Abstract

In a dynamic environment where contingencies change rapidly, flexible behaviour is important. We integrate information from our senses, our stored memories and emotions, so that we are able to interact with, and respond to our surroundings seamlessly. Integration of inputs from multiple senses and decision making based on such integration is key to sensory motor learning and hence flexible behaviour. Multisensory integration (MSI) is known to occur in early sensory regions as well as in executive, higher order regions, like the frontal cortex. However, the relative roles of MSI at the early sensory regions and higher order regions, in perception and behaviour and the mechanisms thereof are not understood. In the current study the objective is to parse the roles of MSI in two such regions, namely the auditory cortex (ACX) and the orbitofrontal cortex (OFC), with respect to audio-visual integration. The OFC, a part of the prefrontal cortex (PFC), is known for its role in flexible behaviour, decision making and in coding value of a stimulus. Previous electro/neuro-physiological studies on multisensory coding have been primarily done in nonhuman primates and by using *f*MRI in humans. Mouse as the model animal needs to be used as it allows use of powerful tools like optogenetics and circuit mapping, which will enable parsing and establishing specific-cell-type based circuits and their causal roles in, and mechanisms of, MSI based behaviour. However, neuroanatomical connectivity of these regions with respect to multisensory neurons are not studied. Thus in the current study the first goal is to perform neuroanatomical and functional characterization, followed by audio, visual and multisensory response characterization in OFC. We further explore the role of OFC in storing multisensory associations and their effect on unisensory processing. This study gives insight into the mechanism where after multisensory exposure how information in one sensory modality eventually dominates the other. The second part of the study looks deeper into the role of auditory areas in processing visual information. There are neurons responding exclusively to visual stimulation in the Primary Auditory Cortex, both by excitation and hyperpolarization. Apart from pure visual responding population, there are multisensory neurons responding to both auditory and visual stimuli that are found closely associated with neurons responding exclusively to auditory stimulus. These neurons for their proximity to auditory specific neurons could potentially influence auditory information within the primary auditory cortex, showing the extent of multisensory influence over the so called ‘unisensory’ area is much more than expected.