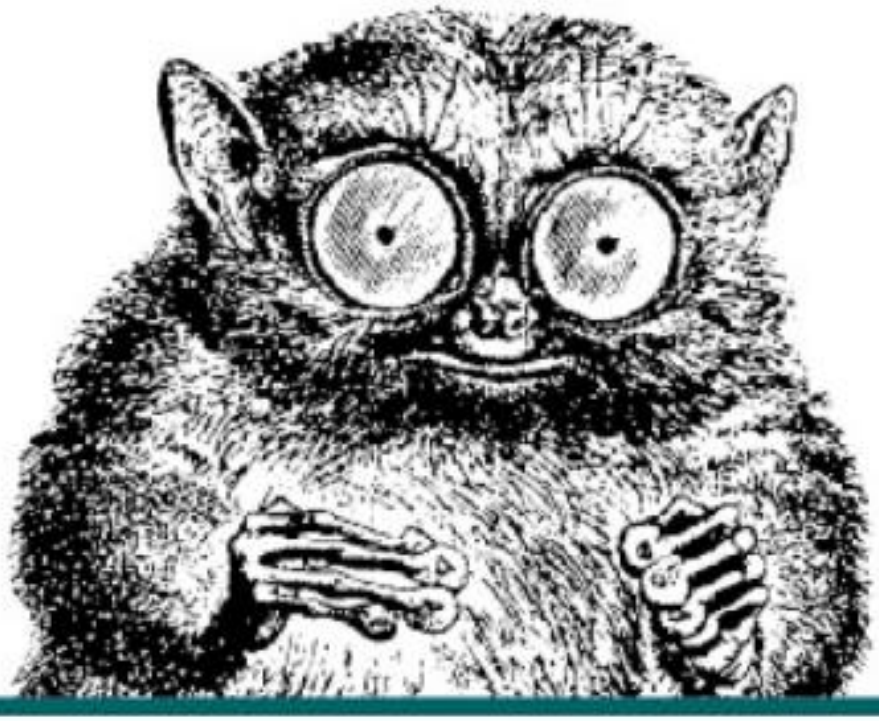

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Ronald van den Berg (Mathematics and Computing Science & Laboratory of Experimental Ophthalmology, Groningen)

Perceptual visualisation

Advances in science and technology resulted in the production of data sets that are huge and that still seem to be growing at an almost exponential rate. Information visualization is a research area that aims at developing methods for effective visual representation of such data. In this project we study perceptual aspects related to visual information communication, in particular eye movements, attention, and perceptual dependencies.

Rainer Beutelmann (Medical Physics, Institute of Physics)

Modelling binaural speech intellegibility in rooms for normal-hearing and hearing-impaired listeners

Speech communication, which is an important part of social life, can be severely disturbed by interferences like noise, other talkers and the effect of reverberation on the mixture of all present sounds. Additionally, a hearing loss usually makes conversations even more difficult. It is well known, that it is possible to make use of binaural hearing to separate useful and detrimental sounds by their spatial features. Psychoacoustics already offers elaborate models of binaural hearing, but using mostly abstract stimuli.
Our objective is to develop a model of binaural speech intelligibility, which can handle the combined effects of spatially distributed sound sources, reverberation and hearing loss. It basically consists of an auditory filter bank, the rather simple equalization-cancellation model in each frequency band and the standardized monaural Speech Intelligibility Index.
The model is supposed not only to help in understanding the underlying principles, but also to provide a useful reference in room acoustics and hearing aid development and fitting.

Melina Brell (Computing Science / Automation and Measurement Technologies)

A vibrotactile display for computer aided surgery

In this dissertation project the use of tactile stimuli as channel for information transmission in handling and positioning processes e.g. in navigation is investigated and a model of the process chain from vibrotactile cutaneous stimulus to the resulting motor reaction of the human is designed. Further a prototypic vibrotactile display is implemented. Therefore vibrotactile pattern perception by the cutaneous and subcutaneous mechanoreceptors on different positions of the body first of all on hand, arm and torso must be analysed as well as the intensity of the stimulus and possible actor designs. In a next step the accuracy of the prototypic system in different tasks like positioning must be evaluated. A field of application is the use of vibrotactile displays for (navigation) systems in computer aided surgery. They mostly provide visual support to the surgeon. The disadvantage is that the surgeon is constrained to draw visual attention to the field of surgery, further equipment in the operating room and the (navigation) system at the same time.

Michael Buschermöhle (Theoretical Physics/ Complex Systems)

Neurosensory Modeling of Signal Detection in Comodulated Stimuli

Many natural sounds share the property of having common amplitude modulations across different frequency regions. These kinds of sounds are used as masking noise in comodulation experiments (e.g. CDD and CMR), where a signal needs to be detected in the presence of noise. Depending on the correlation structure of the masking noise (correlated or uncorrelated amplitude modulations across different frequencies), signal detection thresholds are shifted upwards or downwards. This is known from psychophysical experiments with humans and other vertebrates. For my thesis, I analyzed neuronal recordings from the songbird auditory forebrain taken during the presentation of CDD stimuli. I developed a largely analytically tractable model which is able to explain the measured neuronal firing rates and which has been expanded to other experimental conditions (CMR) as well. The model's basic idea is that CDD and CMR can be viewed as within-channel effects and that signal detection is performed by analyzing the mean compressed envelope of the filtered stimulus.

Sandra Buss (Acoustic Group, Institute of Physics)

Subjective perception of pattern noise, a tonal component of the tyre / road noise, and its objective characterisation by spectral analysis and calcualting contours

The aim is to find an objective measure for the subjectively perceived pattern noise. Pattern noise is a tonal component in tyre/road noises with a speed dependent frequency in the range of the 60-fold rotary frequency of the tyre, called the 1st pitch harmonics. In four listening tests the level and the tonality of the first pitch harmonics are found to be good predictors for the perceived pattern noise strength. By calculating contours, an aurally adequate signal representation (M. Mummert, TU Munich, Dissertation), tonal components are extracted from tyre/road noises. The level of the 1st pitch harmonics of the contours is a measure for the level of the tonal components in the range of the first pitch harmonics. This parameter is found to measure the perceived pattern noise strength best.

Suzan Emiroglu (Medical Physics, Institute of Physics)

Timbre Discrimination in Hearing-Impaired Listeners - Measurements & Modelling

People with sensorineural hearing loss often have problems with timbre distortion and object recognition. In an attempt to characterize differences in perception between normal and hearing-impaired listeners, just-noticeable-differences (JND) of timbre are determined in both listener groups. By linear interpolation of spectral parameters, sounds of musical instruments were cross-faded (“morphed”), whereby stimulus continua between natural instruments were generated, making JND measurements possible. The results show that the timbre JNDs of people with precipitous ("steep") hearing loss are significantly higher than those of normal-hearing and of most other hearing-impaired people.

Bastian Epp (Scholarship MSc student Engineering Physics)

My Bachelor Thesis "Investigation of a parametric sound source for audio sound" dealt with the investigation of the physics behind the possibility to create audio sound by high amplitude ultrasound signals in air. During the last semester of my Bachlor programme I worked as a student assistant for Jesko Verhey in the field of CMR measurements over a broad frequency range. Currently I am working on a project dealing with measurements combining mon-aural and binaural effects (CMR and BMLD) with headphones and in free field condition.

Just van Es (BCN/Neuroimaging Center - Laboratory of Experimental Ophthalmology, University Medical Center Groningen)

Cortical contributions to human color constancy

Color constancy is one of the great unsolved problems of visual neuroscience. In the morning when we go outside, the grass is green, and when we come back late afternoon it is still green, although the color of the physical light that reaches our eyes is quite different. The ability to appreciate constant colors enables us the make use of color information in the ever changing world around us.
This project studies the cortical contributions to color constancy, using fMRI. Our main question is: What does the network of brain areas look like that is providing us with constancy?

Stephan Heise (Neurosensory Science Group, Institute of Physics)

Spectral and temporal effects in modulation perception

Fine Structure Project: Here I investigate how amplitude modulation (AM) of very soft sounds (near the hearing threshold) is processed by the ear. The question is whether we use the periodic level changes of the signal in order to detect AM, or whether we use spectral cues given by the sidebands in the spectrum of an amplitude modulated signal instead. For this I make use of an (often periodic) fine structure which is present in many normal hearing subjects' hearing thresholds. A fast method for screening this fine structure has been developed.
Complex Modulations Project: This project examines how higher order AMs are processed (e.g. a 2nd order AM is an amplitude modulation whose amplitude is modulated, i.e. whose depth changes over time). First experiments have shown that 2nd order AM may interfere with 1st order AM. The goal is to find a model which can predict this processing correctly.

Karin Klink (Zoophysiology and Behaviour Group, Institute of Biology and Environmental Science)

The role of inhibition in auditory processing of the mouse

Inhibition is found to occur throughout the auditory pathway. Modification of inhibition can affect neural responses to acoustic stimuli (e.g., duration dependent responses) and, therefore, its effect should be reflected in auditory perception.
Duration perception has been studied in NMRI mice trained to report an increase in duration of a tone. The mice showed a better duration discrimination for longer tone durations. However, there was no significant difference between subjects in which inhibition was manipulated by strychnine treatment and control animals. Thus, glycinergic inhibition does not appear to play an important role in duration discrimination in mice.
Inhibition is also thought to be involved in comodulation masking release (CMR). Currently, it is tested whether CMR occurs in mice by using a flanking band paradigm that allows to compare the amount of masking release within and across auditory frequency channels.

Cris Lanting (BCN/Neuroimaging Center - Department of Otorhinolaryngology, University Medical Center Groningen)

fMRI of the human auditory pathway; the neural correlates of tinnitus

Chronic tinnitus, the auditory sensation without an external stimulus, can be a serious problem. The prevalence is estimated between 6 and 20 % of the population.
The current understanding of mechanisms of tinnitus generation is however limited. In this project we try to find neural correlates of tinnitus. Functional MR imaging is used with unilateral tinnitus patients and somatic tinnitus patients to get more insight in the role of the (auditory) brainstem nuclei in tinnitus generation.

Julia Maier (Zoophysiology and Behaviour Group, Institute of Biology and Environmental Science)

Mechanisms of sound localisation in mammals

Interaural difference in the time of arrival (ITD) between the two ears is the most important cue for localising the horizontal position of a sound source in mammals adapted to low frequency hearing, including humans. According to a recently proposed model, glycinergic inhibition is a crucial factor in ITD-processing. To test this model I compare in a psychophysical study the minimum resolvable angle (MRA) that young healthy gerbils and gerbils with modified glycinergic inhibition are able to discriminate. In addition I plan to carry out electrophysiological recordings in the inferior colliculus (IC) of the gerbils to search for neural correlates of their behavioural performance. My second focus of interest deals with a possible adaptation-of-excitation mechanism of neural populations above the level of the brainstem. To investigate this I am carrying out electrophysiological recordings in the IC of guinea pigs, using ITD-stimuli with time-varying statistics, i.e. different means of stimuli with a high probability region of ITDs.

Alexandra Mueller(Scholarship MSc Hearing Technologies, Audiology student)

I did a training to become a hearing aid acoustician. Afterwards I studied “Hearing Technologies and Audiology” at the University of Applied Science in Oldenburg and finished with the diploma in June 2005. My diploma thesis was about “Acoustical Measurements of Early Reflections in a Variable Room Acoustics System”. In August 2005 I received a Scholarship from the International Graduate School ”Neurosensory science, systems and applications“ and therefore I study the Master of Science for “Hearing Technologies and Audiology“ at the University of Oldenburg.

Marc Nitschmann (Medical Physics, Institute of Physics)

Modelling inattention and across-frequency processing in binaural psychoacoustics

In the beginning I tried to model the inattention of an observer in a psychoacoustic measurement using animal data collected by Karin Klink. I extended a model suggested by Green [JASA 97, 3749-3760] by introducing a varying inattention parameter that is estimated from the preceding trials.

Furthermore I measured thresholds in a notched-noise experiment with varying notchwidth and an experiment with a broadband masker of varying spectrum level. In both experiments the masker was presented diotically, the sinusoidal signal, however, was either in phase or in antiphase between the two ears. I fitted the parameters of the auditory filterbank of a binaural model based on equalisation and cancellation to the diotic thresholds of the notched-noise experiment.
Modelling the *dichotic* thresholds required wider auditory filters implemented as a combination of the on-frequency filter and the slightly attenuated adjacent filters. This result is in contrast to van de Par & Kohlrausch [JASA 106, 1940-1947] and models based on their argument.

Further experiments concerning spectral effects of the human auditory system have been and will be conducted.

Timm Schaer (Scholarship MSc “Hearing Technologies and Audiology” student)

I studied "Hearingtechnology and Audiology" at the University of Applied Science in Oldenburg from 2001 - 2005 and got my diploma in June 2005. The theme was "Optimisation of single-channel noise reduction systems for the improvement of speech intelligibility". In this thesis I implemented different noise reduction algorithms and tested the performance with the Oldenburger sentence test (OLSA). In September 2005 I got the qualifying scholarship from the International Graduate School "Neurosensory science, systems and applications". Since Octobre 2005 I am studying the Master of Science "`Hearing Technology and Audiology"' at the University of Oldenburg.

Rick Schoffelen (Dpt. of ENT, University Medical Center Groningen)

Measurement of membrane vibrations in the frog’s inner ear

We study the auditory system of the frog in order to learn more about the fundamental mechanics of hearing in vertebrates. Because the frog’s ear has a relatively simple anatomy, but nonetheless shares a number of features with higher vertebrates such as mammals, it is ideally suited for researching basic structures and mechanisms.
In this project we aim to record, measure and model the vibrations of the tectorial membranes in the frog’s inner ear. The question we would ultimately like to answer is: *How do the tectorial membranes aid the hair cells in detecting the incident sound waves?*
Answering this question may provide us with some clues to the working of mammalian cochlea.

Luis Perez de Sevilla (Neurobiology, Institute of Biology and Environmental Science)

Characterization Of Amacrine Cells Expressing Cx45

Electrical synapses play an important role in the mammal's retina. Electrical synapses or gap junctions are formed by two hemichannels or connexons formed by six proteins termed connexins (Cx). Cx45 have been shown to be expressed in seven types of bipolar cells and in two bistratified ganglion cells in the mouse retina. It is known that some amacrine cell types express this connexin but their morphology and characteristics are still unknown. In my thesis I will characterize these neurons using transgenic mice and tracer injections.

Jennifer Shelley (Neurobiology, Institute of Biology and Environmental Science)

Spatial Properties of Horizontal Cell Responses in the Mouse Retina

Horizontal cells are laterally-oriented interneurons which are coupled to each other by gap junctions, forming an extensive network that feeds back onto the photoreceptor cells. The strength of the coupling between horizontal cells is modulated by ambient light by way of neurotransmitters such as dopamine. The horizontal cells therefore shape the receptive fields of the bipolar and ganglion cells, and in this way, play an important role in light adaptation. My current project involves developing a method for measuring intracellularly the light responses of horizontal cells in the mouse retina. By applying this technique to wild type and transgenic mice, several questions will be addressed.

Rike Steenken (Neurocognition, Institute of Psychology)

Psychophysical investigation of unconscious cross-modal priming

My dissertation aims at contributing to solve the controversial question, whether unconscious perception does exist and whether it influences our conscious experience and/or our behavior. Therefore, a cross-modal paradigm will be used presenting visual (suprathreshold) and acoustical (subthreshold) stimuli in a natural environment assuming that the latter influences the reaction on the former. Moreover, the recognisability of the acoustical stimulus is varied (via a white noise masker) to prove if the awareness of that stimulus is independent of the priming and that two processes instead of one (conscious) are responsible for both effects (awareness and motor response), respectively.

Stefan Strahl (Signal Processing Group, Departement of Physics)

Efficient coding of natural sounds

Environmental sound, speech and music are highly structured signals, and there is reason to believe that the auditory system is highly adapted to capture such structure. The main concept is to mimic the evolutionary optimization that took place in the neurosensory system of the (human) brain with mathematical methods from Blind Source Separation and Sparse Signal Representation. With the learned structure, improvements can be achieved in e.g. audio compression or feature extraction for speech recognition.

Riklef Weerda (Cognitive Neuropsychology, Institute of Psychology)

The role of the human primary visual cortex in visual perception and awareness

The human primary visual cortex (V1) is the first cortical instance processing incoming visual information and stands at the border between purely sensory and cognitive processes. There is still substantial debate about its contributions to the neuronal correlate of conscious visual perception. I am studying this issue by means of event related functional magnetic resonance imaging in combination with a signal detection paradigm. The present results point towards a strong correlation between neuronal activity in V1 and perception and therefore confirm a direct contribution of V1 neurons to the neuronal correlate of visual awareness.

Melanie Zokoll (Zoophysiology and Behaviour Group, Institute of Biology and Environmental Science)

Auditory memory in songbirds and humans

To evaluate a sequence of acoustic communication signals it is necessary to keep the previous elements in memory. This not only applies to the analysis of speech by a human observer, but also to the analysis of a long sequence of elements in the song of a bird. The aim of my dissertation project is to measure the persistence and capacity of auditory short-term memory stores in the European starling (*Sturnus vulgaris*) by applying behavioural experiments. Starling data will be compared with self collected human data, obtained under similar conditions. Animal experiments can thereby contribute to clarify the universal validity of existing (short-term) memory concepts, which are often explicitly language-related.