Cognitive neuroscience of auditory and cross-modal perception

Lectures and assignments

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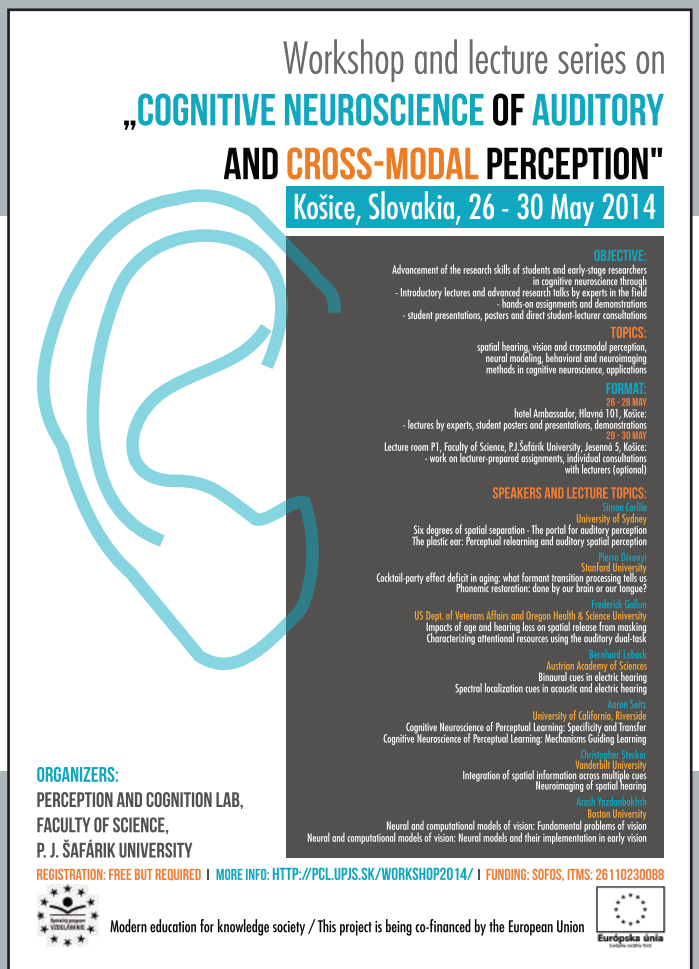

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3.2.6 Cross-modal interaction in spatial attention

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Spatial attention is a form of attention that directs perceptual processes to a location in space. The interaction of simultaneous processing of auditory and visual cues in spatial attention is not well-known. In our study, we used reflexive saccadic movements to selectively focus visual spatial attention during the dichotic stimulation task in healthy individuals. Our results suggest bias in auditory attention in the congruent direction to the evoked shift in visual attention. Furthermore, if the auditory attention shift is congruent to the visual attention shift, the visual processing of saccades is delayed. This delay is more pronounced if the attention is shifted to the right. These differences do not take place if the presentation of both modality cues is asynchronous. The results are discussed with respect to hemispheric asymmetry.

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3.2.7 Prediction processes in the visual modality – an EEG study

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The ability to feel agency has been associated with internal forward modeling. This phenomenon is considered to rely primarily on sensory predictions, and have been increasingly investigated in the auditory modality. Only a few studies were using visual stimuli, none of them focused on stimuli relevant in social interactions. Our aim was to examine prediction-related modification of visual processing by analyzing ERPs elicited by images of hands. Twenty-three adults participated in our experiment. In the ACTIVE condition, predictable stimuli appeared after the participants pressed a button with either right or left hand while in the PASSIVE condition, they were only observing the images. In a predominantly right-handed group, an amplitude decrease over the occipital cortex was observed in the early, 80-120 ms post-stimulus time interval, (i.e. around the visual N1 component) in the ACTIVE vs. PASSIVE condition much stronger for movements made by the dominant hand. We found that dominant hand stimuli and stimuli

shown in the visual field of the dominant side evoke greater neural activity. Considering that these effects appear very early, it can be assumed that the modulation of the activity of the striatal/extrastriatal visual cortex contributes to the feeling of agency connected to hand movements.

3.2.8 Early electophysiological correlates of susceptibility to the double-flash illusion

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A double-flash illusion can occur when a single flash of light is accompanied by two brief auditory stimuli leading to the perception of two flashes. Although susceptibility to this illusion shows great inter-individual variability, which might even be used to differentiate between certain special conditions, reliable experimental protocol for its measurement are still needed. To this end, we recorded electroencephalography (EEG) in 17 participants in order to identify early neural responses, which are less influenced by decisional strategies. Two types of illusory conditions with different inter-sound intervals were used: 67 ms (short condition, SC) and 133 ms (long condition, LC). The strength of the illusion was 75% and 43% in SC and LC, respectively. In line with previous results, moderate to strong correlations between behavioural data and EEG difference waveforms amplitudes were observed in the early 120-140 ms post-stimulus interval. We also found another EEG marker peaking at 30 ms, presumably reflecting stimulus expectancy. In conclusion, we can say, that our experimental protocol is a good candidate for further examination of the relevant factors influencing the susceptibility of this illusion.

3.2.9 Learning of auditory distance with intensity and reverberation cues

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The overall intensity and reverberation are major cues for auditory distance perception in rooms. When exposed to a new room, the auditory system has to adapt to accurately interpret the incoming stimuli. How this adaptation affects distance perception and whether it is subject to room learning remains unclear. Here, a learning experiment was performed investigating whether removing the intensity cue would result in enhancement of the reverberation cue learning [also see Kopčo et al., (2011) "Learning of reverberation cues for auditory distance perception in rooms." J. Acoust. Soc. Am. **129** , 2487]. Seven training sessions were performed on consecutive days, each consisting of 12 runs in which the subject localized a broadband sound in distance. The presented intensity was either fixed (A condition), or roved on trial-by-trial basis (R condition). Testing was performed at the beginning of the first, fourth, or seventh session, with testing condition (R or A) changing after each run. Results suggest that, compared to the A-