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„Stimulus-, Aufgaben- und Aufmerksamkeitsrelatierte Determinanten audiovisueller Integration“

Abstract

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Perception has traditionally been viewed as a modular function, with the different sensory modalities operating largely as separate and independent modules. By contrast, real-world situations often stimulate several of our senses concurrently and merging information across modalities can increase the reliability of our representation of the outside world. Thus, there has been a recent explosion of interest in causal interplay between different senses. A fundamental question in multisensory neuroscience is how information from the eyes and ears is combined in the brain to produce unified perceptual experiences of the objects and events in the natural world. In situations of audio–visual interaction, research has generally found that audition prevails over vision in temporal perception, while vision is dominant over audition for spatial perception. The well-known “ventriloquist illusion” reflects a perceptual consequence of spatial multisensory integration, whereby a sound coming from one location is perceived as if it came from the location of a concurrent visual event. The first goal of this thesis is to investigate the neural basis of audio – visual interactions and especially the neural modulations when the task demands to focus on temporal- versus spatial aspects of audiovisual stimuli. To determine the neural correlate of spatial- vs. temporal task-demands event-related fMRI was used. Here the effects of spatial task-demands modulated central regions of the thalamus while the temporal task modulated the posterior region of the thalamus. Using fMRI the following experiments examined a special case of spatial audiovisual integration, the ventriloquist illusion. In a pilot study we found suppressive effects in auditory planum temporale that co-varied with the ventriloquist illusion. In a follow-up experiment we investigated whether temporal alignment of audiovisual stimuli would affect the ventriloquist illusion and its neural correlate. We found stronger suppression effects within visual and auditory regions for perceived illusions when auditory and visual stimuli were presented synchronously (compared to asynchronously presented stimuli). Finally, we investigated whether the ventriloquist illusion is cognitively impenetrable, as others have suggested. In contrast, here we found that the amount of ventriloquist illusions can in fact be altered by paying attention to the visual stimuli. In conclusion, we have found that audiovisual spatial integration is mediated by a network of visual and auditory regions; and can be affected by multisensory stimulus features (e.g. synchrony) plus the locus of the attentional focus. The volitional control of these integration processes is organized via a network of sensory-specific cortices and most notably thalamic nuclei.