

Title: "Multisensory integration of audition and vision using multimodal approaches: from neurophysiology and brain imaging to neural network modeling "

Organizer: Amir Amedi (The Hebrew University, Israel)

Abstract: In recent years, the role of multisensory integration in sensory processing and perception has attracted much scientific interest. However, the integration from neurophysiology, neuroimaging and especially neural network modeling on specific topics is still very much missing. Similar integration from development and clinical studies is also much needed. Here we propose to achieve such integration, in relation to auditory-visual interactions. The first speaker will present the specialization of the barn owl for hunting small prey in dimly lighted and acoustically noisy environments which advocates it as an excellent model for studying auditory-visual integration. The next two talks will build on this and will present neuroimaging and behavioral experiments of auditory-visual integration in humans. Similarly to the experiments in the barn owl these studies use natural dynamic stimuli. They will specifically focus on audio-visual aspects of human communication, sight restoration and brain development in health and disease (e.g. in congenital blindness and prosopagnosics). We will conclude by presenting a novel neural network model to achieve optimal multi-sensory integration.

Speakers:

Amir Amedi (The Hebrew University): Introduction

Yoram Gutfreund (The Technion): "Visual – auditory integration in the barn owl's brain: A neuroethological approach"

Katharina Von Kriegstein (University College of London, U.K.): "A multisensory perspective on human auditory communication"

Amir Amedi (The Hebrew University): "Audio-visual integration for objects: novel insights from studying sensory substitution and visual cortex development."

Ron Meir (The Technion): "Optimal multi-sensory integration based on dynamic spike train decoding by a neural network"

Title: Cross-Modal Reorganization in Deafness

Organiser: Pascal Barone (Brain and Cognition Center (CERCO), Université Paul Sabatier, Toulouse, France) and

Andrej Kral (University Medical Center Hamburg-Eppendorf, Germany)

Abstract: In congenital deafness the central auditory system is completely deprived of its adequate input. That results in cross-modal reorganization of the auditory cortex both in animal models and in deaf humans. Deafness constitutes a unique opportunity to study the capacity of cortical plasticity within and between modalities, since hearing can be later restored through neuro-prostheses inserted at the peripheral level (even in humans). Speakers of the proposed symposium will elucidate the determinants of these reorganizations by contrasting their specificity at several levels, from anatomy to behavior in both animal models and humans. Cross-modal reorganization is highly specific within the reorganized modality. Supranormal visual performance in deaf is demonstrated for particular functions and is not found in other ones. The reorganization at the cortical level is area-specific, some auditory areas are activated in processing of certain visual and somatosensory stimuli, some are not. Finally, the cortical network for multisensory processing is highly dependent on the onset and duration of recovery of the auditory function in cochlear-implanted deaf subjects. To understand these cross-modal reorganizations is of cardinal interest for basic science as well as for the therapy of profoundly deaf patients.

Speakers

Andrej Kral (University Medical Center Hamburg-Eppendorf, Germany)

S.G.Lomber (University of Western Ontario, U.S.)

A. Sharma (University of Boulder, U.S.)

P. Barone (University Paul Sabatier, Toulouse, France)

N. Skotara (University of Hamburg, Germany)

Title: “Role of neural synchrony for multisensory integrative processes”

Organizer: Andreas Engel (University Medical Center Hamburg-Eppendorf)

Abstract:

Picture yourself on a crowded sidewalk with people moving around. The acoustic and visual signals generated by the people provide you with complementary information about their location and motion. Thus far, it is not well understood how such inputs from different sensory channels are integrated. In this symposium, we present recent studies on multisensory processing and neural synchrony using high-density EEG recordings in humans and local field potential and single unit recordings in primates. Data from these studies suggest that coupled oscillatory activity across a wide range of frequencies may serve to link neural signals across uni- and multisensory regions and to express the degree of crossmodal matching of stimulus-related information. The view that we advocate has several implications: we believe that the investigation of neural synchrony during crossmodal processing allows developing new research approaches and experimental strategies; furthermore, new accounts for abnormal variants like synesthesia and autism can be developed. Thus, we believe that the study of synchronization phenomena may lead to a new view on multisensory processing which considers the dynamic interplay of neural populations as a key to crossmodal integration.

Speakers:

Andreas K. Engel (University Medical Center Hamburg-Eppendorf, Germany)

Christoph Kayser (Max Planck Institute for Biological Cybernetics, Tübingen, Germany)

Peter Lakatos (Nathan S. Kline Institute, Orangeburg, NY, U.S.)

Daniel Senkowski (University Medical Center Hamburg-Eppendorf, Germany)

Peter König (University Osnabrück, Germany)

Title: “Multisensory processing of visual and tactile information”

Organizer: Krish Sathian (Emory University, Atlanta, U.S.)

Abstract: Vision and touch share a number of information-processing goals, including extraction of information about the shapes and locations of objects. This symposium brings together a range of methodological approaches that have been applied to the study of visuo-tactile integration, focusing on recent findings. Alberto Gallace will discuss behavioral work showing that crossmodal perception of changes in stimulus location can be disrupted by inserting a visual or tactile mask between stimulus displays (crossmodal change blindness). Marc Ernst will assess the extent to which behavioral integration of visual and haptic information about shape is statistically optimal, and the conditions under which integration starts to fail. Joshua Lucan will present ERP data on the spatio-temporal brain dynamics of somatosensory shape discrimination that suggest activity in the lateral occipital cortex beginning within the first 500ms of information processing. Krish Sathian will outline functional MRI studies showing common visuo-haptic processing of both object shape and object location, and explore the role of visual imagery in the crossmodal recruitment of visual cortex.

Speakers:

Krish Sathian (Emory University, Atlanta, U.S.)

Joshua Lucan (City College of the City University of New York, U.S.)

Alberto Gallace (Università degli Studi di Milano–Bicocca, Milano, Italy)

Marc Ernst (Max Planck Institut für biologische Kybernetik, Tübingen, Germany)