similar situations are reoccurring – guiding our behaviour and sometimes even overriding logical reasoning: which makes perfect sense if the long-term benefit is more important than only short-time success.

However, everyday experience shows that even with emotion, decisions are often not easy to make. Situations in which two alternatives are equally favourable pose the emotion, decisions are often not easy to make. Situations in which two alternatives are equally favourable pose the brain into a struggle for perception. Stimuli with two possible interpretations are used as probes for investigating the brain processes which are putting all the “bits” of a scene together into a coherent percept. In the Institute for Psychology and Cognition Research, EEG recordings performed by the group of Prof. Dr. Canan Basar-Eroglu, Prof. Dr. Michael Stadler and Prof. Günter Vetter reveal the complex communicative processes between different brain areas during this perceptive struggle, and reveal how this exchange of information is impaired in humans affected by psychotic experiences. Often small changes in a stimulus’ context can change perception drastically.

Understanding this context-dependence of visual perception is not only important for studying higher cognitive processes, but also for technical applications as e.g. for intelligent image retrieval systems. While two pictures of a male face and a female face may be very similar on the basis of single image pixels, their semantic content is quite different for humans. The semantic analysis of pictures and videos thus profits from knowing how the brain analyzes visual scenes: segmentation of textures and contours, incorporation of temporal context, probabilistic inference based on prior knowledge, and controlled by directed hypotheses, are steps towards semantic retrieval systems and unsupervised content classification algorithms in large data bases. Prof. Dr. Otheline Herzog and his group at the Technology Center for Computer Science put these principles into action: their...
application ‘PictureFinder’ allows to find images with similar semantic content by simply providing the system with a picture sample or even with only a hand-drawn sketch of what users of this software are currently looking for. In a society where information plays a key role in life, technical solutions which provide the ‘intelligence’ to interpret data in a ‘human’ way are a great relief for visually impaired or blind people, allowing them to interact with their environment and hereby increasing their life quality.

The progress in implementing ‘intelligence’ into technical applications puts this concept into a new perspective. Almost all cognitive phenomena linked to intelligent behaviour are not unique to human beings, thus it is resonable to ask if mankind is really the crown of creation? Indeed it is possible to find neural correlates of intelligence even in amphibians. Prof. Dr. Ursula Dicke discovered that certain connective and dynamical properties of the cortex and pallium are tightly linked to intelligent behaviour in those animals. Thus the differences between animals and humans are predominantly quantitative – but not of a qualitative nature. One advantage of experiments with amphibians for modeling studies is that the structural complexity of their brains is comparable to state-of-the-art, large-scale computer simulations of neural networks, making it possible to test intuitions gained from behavioural experiments quantitatively in simulations or with real robots.

What does society gain from all these insights into brain function and cognition? First of all, understanding the brain enables us to invent strategies to counteract or to cure brain diseases, which is highly important for mankind. From the viewpoint of fundamental research, cognitive buzzwords like ‘attention’, ‘perception’, ‘intelligence’, ‘emotion’ and many others are demystified and replaced by more stringent, scientific concepts which can be measured and quantified, reducing arbitrariness in their usage and interpretation. Other findings in neuroscience research shed new or different light on social phenomena, giving impulses for establishing novel strategies in teaching, education and rehabilitation. In this context, we will close this overview by one research highlight in the Center for Cognitive Sciences which remained as yet unmentioned: the development of Brain-Computer-Interfaces (BCIs).

Many people suffer from brain diseases which impair their ability to walk, to speak or to move. Many patients are completely disabled after strokes, but with large parts of the brain being still intact. The idea of BCIs or brain prostheses is to record signals from the brain, to decode the intentions of the disabled subject from this data, and then to control a robotic device to perform the action the user of such a prosthesis has currently in mind. In the ZKW, the Institute of Automation, Institute of Theoretical Physics and the Institute for Brain Research are currently working on several major aspects in constructing robust, reliable and easy-to-use brain-computer interfaces. Advances are made in devising adaptive learning algorithms promising a much higher independence of the BCI user by eliminating recurring training procedures in a clinic. Further progress is in sight by the development of wireless recording technology, which is currently thoroughly tested in monkey experiments before being applied to human patients. An autonomous wheelchair is constructed that extends a subject’s autonomy even beyond the table’s range. These examples of BCI research are complemented by efforts to better understand the neural code in the visual system, e.g. for using attention to select letters on a spelling board, or for feeding visual signals in the brain of humans who have lost eyesight.

These highlights taken together demonstrate that neuroscientific research in the ZKW in Bremen has an excellent international standing in a competitive field, where different academic disciplines collaborate to understand the brain. We believe that this success will continue over the following years, and further establish the ZKW as one of the major neuroscientific research institutions in Germany, and in the world.

For a closer look into these highlights of ZKW research, please see our detailed brochure which can be downloaded from http://www.neuro.uni-bremen.de/~zkw/downloads/ZKW.pdf or sent to you by mail (send an e-mail to Agnes Janßen, ajanssen@neuro.uni-bremen.de).
Main Groups of the ZKW and their research

Institute for Psychology and Cognitive Neuroscience Research (Prof. Dr. Canan Basar-Eroglu)

The Institute of Psychology and Cognition Research was founded 1984, and today consists of several research groups: a) cognitive EEG research, b) psychology of gambling, c) psychology of arts and cultures, and d) forensic psychology. The EEG research laboratory was founded in 1996. It now forms one of the major research focuses of the institute and is associated with the Center of Cognitive Sciences.

The main topics are investigation of Event-Related-Potentials (ERPs) and Event-Related-Oscillations (EROs) of the brain during different cognitive processes, such as attention, perception and memory. Furthermore, our work has a clinical focus involving studies on clinical populations, such as patients with schizophrenia, multiple sclerosis, and parkinson’s disease. The general neurophysiological correlates of the cognitive processes in healthy young subjects are of interest as well as alterations of these processes during the lifespan (including childhood), in schizophrenia, in parkinson’s disease, multiple sclerosis and other neurological and psychiatric illnesses. Specifically, some of our current research projects include the following:

- Multistable visual perception: Reversible figures, such as the Necker cube, make up a well-known class of visual phenomena in which an invariant stimulus pattern gives rise to at least two different perceptual interpretations. A better understanding of the neurophysiological processes underlying perceptual reversals might help to disentangle bottom-up from top-down influences on multistable perception. Thus, the altered interplay of top-down and bottom-up processes and their neuronal correlates in different subject groups are also of interest.

- Working memory: Here, we investigate the relationship between executive control, specifically action monitoring and working memory (WM) formation and their neurophysiological correlates. The possible functional role of event related oscillatory activities during WM processes are the core of our studies in this field.

- Selective and sustained attention: Several studies show that neural phase-locking and synchrony are critical for attentional processes. Because of this, we investigate the interplay between EEG phase and power in the different frequency ranges. By applying long lasting sustained and selective attention paradigms (visual and auditory tasks) we find interesting results on how the brain coordinates attentional processes and response or response inhibition.

Canan Basar-Eroglu (Research interests: Electroencephalography (EEG), event-related dynamics and oscillations of the brain and body, perceptual and cognitive processes of the brain, brain dynamics in patients with neurological and psychiatric disorders)
Selected articles:


For further publications see:
http://www.ipk.uni-bremen.de/mitglieder/basar.html
Human Biology, or Biological Anthropology, tries to answer the question of ‘humanity’ from the standpoint of natural science. Our institute contributes to this aim by studying the human central nervous system, arguably the most complex and most specific human organ. We believe that most of the richness in behaviour, feelings, and emotions of human beings as compared to other animals is based in our brains. Our research is focused on those areas of the human cortex that are dealing with the processing of visual information. These areas make up about one third of the human cortex, so obviously, seeing is an important feat for humans and one that employs much of the brain.

The Human Neurobiology unit pursues two aims within this realm. The first is to study the function of the normal visual system by vision research, employing (mostly) psychophysical techniques including eye movement recordings and eye-hand coordination, combined with multi-channel EEG-recordings, MEG recordings, and functional Magnetic Resonance Imaging (fMRI). Here, the aim is to better understand visual scene analysis and object recognition in the visual system, including ‘Gestalt’ perception and plasticity and adaptation through visuo-motor feedback and learning. The emphasis lies on hyperacuity tasks, i.e. tasks yielding thresholds either below that of a foveal photoreceptor (in spatial hyperacuity) or below the temporal flicker frequency (in Temporal Hyperacuity, Figure Ground Segregation, and Parallel Processing) over the entire visual field.

The second aim of the unit is to make use of the results obtained within the unit as well as in other institutions pursuing basic research on the visual system to improve diagnosis (and eventually, treatment) of patients suffering from disorders of the visual cortices, i.e. to improve diagnosis of neuroophthalmological and some neurological patients. Here, the emphasis is on developing new and fast methods for screening as well as quantitative testing of the visual field and using electrophysiological, imaging, and new psychophysical techniques in the diagnosis of neuroophthalmological disorders. Thus, the unit bridges the gap between pure basic research into the visual brain on one side and clinical applications on the other side for example by developing new tools and techniques for clinical use.
Selected articles:


M. Herzog and M. Fahle, Modelling perceptual learning: difficulties and how they can be overcome, Biological Cybernetics 78, 107-117 (1998).


Invited articles:


For further publications see:
http://www.humanbio.uni-bremen.de/Forschung/publikationen.htm
The Institute of Automation at the University of Bremen (IAT) has a strong tradition in robotics and related technologies for assisting people with movement disabilities. Millions of people have movement disorders that impair communication or interaction with the environment, ranging from tremors and shaky movements caused by neurodegenerative disorders such as Parkinson’s disease to total paralysis resulting from brainstem stroke or irreparable injury to the spinal cord. IAT research explores substitute means of interaction for disabled persons, which reduces dependence on other people and widens the array of possible activities that can be performed.

The AMAROB group at IAT has developed the (semi) autonomous rehabilitation robot FRIEND II, a wheelchair combined with a robotic arm. FRIEND II is an assistive robotic system that allows people to send simple, high-level commands to accomplish supportive tasks. For example, a disabled user can direct FRIEND II to get a drink by issuing a single command. FRIEND II generates autonomously the necessary subtasks and accomplishes them to achieve the goal, such as getting a glass, opening a refrigerator door, getting a bottle, and pouring a drink into the glass. These tasks require dozens of movements that FRIEND II performs autonomously even in partially unknown environment without burdening the user with unnecessary details. Only if the autonomous control unit fails to find a solution is the user asked for support.

A vital part of an assistive robotic system is the interface between human and computer. Many patients are unable to use conventional interfaces such as keyboards and mice, and some are unable to use any interface that requires movement. The Institute of Automation has developed several brain-computer interfaces (BCIs) to allow people to communicate without movement. Instead, BCIs allow patients to send information directly through brain activity. Advanced signal processing methods are then applied to find patterns in the brain signals that could reflect commands such as spelling, getting a drink, or changing music.

As coordinator of the European Union project BRAINROBOT, the Institute of Automation is pursuing brain-computer interface research with several of the most highly regarded groups in the world, including labs in Graz, Tübingen, Glasgow, and New York. One BCI approach uses signals originating in the visual cortex to control a robot arm with 7 degrees of freedom, spell, or control a wheelchair. At the recent International Conference on Rehabilitation Robotics (ICORR), IAT gave a live demonstration of the FRIEND II system, controlled by an SSVEP based BCI, performing tasks in an intelligent kitchen environment. Other BCI systems being developed at IAT utilize other mental activities and brain regions, such as imagined motor activity over motor areas of the brain. BCIs may also be useful for rehabilitation. BCI systems were used to treat seizures already 20 years ago. Very recent work has shown that BCI training could also treat stroke, autism, attentional deficit hyperactivity disorder (ADHD), and other conditions. IAT is beginning a new research path to pursue rehabilitation applications of BCIs, with emphasis on ERD/ERS BCIs to treat both spasticity and paralysis resulting from stroke.
Selected proceedings:

B. Allison, B. Graimann and A. Gräser, Why use a BCI if you are healthy? Workshop Brain-Computer Interfaces and Games, ACE 2007, Salzburg (2007).

B. Graimann, B. Allison and A. Gräser, New applications for non-invasive Brain-Computer Interfaces and the need for engaging training environments, Workshop Brain-Computer Interfaces and Games, ACE 2007, Salzburg (2007).


For further publications see: http://www3.iat.uni-bremen.de/sixcms/detail.php?id=592&template=d_staff_publications

Bremen Brain-Computer Interface with spelling application

FRIEND II performing a semi-autonomous task

Spelling application and stimulation unit

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The Department of Neuropsychology and Behavioral Neurobiology is a recently established institution at Bremen University. It forms part of the interdisciplinary Center for Cognitive Sciences (ZKW). Research and teaching is based on a holistic concept combining (sub-) cellular and systemic approaches to Cognitive Neuroscience. The Department of Neuropsychology and Behavioral Neurobiology runs four labs:

- a functional imaging (fMRI) lab equipped with a 3T-MRT head scanner,
- an electrophysiology (ERP) lab equipped with 36- and 128-channel EEG devices,
- a molecular neurobiology group, and
- a clinical and experimental neuropsychology lab.

In the field of cognitive neuroscience we aim at the investigation of neuronal activity patterns underlying executive control processing by the use of combined spatio-temporal information. Recent research additionally focus on the neurobiological mechanisms underlying the emotional modulation of cognitive functions. Research in clinical neuroscience concentrates on release patterns of brain-originated proteins in acute and degenerative disorders of the central nervous system (CNS). We particularly try to study the association of molecular markers of brain damage and the short- and long-term behavioral and cognitive outcome, and how neuroprotective drug treatment affects both sequelae of brain damage.

There are several ongoing projects in the various fields of research outlined above:

**Molecular markers of brain damage:**
- Molecular marker of brain damage – Evaluation of a new luminescence immunometric assay to analyze GFAP in serum
- Molecular monitoring of neuroprotective drug treatment in acute stroke with human recombinant erythropoietin (rHuEPO)

**Executive control and action monitoring:**
- Working memory maintenance of simple and complex stimuli during continuous shape-tracking
- Cognitive control and error processing

**Emotional modulation of executive functions:**
- Interference processing in emotional face perception
- fMRI investigations of the perception of dynamic and static emotional expressions
- Neuronal correlates of perceiving and processing aggressive behavior
Selected articles


Selected books:


For further publications see:
http://www.neuropsychologie.uni-bremen.de/
The Image Processing Department attacks the content-based analysis of images and image sequences. To achieve this, high-level methods from artificial intelligence (knowledge representation and processing) as well as pattern recognition methods from image processing (segmentation, filters, colour, texture, and shape algorithms) are developed. As a result of the combination of high-level representations based on low-level features a technological breakthrough in the area of content-based image retrieval and the interpretation of images and scenes was achieved in the project IRIS - Image Retrieval for Information Systems.

The PictureFinder system allows for a graphical image retrieval based on colour, texture, and shape regions for very large image databases. Queries are formulated by sketches or by image examples. The needed colour and texture features are extracted fully automatically.

Through the projects DIVA, AVAnTA, and Advisor the research focus was extended from single images to image sequences. A large body of research was completed on the detection of shot boundaries, semantic video structuring, analysis of camera and object motion, detection of text in images, and topic classification in order to automatically extract data and metadata. Automatic video indexing methods are the basis of the SVP system which is able to analyse movies and to automatically generate trailers for them. The content analysis methods were also used for video art in the project iMediathek in cooperation with the University of the Arts, Bremen, and the video arts distributor ‘Heure Exquise’ France.

Highly specialized automatic image analysis methods are developed, e.g., in the project IBU in cooperation with the Alfred Wegener Institut für Polar- und Meeresforschung (Alfred Wegener Institute for Polar and Marine Research). This project deals with causes and effects of physical, chemical and biological gradients at the sea floor. ROVs collect large amounts of (image) data (see figure below). The data are automatically analysed for interesting features like bacteria, and the results are integrated into a GIS (Geographic Information System) for further processing.

Another line of research is the theory of qualitative representations of polygons which enables the qualitative comparability of visual shapes.

Furthermore, there is also a joint project with the OFFIS, Oldenburg, where city maps are analysed and the map features are represented by special sounds which can be selectively initiated by visual impaired people enabling them to selectively explore maps and understand their features.

Furthermore, the image processing department is a partner of the EU DELOS Network of Excellence for Digital Libraries and participates in the field of ‘Audio/Visual and non-traditional Objects’, especially with introducing and developing further multimedia indexing, management and search methods for large image and video data bases.

Otthein Herzog (Research interests: Knowledge management including spatial and temporal knowledge, context representation for dynamic scenes, data mining and knowledge discovery, automatic semantic content analysis and annotation of still images, videos and sound, video abstracting and automatic content-based generation of videos, advanced vision systems including 3D scenes)
Selected articles:


Selected proceedings:


Selected books:


For further publications see: http://www.tzi.de/de/publikationen/wiss-veroeffentlichungen/
The Department of Neuropharmacology has an active research programme in the areas of behavioural neuroscience and pharmacology in rodents. The main interest is focussed on the roles of the prefrontal cortex, the limbic system (amygdala and hippocampus) and the basal ganglia in different cognitive functions (learning, memory, attention, sensorimotor gating, behavioural flexibility and response inhibition). These brain systems and cognitive functions are relevant for the understanding of several neuropsychiatric disorders such as Parkinson’s and Huntington’s disease, dementias, schizophrenia, aggression, fear- and anxiety-related disorders, drug addiction, depression obsessive-compulsive disorder and attention deficit/ hyperactivity disorder, as well as frontal lobe injury.

Specific ongoing projects:

We investigate the role of the glycoprotein Reelin in cognitive processes and synaptic plasticity in the juvenile and adult rat. For this purpose, the Reelin-gene-translation is temporarily blocked by local application of antisense-oligonucleotides in the rat medial prefrontal cortex during maturational processes with subsequent behavioural testing as adults, and during learning of behavioural tasks known to be mediated by the prefrontal cortex. Another aspect of the behavioural and structural deficits induced by Reelin deficiency is covered by a project where the Reelin promoter is silenced by methylation due to chronic L-methionine treatment. The medial prefrontal cortex has been shown to regenerate to a vast extent after neonatal lesion. The aim of a current project is to further characterize the anatomical and biochemical alterations in the adult rat brain after neonatal lesion, with a special focus on proteins that are known to be changed in neuropsychiatric disorders, e.g. the 67 kD isoform of glutamate decarboxylase, a GABA synthesizing enzyme. Additionally, possible beneficial effects of an enriched environment on regeneration and functional recovery during early stages of life are examined.

The serotonergic system has been implicated in the regulation of impulsivity. We conduct behavioural pharmacological investigations in rats on impulse control mediated by the orbito-frontal cortex and the amygdala, measured within the 5-choice serial reaction time task paradigm, and its possible relation to aggressive and/or impulsive behaviour.

There is evidence that chronic cannabis use, especially during early stages of development, results in lasting neurobehavioural changes. We investigate altered activity of the CB1 cannabinoid receptor system after chronic exposure to a cannabinoid receptor agonist during puberty and adulthood. Additionally, this project tests the involvement of different brain areas (nucleus accumbens, hippocampus) in cannabinoid signalling related to behavioural changes, e.g. sensorimotor gating, and locomotor activity and learning.

A further project is concerned with the selective breeding of rats for high or low expression of prepulse inhibition (PPI) of startle. PPI is a measure for sensorimotor gating processes that are known to be disturbed in some neuropsychiatric diseases. We have now characterized rats with high and low PPI-performance using several behavioural paradigms in order to correlate cognitive functions to high or low PPI.
Main Groups of the ZKW and their research

Selected articles:


K. Schwabe, F. Freudenberg and M. Koch, Selective breeding of reduced sensorimotor gating in Wistar rats, Behav Genet 37, 706-712 (2007).


M. Schneider and M. Koch, Deficient social play in juvenile and adult rats after neonatal cortical lesion: effects of chronic pubertal cannabinoid treatment, Neuropsychopharmacology 30, 944-957 (2005).


M. Schneider and M. Koch, Chronic pubertal, but not adult chronic cannabinoid treatment impairs sensorimotor gating, recognition memory and the performance in a progressive ratio task in adult rats, Neuropsychopharmacology 28, 1760-1769 (2003).

Selected books:


For further publications see:
http://www.ifh.uni-bremen.de/koch/

The working group investigates the interaction between the cerebral cortex and subcortical structures (e.g. basal ganglia, hippocampus and amygdala) in cognitive functions and with regard to behavioral flexibility. We put special emphasis on the nature of neurotransmitters involved in these mechanisms, and how psychoactive drugs affect these systems.
Institute for Brain Research III. Department of Theoretical Neurobiology
(Prof. Dr. Andreas Kreiter)

Complex brain processes require the coordinated activity of a huge network of neurons in many cortical areas. Research within the Department of Theoretical Neurobiology is mainly directed towards the question, how these coordinated neuronal interactions are organized. An influencing theoretical framework that is extensively investigated in our group is the temporal correlation hypothesis. Within this framework, it has been stated that neuronal interactions take place by synchronization of neuronal spiking activity within the millisecond range. Synchronization of large groups of neurons may give rise to distinctive oscillatory activity patterns that recently have been closely associated with higher cognitive states of the brain, e.g. alertness and attention, memory, learning, and perceptual processes.

Recent research indicates that a wide variety of neuropsychiatric disorders like schizophrenia, epilepsy, and autism is associated with distinctive specific changes in the temporal interactions among neurons. It is therefore of basic and clinical interest to understand the organizing principles behind the coordinated activity of neurons that constitute functional assemblies. Our research focuses on the mechanisms by which individual neurons are grouped into functional assemblies and how the information flow in the cortex is dynamically routed. We further investigate mechanisms and coding strategies used to process information within such functional groups.

Our research programme is mainly based on single and multi-electrode recordings from monkey visual cortex. We use elaborated cognitive tasks requiring e.g. selective attention, working memory, or object recognition in order to study neuronal processes that are closely associated to these brain states, and a wide variety of analytical tools to reveal the underlying computational principles. In addition, we employ monkey and human fMRI in order to bridge the gap between neurophysiology and neuroimaging as well as psychophysical experiments for testing predictions derived from neurophysiological and modelling data with respect to their impact for perceptual processes. In addition, the group continuously aims to improve established methods and to develop new techniques in order to gain deeper insight into the important field of the principles of neuronal interactions.

The work with behaving macaque monkeys requires serious and steady efforts to ensure well being of the animals. Our monkeys are housed in a sophisticated animal facility with manifold possibilities to play, interact, explore or relax. All training is strictly confined to positive reinforcement techniques, and all experimental methods are designed with respect to the welfare of the animals.

The department has many co-operations, among which the close collaboration with the Institute of Neurophysics at the University of Bremen is of outstanding character. In addition, the department is part of the Center for Advanced Imaging (in cooperation with the University of Magdeburg), and the Bernstein Center for Computational Neuroscience (in co-operation with the University of Göttingen). The group is currently supported by several grants from the German Research Association (DFG), the Federal Ministry of Education and Research (BMBF), and by individual grants to various group members.
Selected articles:


For further publications see: http://www.brain.uni-bremen.de/research/publikationen.htm

Selected book chapters:


For further publications see: http://www.brain.uni-bremen.de/research/publikationen.htm

Working group

Manufacturing of glass microelectrodes. The department possesses sophisticated technical equipment in order to develop and improve experimental techniques.

The tip of a quartz-platinum micro-electrode is ground under microscopic inspection.

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Main Groups of the ZKW and their research

Institute for Theoretical Physics, Neurophysics
(Prof. Dr. Klaus Pawelzik)

One of the greatest challenges of our time is understanding the function of the brain - which mechanisms in our brain allow us to see, to hear, to act, and to feel? In the past decades, neurobiological, biochemical, biophysical, and psychophysical research has uncovered a growing body of special knowledge on specific aspects of brain function, ranging from the detailed properties of single nerve cells up to the different principles governing human perception.

Still, many seemingly simple questions are largely unanswered. What code does the brain use for transmitting and processing information? What are the neural mechanisms and algorithms explaining perceptual phenomena like object recognition or figure-ground segregation? How does the brain memorize and recall information? How does it adapt to different sensory environments or to different behavioral tasks? What are objectives and principles underlying the emergence of behaviour?

It is generally accepted that the neocortex with its numerous, tightly interconnected grey cells contains the key to these questions. Theoretical Neurophysics aims at finding answers by developing and studying fundamental concepts of neuronal information processing. Emerging hypotheses of brain function are evaluated by analyzing and simulating models of neural networks which incorporate experimental evidences from multiple disciplines.

The starting point of our investigations is the hypothesis that cortical information processing relies on the collective dynamics of neural populations and of their synaptic interactions. Within these populations, perception and other cognitive functions are expressed in the spatio-temporal arrangements of activity patterns and synaptic efficacies. Simulations of neural networks reveal emergent collective phenomena which might underly cortical function. Methods from mathematics and physics allow one to analyze these phenomena and understand underlying mechanisms. Close collaborations within the ZKW allow us to test theories of brain function in neurophysiological, neuropharmacological, and psychophysical experiments. Bridging these different methodological approaches, Theoretical Biophysics provides the much needed links between seemingly unrelated or even contradictory empirical evidences.

Here is a short glance on selected topics which are currently pursued by our team: Encoding and Decoding of Information

We evaluate methods and models of fast information transmission with stochastic action potentials (spikes), and suitable algorithms for decoding the information contained in this activity. One goal of our studies is to develop efficient neuronal networks which are capable to solve real-world tasks like object recognition with as few spikes as possible. Another objective is to understand cortical representation of information by decoding brain signals. In collaboration with the Institute for Brain Research, we investigate how attention improves coding accuracy and how complex visual stimuli are represented in the cortex of awake behaving macaque monkeys. Understanding this encoding allows us to design improved algorithms for Brain-Computer Interfaces (BCI) which will help handicapped people to regain autonomy. In cooperation with industrial partners, we develop wireless electrodes for improving autonomous recording of brain signals for BCI applications.

In the early visual system, many neural computations take place that are fundamental for perception and object recognition.
We intend to identify suitable mechanisms or building blocks of these computations which are compatible with the known neurophysiology. Focusing on the processes of contour integration and feature binding, we combine modeling studies and theoretical analysis with electrophysiological and psychophysical experiments in animals and humans, in collaboration with the Institute for Human Neurobiology and Institute for Brain Research. Combining investigations on these different levels allows us to evaluate competing model classes and to discover previously unknown principles of brain function.

**Exploration, Learning and Sensorimotor-Control**

Navigation in an unfamiliar environment is a challenge both for humans and mobile robots: using sensory information only, one has to build an ‘internal representation’ of the surrounding areas efficiently and rapidly. An agent moving in a changing world is a highly recurrent, adaptive system which needs suitable learning algorithms in order to produce meaningful behaviour. The development and analysis of such algorithms is one goal in our studies, which includes testing of exploration strategies in real robots helping to understand human and animal behaviour in similar situations. An intriguing aspect in such a ‘closed-loop’ system are changes in the environment: how flexibly can agents adapt to them? Theoretical investigation of this problem for the control of posture (balance) or limb movement is complemented by empirical studies in virtual reality environments in the Institute for Human Neurobiology.

**Selected articles:**

- David Rotermund, Udo Ernst, and Klaus Pawelzik, Towards online adaptation of neuro-prosthesis with neuronal evaluation signals, Biological Cybernetics 95 (3), 243-257 (2006).

**For further publications see:**

http://www.neuro.uni-bremen.de
Institute for Brain Research I, Department of Behavioral Physiology and Developmental Neurobiology
(Prof. Dr. Dr. Gerhard Roth, Prof. Dr. Ursula Dicke, PD Dr. Dr. Gerhard Schlosser)

Our research at the department of behavioral physiology and developmental neurobiology focuses on three topics (1) the interplay between cognitive and emotional-affective functions, (2) ontogeny of sense organs, and (3) nerve regeneration.

The first topic includes studies on visual guidance of feeding behavior in amphibians. Amphibians have the simplest brains among terrestrial vertebrates, which at the same time contain essentially all cognitive and emotional centers found in the mammalian brain. We investigate how prey object recognition, prey selection, emotional-affective formation of prey preferences and motor control of prey capture proceed at the level of single cells and their components, such as synapses, as well as of small and intermediate neuronal network. Our studies include behavioral experiments (stimulus preference tests, positive and negative conditioning), functional neuroanatomy and immunocytochemistry, extra- and intracellular electrophysiology in vivo and in vitro. Our ultimate goal is a qualitative and quantitative assessment of the pathways from sensory perception via cognitive-emotional evaluation and learning to motor action. This insight into the construction principles of brains could form the basis for the creation of artificial self-evaluating systems such as ‘autonomous’ robots.

Emotional-affective behavior is likewise studied in inbred strains of rats. We attempt to elucidate the different components of agonistic-aggressive behavior with respect to sex, experience, intrasexual and intersexual dominance, and related changes at the level of neurotransmitters and (neuro)hormones.

The second topic of our work concentrates on the ontogeny of sense organs in amphibians. Here, we study different aspects of early placodal development in embryos. We focus on the early embryonic origin of placodes and the expression patterns of several genes such as Eya1 and Six1.

The third topic includes regeneration of nerves in rats, which is studied by allotransplantation of nerve segments or artificial nerve conduits. The success of long-term regeneration is assessed by walking track analysis and histological methods. These investigations are conducted in collaboration with clinicians. Our goal is a comparison of nerve reconstruction procedures based on animal experiments with those commonly applied in the clinic.
Selected articles:


N. Schuelert and U. Dicke, Dynamic response properties of visual neurons and context-dependent surround effects on receptive fields in the tectum of the salamander Plethodon shermani, Neuroscience 134, 617-632 (2005).


Selected books:


For further publications see:
http://www.ifh.uni-bremen.de/roth/eindex.html
http://www.ifh.uni-bremen.de/dicke/index.html
The study of philosophical problems in physics, biology and economy is one of the central themes at the Institute for Philosophy. We offer courses and interdisciplinary seminars on methodological issues of physics and biology as well as on topics from the philosophy of mind and on philosophical aspects of neurosciences.

We are especially interested in details of the relation between fundamental and special sciences. Various concepts of reduction and emergence have been studied in this context. We analyze the prospects and limits of atomistic research strategies and the epistemic and ontological reasons for acknowledging new levels of nature. A central topic is methodological problems arising in theories of complex systems.

**Ongoing Research Projects**

**The Nature of Time**

It is a classical philosophical puzzle how the modal time, the series of past, present and future, the passing ‘now’, is related to objective physical processes or possibly to processes in the brain. We survey new results in the foundations of thermodynamics, in neurosciences and in the metaphysics of time in order to find out how our experience of modal time can be integrated into a naturalistic world view.

**Interpretation of Quantum Field Theory**

Quantum Field Theory is the most basic ‘language’ in fundamental physics. Despite its practical success the debate on the nature of the basic entities of this theory (particles? fields?) is still going on. Our aim is the establishment and evaluation of different ontological interpretations of quantum field theory. Some of our more extensive studies deal with different substance ontologies as well as with process and trope-ontological models.

**Basis Ontologies**

The discussions in quantum physics are a special case of the more general question how scientific disciplines construct or determine their basic objects. Our aim is to analyze the logic behind the determination of such basis ontologies. To put it another way, we do not pursue what the basis ontologies of particular sciences are; rather we analyze which criteria (‘being uncomposed’, ‘being unstructured’, ‘being the smallest functional unit’) lead to basis ontologies. We investigate examples of particular sciences, which
can be characterized by the key words fundamental, organic and formal (or structural), thus representing a broad spectrum of types of sciences. We aim to formulate a comprehensive meta-criterion which explains the special criteria of special sciences and their function. The results will provide us with a deeper understanding of the hierarchical structure of the sciences and the stratification of nature.

Methods in Physics and Economy

Econophysics applies methods of theoretical physics to economical problems. The successful transfer of methods into a quite different area of science is puzzling. The surprise about this similarity of activities in statistical physics and econophysics is partly due to the fact that in physics fundamental theories are available while this is not the case for large areas of economics, e.g. for financial markets. Nevertheless, in both fields models are used that are to a certain degree independent from an underlying theory. While in statistical physics fundamental theories are often not needed since various micro details are irrelevant for many questions, a corresponding fundamental theory is simply nonexistent for many economical issues. The nonexistence of fundamental theories in economics need not imply that models only act as substitutes. It is the very similarity between statistical physics and econophysics, e.g. for financial markets. Nevertheless, in both fields models are used that are to a certain degree independent from an underlying theory. While in statistical physics fundamental theories are often not needed since various micro details are irrelevant for many questions, a corresponding fundamental theory is simply nonexistent for many economical issues. The nonexistence of fundamental theories in economics need not imply that models only act as substitutes. It is the very similarity between statistical physics and econophysics, e.g. for financial markets. Nevertheless, in both fields models are used that are to a certain degree independent from an underlying theory. While in statistical physics fundamental theories are often not needed since various micro details are irrelevant for many questions, a corresponding fundamental theory is simply nonexistent for many economical issues. The nonexistence of fundamental theories in economics need not imply that models only act as substitutes. It is the very similarity between statistical physics and econophysics, e.g. for financial markets. Nevertheless, in both fields models are used that are to a certain degree independent from an underlying theory. While in statistical physics fundamental theories are often not needed since various micro details are irrelevant for many questions, a corresponding fundamental theory is simply nonexistent for many economical issues. The nonexistence of fundamental theories in economics need not imply that models only act as substitutes.

Explanations in Complex Systems

Econophysics is a great challenge to theories of explanation that are offered in the philosophy of science. There seem to be four main aspects of explanation (subsumption, unification, causality, pragmatics). In contrast to most of the literature we do not treat any one of these four aspects as the basis for a monistic theory of explanation. Rather we think that only the consideration of all four aspects yields a more or less complete picture of how econophysics (or in general: sciences of complex systems) explain. The identification of ‘mechanisms’ seems, for example, to be essential in order to explain the behaviour of complex systems. Our conception of mechanisms differs from other approaches in a number of respects. Although we like and draw on Woodward’s theory of causation, we think that his notion of mechanisms is too abstract for a satisfactory understanding of scientific practice. Science is in large part concerned with the identification of mechanisms, in a way that is as detailed and empirically connected as possible. To this end, scientists specify how the parts of a mechanism interact to produce a certain behaviour. Our account of mechanisms is largely in accord with Glennan’s, the most important difference concerns his notion of a complex system. We think that contemporary theories of complex systems, such as the ones one encounters in econophysics, use a more specific concept of a complex system than Glennan’s. We argue that it is more appropriate to analyze a mechanism as a robust dynamical feature of a model for the generation of higher-level patterns in terms of lower-level interactions.

Selected articles:


Main Groups of the ZKW and their research
Selected books:


For further publications see:

http://www.philosophie.uni-bremen.de/fileadmin/mediapool/philosophie/Publikationslisten/Publikationsliste_Stoeckler.pdf

http://www.philosophie.uni-bremen.de/fileadmin/mediapool/philosophie/Publikationslisten/Publikationsliste_Kuhlmann.pdf
Further departments of the ZKW and their research

DEPARTMENT OF NEUROLOGY II
Head: Prof. Dr. med. Hans-Jochen Heinze
Department of Stereotactic Neurosurgery
Head: Prof. Dr. med. Jürgen Voges
University of Magdeburg

The main focus of research at the Department of Neurology II is the cognitive control of human behaviour from a behavioural neuroscience perspective. This theme is divided into several subtopics that are investigated in the Center of Advanced Imaging (CAI) established in 2002 as an integrated neuroscientific research center for the Department of Neurology II at Otto-von-Guericke Universität in Magdeburg (the coordinating institution), the Leibniz Institute for Neurobiology in Magdeburg (IfN), the Zentrum für Neurowissenschaft (ZeN) in Bremen, and the Hanse Wissenschaftskolleg in Delmenhorst. In addition, the recently (2005) founded Department of Behavioural Neurology is concerned with neural mechanisms underlying human behaviour.

The CAI concentrates on investigations of the control of higher brain functions in the following three areas: visual and auditory perception, memory, decision-making and activity control. We investigate the ability of humans to coordinate thoughts and actions with internal goals and concepts. The aim is to identify the neural mechanisms which transform strategies, expectations and convictions into percepts, memory traces, emotions, language and action.

Prof. Dr. med. H.-J. Heinze
(Research interests: Functional imaging of cognitive functions of visual attention and reward processing, behavioural neuroscience, awareness and consciousness)

The comparison of data from studies in humans and animal experimental results allows for an enhanced understanding of brain imaging outcomes. An additional shared goal is the development of new neuroimaging and visualization techniques. More detailed information is provided on the CAI-Web presentation at http://www.med.uni-magdeburg.de/cai/index.htm

At the Department of Behavioural Neurology, we investigate neural mechanisms underlying human behaviour, with particular emphasis on processes related to motivation and the control of perception, learning and action. Our methodology is characterized by a multimodal approach combining neuropsychological testing with non-invasive brain imaging (fMRI/ PET) and electrophysiology (EEG/MEG), (ii) intracranial recordings from target brain structures in awake patients and (iii) molecular biological and biochemical approaches (molecular genetics, immunohistochemistry).
In the following we provide a short survey of some of the department’s working groups:

**Visual attention and perceptual learning**

The research group “Visual attention and perceptual learning” focuses on the neural mechanisms that underlie the enormous flexibility and plasticity of visual selection (Hopf et al., 2005). To this end we combine several non-invasive technologies that provide high temporal (MEG, EEG) and high spatial resolution (fMRI) to assess brain activity in human observers.

**Stereotactic Neurosurgery**

As a well-established method in the treatment of advanced-stage Parkinson’s disease and related movement disorders deep brain stimulation (DBS) is also successfully used in psychiatric conditions, particularly obsessive-compulsive disorder. It has also been accepted as an experimental therapeutic approach in therapy-refractory cases of other neuropsychiatric disorders, such as depression and addiction. With the goal of supporting the identification of optimal target points for the stimulation we use invasive recordings are likely to provide insight into electrophysiological mechanisms related to the basic brain function represented in these structures.

**Object based selection, Neuroplasticity**

This research group focuses on the neural and psychological mechanisms underlying human perception and cognition, with particularly strong interests in the mechanisms of visual attention and perception. To study these phenomena we combine various brain imaging techniques, principally event-related potentials (ERPs), magnetoencephalography (MEG) and functional MRI (fMRI), along with concomitant recording of behavioural measure.

**Selected articles:**


For further publications see: http://neuro2.med.uni-magdeburg.de/site_de/frameset.html

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The field of systems neuroscience is currently undergoing a major paradigm shift. Theories in which the brain is understood as a simple accumulation of specialized components are being replaced by approaches which describe the nervous system as a complex network of many interacting processors. Our lab contributes to these new approaches by addressing structure-function relationships in complex neural networks. In particular, we investigate the layout and global organization of connections in the mammalian cerebral cortex, which is responsible for the impressive, diverse and adaptive functions of the mammalian brain.

Organization of complex brain networks

Our main effort is devoted to investigating the fundamental principles of the organization of complex brain networks using theoretical analyses. We collaborate closely with neuroanatomists who study fiber connections among different brain regions. We have developed new computational approaches for the global analysis of these very many projections in the mammalian cortex. Such analyses have revealed surprisingly regular cortical projection patterns, as well as a highly modular organization of structural connections and functional neural interactions. In addition, our modeling studies investigate how the specific neural topology arises during brain development, and how the structural features contribute to the efficient and robust functioning of the brain. This research focus is linked to network studies carried out at the Institute of Theoretical Physics (Prof. Bornholdt, Prof. Pawelzik).

Functional contributions of specialized components in brain networks

Our theoretical studies are complemented by experimental investigations that characterize the functional contributions and interactions of specialized components in brain networks, based on performance changes after brain lesions. This research particularly focuses on the brain network for spatial attention, which is distributed over several cortical and subcortical stations and is known for dynamical adaptation phenomena. These phenomena include ‘paradoxical’ lesion effects, in which some aspects of behavior surprisingly improve after lesions or impairment of neural components. We have produced such effects experimentally in healthy human subjects, using the ‘virtual lesion’ technique of transcranial magnetic stimulation (TMS). In collaboration with Prof. Fahle of the Institute of Human Neurobiology, we also use TMS to probe the adaptive organization of the human visual cortex. In addition, we have developed a game-theoretical analysis approach for identifying the causal functional contributions of brain regions from multiple-lesion experiments. These approaches illuminate the complex network function of the brain and provide the basis for new therapeutic approaches in the treatment of patients after brain injuries.
Selected articles:


For further publications see:
http://www.jacobs-university.de/schools/ses/chilgetag/08366/
Honeybee Research Unit
(Dr. Dorothea Brückner)

The research of the honey bee research unit (Forschungstelle für Bienenkunde) deals with many aspects of the behaviour of honeybees (Apis mellifera). Honeybees show unique behaviour on the individual as well as on the colony level. The complexity of honeybee behaviour is one of the most highly developed in the whole animal kingdom.

After a detailed study of the olfactory system of worker and male bees (drones) which show a sexual dimorphism in their brain structures, I have extended my research topic towards a comparison of the European and Asian honeybee species, Apis mellifera and Apis florea. The minaturisation of the brain of the dwarf honeybee, Apis florea might lead to behavioural constraints concerning learning and memory storage of individuals as measured with the PER paradigm. We study their brain structure in relation to various cognitive abilities of individuals as well as of the colony as a whole.

A second topic that I pursue is the comparison of cognitive functions of humans in art and science. How many common principles are there to be found in pictorial presentations, colour codings and figures of artists and scientists. This work is jointly done with the artist Bärbel Rothhaar partly on the basis of her work with living bees in art.
Selected articles:


A. Brockmann and D. Brückner, Structural differences in the drone olfactory system of two phylogenetically distinct Apis species, Apis florea and Apis mellifera, Naturwiss. 88, 78-81 (2006).


Selected books:


For further publications see: http://bienenkunde.uni-bremen.de/index.php/Publications

Proboscis extension behaviour (PER) of a honeybee worker

Our research focuses on information acquisition, processing, and decision making in animals. It is based upon a behavioural ecological approach, often using a combination of theory, in order to generate testable predictions, and experimentation. Currently, we have three main topics in this field of research, namely (1) the mechanistic rules of animal decision making, (2) information acquisition and learning in insects, and (3) the condition dependent plasticity of animal decisions.

The first topic mainly uses insect parasitoids – small insects that forage for the developmental stages of other insects on which they oviposit and on which their offspring develop – that often need to maximize the encounter rate with host insects and thus their lifetime reproductive success. Insect parasitoid systems are ideal research subjects in this respect, because their foraging success is directly linked to measurable increments in Darwinian fitness. In order to maximize foraging success, parasitoids need information about the quality of the habitat they search. Using theory guided experimentation and statistical models for data analysis, we investigate which information cues and signals are of importance and how this information is used in the decision making process. Lately, we have started to compare such mechanisms of information use in decision making in insect parasitoids and humans that we confront with comparable foraging scenarios.

Our second research topic focuses on the kind of information used and the storage of information for further decision making. We ask, among a huge variety of available information cues and signals, which are the most relevant and which are the ones taken into consideration by insect parasitoids. We also investigate whether information is stored in the short, medium or long term memory, and we plan to elucidate the similarities and differences between associative learning and the learning of information like habitat quality estimation that requires constant updating.

In our third topic we acknowledge that external states like the quality of a habitat or internal states like physiology are not constant enough to allow invariant responses across the lifetime of an organism. We therefore study the plasticity and behavioural response to changes in external and internal states. These experiments are usually guided by dynamic theory that is able to predict optimal responses to alteration in external and internal states. For example, we analyse an animal's willingness to take risks as a function of the possible gains it can achieve.

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Thomas Hoffmeister (Research interests: Animal information use and decision making, predator prey interactions, parasitoid life-history evolution, chemical communication). What search pattern is used by parasitoids when they search for host larvae?

Professor Thomas Hoffmeister monitors a wasp’s behaviour and search path by means of a video tracking programme. He is then able to calculate the time female parasitoids spent at any one location, the search trail they follow and the behavioural patterns which are revealed.

Our second research topic focuses on the kind of information used and the storage of information for further decision making. We ask, among a huge variety of available information cues and signals, which are the most relevant and which are the ones taken into consideration by insect parasitoids. We also investigate whether information is stored in the short, medium or long term memory, and we plan to elucidate the similarities and differences between associative learning and the learning of information like habitat quality estimation that requires constant updating.

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Proboscis extension behaviour (PER) of a honeybee worker

Department of Animal Population Ecology
(Prof. Dr. Thomas Hoffmeister, Dr. Andra Thiel)
Selected articles:


Selected books:


For further publications see:
http://www.popecol.uni-bremen.de/
The international Master of Neuroscience programme at the University of Bremen will start in autumn term 2008. It will be held by all members of the ZKW in cooperation with the different neurological and psychiatric hospitals in Bremen as well as with the Center for Advanced Imaging (CAI).

The programme provides an intensive education in the neurosciences that will give an excellent background for further education (graduate training) in all disciplines of basic research neuroscience as well as in clinical neuroscience. Although covering a broad scope of neuroscientific approaches the emphasis of the programme is on cognitive and computational neuroscience.

The curriculum is mainly provided by the groups of the Brain Research Institute in the Faculty of Biology (Fachbereich 2), i.e. by the Departments of Behavioural Physiology and Developmental Neurobiology, Human-Neurobiology, Neuropharmacology and Theoretical Neurobiology, as well as by the Institute of Theoretical Neurophysics (Fachbereich 1/Physik), the Institute of Psychology and Cognitive Sciences and the Department of Neuropsychology and Behavioural Neurobiology (Fachbereich 11/Psychologie). Students can also attend modules provided by the Master programme in Informatics, in Ecology, and in Biochemistry and Molecular Biology.

The Master programme covers four semesters (120 CP incl. Thesis) and includes the following modules:

• Cellular and Molecular Neurosciences
• Systemic Neurosciences
• Theoretical Neurosciences
• Complementary Methods in Neurosciences
• Neurogenetics
• Neuro- and Electrophysiology
• Neuroparmacology
• Experimental Neuroanatomy
• Behavioral Physiology
• Psychophysics and Human Neurophysiology
• Clinical Neuroscience
• Functional MR-Imaging
• Electroencephalography
• Neurophysics
• Neuroinformatics
• Project Proposal and Defense
• Lab Rotation 1 and 2, or clinical hospitalitation
• Master Thesis and Colloquium

Applicants should hold a Bachelor of Sciences in Biology, Chemistry, Physics, Psychology, Informatics, or an equivalent in human or veterinary medicine, and shall be selected on the basis of their educational achievements by a selection committee.

Promotion of young researchers 2007 and in the near future

The main groups of the ZKW aim at promoting young researchers. This is done in different ways:

In February 2007 the spring school ‘Neurosensory and Cognitive Science in the North’ took place at the Hanse Wissenschaftskolleg (HWK), Delmenhorst and another one is planned for 2008. It is a joint project of the HKW Delmenhorst, the Carl von Ossietzky University of Oldenburg and the University of Bremen. The spring school is designed primarily to suit the interests of Ph.D. candidates within various fields of neuroscience such as neurobiology, neuropsychology, biophysics and medical physics. Application is open for candidates who have a qualified university degree (BSc, MSc, Diploma) or have passed the intermediate diploma examination. About 28 participants took part.

Several members of the ZKW participate regularly in scientific colleges organized by the Biological Sciences Section of the ‘Studienstiftung des Deutschen Volkes’, e.g. in Köln in September 2007 (others are planned for April and September 2008), in the summer-academies ‘Seele und Gehirn’ in Göttingen and ‘Dynamics of cognitive processes in the brain’ in Olang, both in September 2007. Prof. Dr. Dr. Gerhard Roth, Director of the Department of Behavioral Physiology and Developmental Neurobiology, is President of the ‘Studienstiftung des deutschen Volkes’.

The Norddeutsches Exzellenz-Netzwerk, NEN (Northern German Network of Excellence) at the HWK, Delmenhorst, offers professional programmes addressed to especially talented PhD students in the natural sciences, biosciences, social and arts sciences. There are meetings several times during a year, e.g. Oct. 2007 (‘Die Natur des Geistes’), March 2008, Oct. 2008 and March 2009. Presently all High Schools in Lower Saxony, the University of Bremen and Magdeburg are involved.

The European Diploma in Cognitive and Brain Sciences (EDCBS) is a still very young European initiative. It was started by a group of scientists with support from the HWK in Delmenhorst, the Max Planck Institute for Psychological Research in Munich, the University de la Laguna and the Town Council of Tenerife. The main purpose of the EDCBS is to bring together highly motivated young scientists from a variety of disciplines and countries and give them advanced training over the most relevant topics, and a critical overview of current debates and controversies in the field. Also, fostering a network for future research in Europe is very important.

Some of the main groups are engaged in programmes for exchange of students like Erasmus (exchange of students from European Universities), DAAD - Acciones Integradas Exchange Program with the University of Barcelona, KAIST (Korean Advanced Institute Science and Technology), USA (Harvard, MIT), Spain (Barcelona and Madrid), UK (Exeter, Northumbria) and Australia (Melbourne, Sydney).

Another joint project of the HWK, the University of Bremen and the Jacobs University Bremen called Research Group ‘Neuroscience of Emotion’ should be mentioned.

Since 2002 there is a yearly Postdoc-Workshop taking place on different islands in the North Sea. This workshop is a forum providing a comprehensive overview of the actual research topics in the ZKW on a post-doctoral level. With plenty of time allotted for discussing projects, one of its main goals is to identify potential collaborations for exploiting the synergies between the members of the ZKW.

Support of young people already starts at school. Within the project ‘Jugend forscht’ (young people researching) 2 pupils won the 1st price in Bremen and ‘Nachwuchspreis’ (young researcher price) of the Neurowissenschaftliche Gesellschaft (NWG) in 2005. They were supported by Prof. Kochs group at the Bremen University.

October/November 2004: Island Workshop on Spiekeroog
The Center for Advanced Imaging (CAI) is an initiative combining research groups at the Universities of Magdeburg and Bremen, and at the Hanse-Wissenschaftskolleg (HWK) at Delmenhorst. It was installed by the Bundesministerium für Bildung und Forschung, BMBF (German Ministry for Education and Research) in 2002 as one out of five centers of excellence in the field of brain imaging in Germany. In 2006 the BMBF funding was extended for another 3 years period.

During the first phase of funding the CAI initiative has substantially improved the conceptual, methodological and structural basis of systemic and clinical neurosciences at the universities of Magdeburg and Bremen, and has shaped basic and clinical research at the cooperating universities and hospitals in the northern part of Germany.

Since installation of the CAI at Bremen University a variety of milestones were achieved:

- A scientific framework was installed that has integrated the pre-existing basic and clinical research expertise at both universities into a synergistic network.
- An organization was build up which successfully manages a large number of national and international projects, cooperative enterprises, and grant applications.
- Methodological and technological issues focus on a special expertise in multimodal imaging, image post-processing, spectroscopy and high-field MR technology.
- The universities introduced a special program for the education of top-level young scientists in the fields of systemic neurosciences and neuroimaging within the teaching program of a M.Sc. degree of Neurosciences.

The success of the center has fostered a general political decision by the states of Sachsen-Anhalt and Bremen. In the Free Hanseatic City of Bremen the cognitive neuroscience is considered a high priority topic within the framework of the Science Plan 2010 both with respect to research and teaching facilities promoted by the Senator für Bildung und Wissenschaft (Senator for Education and Research). During the current funding period, the central theme of the CAI has emerged as Cognitive Control of Human Behavior. This topic refers to the ability of humans to coordinate thoughts and actions with internal goals and concepts. The research program aims at the identification of the neural mechanisms which transform strategies, expectations and convictions into percepts, memory traces, emotions, language and action. Thus, the focus of research is the translation of top-down control into the cortical periphery. According to this central topic of the CAI the Bremen site focuses on the experimental and methodological implementation of a combined human and animal approach in cognitive neuroscience. Main research topics are within the area of ‘attention / perception’, ‘memory’ and ‘methods and technology’. Based on the development of new methods in the field of structural and functional MR-imaging and -spectroscopy these efforts are expected to contribute to comparing and contrasting animal and human data. Thus, the present approach will promote the endeavour to reduce, refine and replace (3R) research in nonhuman primates.

The CAI-Bremen is organized and coordinated by the Department of Neuropsychology and Behavioral Neurobiology (Prof. Dr. Dr. Manfred Herrmann) and forms a central institution at the new Cognium building which will also house the major part of working groups in the field of Cognitive Neuroscience at Bremen University. The Bremen CAI project comprises the following departments and advising board of directors:

- Department of Human Neurobiology (Prof. Fahle)
- Department of Theoretical Neurobiology (Prof. Kreiter)
- Department of Instrumental Analysis (Prof. Leibfritz)
- Department of Neuropsychology and Behavioral Neurobiology (Prof. Herrmann)
- Center for Medical Diagnostic Systems and Visualization (MeVis, Prof. Peitgen)
- Hanse Wissenschaftskolleg (HWK, Prof. Roth)

The Bernstein Group ‘Functional Adaptivity of the Visual Cortex’ has been established in April 2007 as a collaboration between the Institute for Theoretical Physics, Institute for Brain Research and Institute for Human Neurobiology. The group received 1.5 Million Euros for initially three years, funding four projects staffed with one postdoctoral fellow, 6 PhD-students, technical assistants and associated members. The projects are pursued in collaboration with the Bernstein Centers in Berlin (Prof. Dr. J.-D. Haynes) and Göttingen (Prof. Dr. T. Geisel, Prof. Dr. F. Wörgötter, Dr. Fred Wolf and Dr. M. Herrmann). The principal idea of the Bernstein initiative is to encourage and facilitate close cooperation between theory and experiment for the mutual benefit of both.

The scientific goal of the joint effort is to understand adaptive computation in the visual system: Information processing in the brain is astonishingly fast and reliable, despite permanent and huge changes in the outside world. For example, animals can effortlessly walk through difficult terrains under grossly varying lighting conditions, carefully avoiding obstacles, while being attentive to the sudden appearance of predators. Humans navigate cars in heavy city traffic with many moving objects, ignoring distracting and irrelevant signals and stimuli, while using inconspicuous parts of the scene like barely visible traffic signs to plan a route to a distant destination. Understanding these capabilities of the brain is one of the big puzzles in Neuroscience of which some pieces are put together in the Bremen Bernstein Group. Solving this puzzle will give major impulses for technical applications, as there is yet no robot which could compete with humans or animals in one of the above mentioned situations.
One key concept in understanding adaptive computation is selection of information. For climbing in an overgrown forest, an animal focuses its cognitive resources on trees and branches rather than on every single leaf. This ability of the brain termed selective attention is investigated in a project combining electrophysiological recordings in awake behaving macaque monkeys with advanced methods of data analysis and modeling studies. The recordings allow us to understand how visual information is routed through the brain, from lower to higher visual areas, depending on the task given to the animal. For a theoretical understanding of the experimental data, it is a challenge to find out how neurons and synapses work together for adapting the flow of information to the actual demands, and how the neural ‘switches’ are constructed which control this routing.

But selection of relevant information alone is not sufficient to explain the speed and versatility of adaptive processing: the brain also makes extensive use of previously acquired experience and information accumulated over time for an improved perception of its environment. In city traffic, information gathered about the actual speeds and directions of other cars are used to predict their future positions and to rapidly decide whether to accelerate or to brake. Navigating in a familiar surrounding allows to ignore a large part of an already known scene, and to better concentrate cognitive resources on the driving itself or on unexpectedly occurring events. Temporal constraints in these tasks require the brain to gather as much information from as few action potentials as possible, and to incorporate this information into an internal picture or representation of the outside world - a further challenge for neural networks and probabilistic algorithms, which are studied in large-scale simulations of biophysically realistic networks on computing clusters in all of the Bernstein projects.

Combination of information not only is crucial within a visual scene, but equally important across sensory modalities: a monkey delicately picking a banana from a tree combines visual with haptic feedback to grab the fruit without squashing it at the same time. The adaptivity of such sensory feedback integration mechanisms are a further topic studied in the Bernstein group. The use of virtual reality equipment allows in psychophysical experiments to precisely control the environment and to challenge the brain: humans are first confronted with conforming, and then with non-conforming visual and haptic information - can they learn to find a match between diverging information sources? How fast can humans adapt to different situations, and where are the limits of the adaptivity of the brain?

Understanding adaptivity in the visual system and in other parts of the brain is of particular interest for developing novel therapies for brain disorders. Research along these lines helps to understand which deficits might be remediable, and subsequently to identify directions in which to ‘push’ the visual system for compensating these disturbances. This aspect fits well into the scope of the Bernstein initiative, of which a main target is to promote clinical applications.
End of May 2008 some of the ZKW labs and its members will move to a new laboratory, the ‘Cognium’. An attractive combination of working groups from different research fields is stationed there: In detail, these are the departments of Neuropsychology and Behavioral Neurobiology (Prof. Herrmann), Neuropharmacology (Prof. Koch), Psychophysics (Prof. Fahle), the Institute for Brain Research (Prof. Kreiter), the Center for Advanced Imaging and the Theoretical Neurophysics (Prof. Pawelzik). Furthermore, the MRI-scanner for humans, rooms for lectures as well as practical training facilities on the 1st floor are accommodated in the building. There are areas for laboratories, two lecture rooms and on every floor space for ‘coincidental’ meetings, which are so important in science. These places can and will also be used for smaller meetings, facilitating lively exchanges of ideas between the disciplines.

After a long phase of conception and planning, finally the vision of an intensive interdisciplinary cooperation of different research fields in the neuro- and cognitive sciences was realised.
Besides the different activities within the University of Bremen, members of the ZKW main groups are engaged in various other important positions/activities in institutions/organizations all over Germany and abroad, viz.:  

Prof. Roth is President of the ‘Studienstiftung des deutschen Volkes’ (German National Academic Foundation), Member of the Berlin Brandenburgische Akademie der Wissenschaften BBAW (Academy of Science Berlin Brandenburg), Rector of the ‘Hanse Wissenschaftskolleg’ (HWK) (Hanse Institute for Advance Study) and belongs to the Board of Trustees ‘Deutscher Studienpreis’ (German Price for Studies).

Prof. Fahle is a part-time Professor of Visual Science and Co-Director of The Henry Wellcome Laboratories for Vision Sciences at the City University of London. Additionally he is member of the Editorial Board of ‘Public library of Science, Biology’.

Prof. Gräser is Advisory Professor of the Korean Advanced Institute Science and Technology (KAIST) and also a member of the executive Board of Deutsche Forschungsvereinigung für Meß-, Regelungs- und Systemtechnik e.V. (DFMR5).

Prof. Basar-Eroglu is a member of the Board of Governors of the International Journal of Psychophysiology (IOP) and the COST Action B27 Program ‘Electric Neuronal Oscillations and Cognition’ (ENOC).

Prof. Herrmann is a member of the Editorial Board of ‘Aphasiology’, ‘Zeitschrift für Neuropsychologie’, ‘Zeitschrift für Neurolinguistik’. Additionally he belongs to the Board of Trustees ‘Forschungspreis der Fürst Donnersmarck-Stiftung’ and is Scientific Board Member ‘Gesellschaft für Neuropsychologie’. In 1997 he was appointed ‘Honorary Research Associate’ at the Faculty of Health Sciences, University of Sydney (Australia).

Prof. Herzog is not only Research Associate of the Center for Discovery Science and Health Informatics at the George Mason University, Fairfax, VA but also member of the acatech - Kollegium des Konvents für Technikwissenschaften der Union der deutschen Akademien der Wissenschaften. Furthermore he is Trustee and Chairman of the Board of Trustees of the Fraunhofer Institute for Applied Information Technology (FIT), Birlinghoven and Board Member of FIB - Fiber International Bremen e.V. He is Chairman of the Board of OFFIS-TZI e. V., member of the Board of Directors of the Bremer Design GmbH, member of the Advisory Board of syyx GmbH and finally member of the IFIP Board of the Gesellschaft für Informatik.

Prof. Koch is in the Editorial Board of the journal ‘Psychopharmacology’ and European Affiliate of the NIH Center for the Study of Emotion and Attention (CSEA).
Development of personnel

As a consequence of the SFB 517 ‘Neurokognition’ within the period 1996-2005 the part of the scientific staff financed via third parties was considerably high. After a short transition time since 2006 the number of scientific personnel financed via third parties increases again steadily. In some working groups it is now even higher than those financed via Bremen University.

Statistics of personnel (counted as the number of half-timepositions) during the past six years.

A positive development regarding graduations (PhD-theSES as well as diploma/masters) can be stipulated especially after 2004. Additionally there were habilitations in the following years: In 2002 (group of Prof. Basar-Eroglu), 2003 (groups of Prof. Roth and Prof. Herrmann), 2004 (group of Prof. Fahle), 2006 (group of Prof. Koch) and 2007 (group of Prof. Herrmann).

Statistics of successful graduations (PhD’s and diplomas/master’s degrees)

Grants from 2002-2007

Main Groups of ZKW Members

We take this opportunity to thank all the organisations for the financial support:

- Aif “Otto von Guericke” e.V.
- Alexander-von-Humboldt Stiftung
- Arbeitsausschuss Münzautomaten
- BMBF
- Bremh. Gesellschaft f. Investitionsförderung
- Bristol-Myers Squibb
- Bundesministerium für Bildung und Arbeit
- Casinos Austria
- DAAD
- DFG
- EADS, WebMen Internet GmbH
- EU
- Faserinstitut e.V., Moving
- FNB Niederlande
- Fujisawa, Reemtsma-Stiftung
- Future Diagnostics
- Jansen-Cilag
- Kassenärztliche Vereinigung
- Land Bremen
- Sangtec Medical
- Senator für Wirtschaft und Häfen
- Tonjes-Vagt-Stiftung
- VolkswagenStiftung
- Westdeutsche Lotterie

The graph displays the total grant amount distributed over the years 2002-2005. Especially we like to point out that the SFB 517 ‘Neurokognition’ was financed by the DFG from 1996-2005 with altogether €7,541,439.00 (light grey area). The Universities of Bremen and Oldenburg were involved.

Overview over single funds larger than 250,000 Euros (numbers give the fund size in thousands of Euros).
Special awards for personnel of the Main Groups of the ZKW

In the course of the last 5 years a considerable number of special awards were given to members of the ZKW main groups. These are in detail:

2002
- Junior Scientist Award for Dr. Christine Schmidiet (Prof. Basar-Eroglu) 1st place for best lecture during the Neuronord Conference in 2002
- Junior Scientist Award for diploma student Niklas Schülert in biology (Prof. Roth/Dicke)

2003
- ‘Bremer Studienpreis’ for PhD-thesis in natural and engineering sciences to Dr. Thomas Müller (Roth/Dicke)
- Young researcher price in ‘Clinical and Cognitive Neuropsychology’ – GNP, Gesellschaft für Neuropsychologie for Dr. Claudia Grubich (Prof. Herrmann)
- Nomination of Prof. Dr. Gerhard Roth for the ‘Studienstiftung des deutschen Volkes’

2004
- Nomination of Dr. Michael Herzog for an associate professorship at the École Polytechnique Fédérale de Lausanne (Prof. Fahle)
- Special price of Bruker Daltonik GmbH for PhD-thesis of Christian Martens (Prof. Pawelzik)
- Special Price of the Rotary Club Bremen for the PhD-thesis of Dr. Miriam Schneider (Prof. Koch)
- ‘Bremer Studienpreis’ for best PhD-thesis in natural sciences at the Bremen University for Dr. Matthias Bethge (Prof. Pawelzik)

2006
- Heisenberg Stipends for PD Dr. Dr. Gerhard Schlosser (Prof. Roth/Dicke)
- YACHT-price for the best PhD-thesis in electrical engineering for Danijela Ristic (Prof. Gräser)
- D. Ojdanic, T. Lüth, O. Friman, O Prenzel and A. Gräser received the award ‘Best Interactive Presentation’ for their presentation at the ICCOR (10th International Conference on Rehabilitation Robots)
- Appointment of the academic designation of Professor for HD Dr. Ursula Dicke
- Appointment for Professorship of Dr. Frédéric Laberge at Guelph University, Canada (Roth/Dicke)
- Cross of Merit on Ribbon of Lower Saxony for Prof. Dr. Dr. Gerhard Roth

2007
- Heisenberg Stipends for PD Dr. Dr. Gerhard Schlosser (Prof. Roth/Dicke)
- YACHT-price for the best PhD-thesis in electrical engineering for Danijela Ristic (Prof. Gräser)
- D. Ojdanic, T. Lüth, O. Friman, O Prenzel and A. Gräser received the award ‘Best Interactive Presentation’ for their presentation at the ICCOR (10th International Conference on Rehabilitation Robots)
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- Cross of Merit on Ribbon of Lower Saxony for Prof. Dr. Dr. Gerhard Roth

Meetings organized by the Main Groups of ZKW members in 2007 and in the near future

In the course of the year 2007 and in the near future several meetings are planned to be held by members of the ZKW. They will partly take place at the Hanse Wissenschaftskolleg (see www.h-w-k.de).

For 2007 the following meetings should be pointed out:
- Symposium in cooperation with the General Hospital Bremen-East (PD Dr. Martin Heine) at the DGPPN Congress in Berlin, Topic: ‘Event-related oscillations and possible clinical applications’ (November 2007), http://www.dgppn-kongress.de (both organised by Prof. Basar-Eroglu)
- Profs. Roth/Dicke are engaged in the conference ‘Extreme Violence’ at the Berlin Brandenburgische Akademie der Wissenschaften BBAW (Academy of Science Berlin Brandenburg), December 2007
- Meeting at the HWK 2007: ‘Preemptive Vision’ organized by Profs. Roth and Fahle as well as by Prof. Bodis-Wollner from New York
- ‘Topics in Advanced Imaging - Interdisciplinary Symposium on Neuroimaging’, Oct. 19, 2007 at the Hanse Wissenschaftskolleg (HWK) in Delmenhorst by Prof. Herrmann

For 2008 several meetings have already been fixed, viz.:
- Prof. Basar-Eroglu is involved in both, the Organisation Committee of the World Congress of Brain Oscillations in St. Petersburg (September 2008), http://www.world-psychophysiology.org/iop2008/invitation.htm, and in the Scientific Committee of the X International Conference on Cognitive Neuroscience in Bodrum, Turkey (September 2008), http://www.iconxbodrum.org/sc.htm
- The Lindau Psychotherapy Weeks have been organized with participation of Profs. Roth/Dicke in April 2008
- An international workshop of the Bernstein Group, ‘Aspects of Adaptive Cortex Dynamics’, is scheduled at the HWK for Sept. 2008, organised by Prof. Pawelzik. In 2009 the Pawelzik group will also organize and host the 18th International Computational Neuroscience Conference (CNS) in Berlin, with more than 400 participants.
PARTNERS OF COLLABORATIONS

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Asia and Australia
Members of the ZKW strive to make their research open to the public. A brochure has been published in 2006 by the Senator für Bildung und Wissenschaft (Senator for Education and Research) of the Free Hanseatic City of Bremen to illustrate the highlights of research.

In regular intervals, the ZKW emits its ‘Newsletters’, showing up-to-date research of ZKW members in the form of posters which have been presented at international conferences and symposia.

Besides that, members of the ZKW give regular talks for the public with topics of general interest. They are engaged in projects like ‘Universität für Alle’. In this programme, scientists of the Bremen University have presented their research to the public since 1991. This project is initiated by ‘Freunde der Universität Bremen und der Jacobs University’ (Unifreunde) who aim at establishing a dialogue between Science and the Public of Bremen.

Furthermore ZKW members contribute to ‘Saturday Morning physics’ (mostly talks for pupils, their parents, teachers, etc.), to the Sommeruniversität, and to the Conrad Naber Lecture ‘Visions’. Named according to its sponsor Naber, the aim is to accompany and cross-fertilize the development of Bremen to a scientific ‘Center of Excellence’.

Moreover they show up in political discussions regarding ethical questions. For example, in November 2007 Andreas Kreiter and others contributed to a 90-minute Deutschlandfunk radio feature and discussion within the ‘Journal am Morgen’. A number of TV productions can also be mentioned (e.g. from the group of Prof. Herrmann: RTL – Future Trend Reportage, a scientific telecast at German television).

Articles of public interest as well as TV productions can be followed up on the ZKW Homepage http://www.neuro.uni-bremen.de/~zkw/newsticker.php

ZKW Website http://www.zkw.uni-bremen.de

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Agnes Janßen
Dr. David Rotermund

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ZKW members also invest time to give lectures in schools, participate in the initiative ‘Lehren und Lernen’ (Teaching and Learning), and they offer e-learning mobile lectures. In July 2007, a summer school in the programme Teaching and Learning entitled ‘Neurophysiology of Learning’ took place (http://www.sommeruni.uni-bremen.de) with major contributions from the ZKW.
ZENTRUM FÜR KOGNITIONSWISSENSCHAFTEN