

Testing for multimodal perception of audio-visual signals - an ecological perspective

Animals communicate through many sensory channels. Their signals may consist of one or more components, produced in one or more modalities, and as such must be perceived by many senses. Where at least two components are produced in more than one modality, it is called multimodal signalling. Multisensory integration is responsible for the perception of multimodal signals and its measurable symptoms are illusions. Illusion is what the receiver's brain produces, which in fact does not exist. For example, viewers suffer illusion that people on a screen are talking when they see silent visual images and hear sounds from speakers away from the screen. This illusion is so effective that we don't even recognise it is an illusion.

Animals can also experience many types of multisensory illusions, although audio-visual illusions are best known. The interactions of these modalities have always attracted the greatest attention as both senses play a key role in the spatial orientation of animals. At the same time, they are functionally complementary. Vision has a higher spatial resolution and hearing has a higher temporal resolution. Overall, mismatches, be it on a temporal or spatial scale, can lead to a misinterpretation of reality, creating the illusory impression of an object's position, time of its occurrence, number of objects, continuity of events in time and space. At the same time, species differ in reactivity to auditory and visual stimuli. Therefore, the study of audio-visual illusions of various species requires taking into account a specific context.

The ecological context of the production and perception of multimodal signals is one of the main causes of illusions in natural conditions. As sounds and vision travel at different speeds, in order to understand how a signal will be received, we need to know when and where it was produced, the physical properties of its components and the transmission parameters of the environment, and how many receivers there are and where they are in relation to the sender. However, most of the research to date on multimodal perception has been carried out under laboratory conditions. In this way, we obtained a lot of information about the neural background of illusions, but little about their real importance for communication. The main goal of the project is to assess the impact of ecological variability in audio-visual signalling on multimodal perception. The subject of the research will be birds, a group of animals with better audio-visual perception than humans, and the research will be conducted in natural conditions.

Studying the role of ecological factors in multimodal perception is justified for two main reasons. First, we do not understand how time and space are incorporated into the perception of multimodal signals. Species vary in sensitivity, cognitively and neuronally; they also evolved under different conditions. On the other hand, many of the phenomena known in humans find their counterparts in the reactions of other species. However, little is known about multisensory integration in natural conditions. Second, we do not understand how the integration of a multimodal signal with environmental factors affects the signal functions and the entire communication process. When the multimodal signal is integrated by the receiver taking into account some environmental factor, the expected effect of this interaction may differ significantly from the integration process in which this factor is not taken into account. This difference may be purely behavioural, but in theory it could also have evolutionary implications. If this interaction is translated into a signal function, we can assume that it does indeed have evolutionary consequences. Ignoring the possibility that integration of a signal with certain environmental parameters may be adaptive can yield misleading results regarding the relative importance of the various signal components. Therefore, when tested in laboratory conditions, the key component of the signal may appear irrelevant.

The results of this project should contribute to a better understanding of multimodal perception of animals in general and multisensory illusions in particular. This project is also an attempt to look more realistically at the functions of these phenomena in communication. There are a number of reasons why illusions can improve communication, but also many situations where they can encourage manipulation. Contrary to popular opinion, multisensory illusions are not rare side effects of multimodal perception, but its immediate consequences. We succumb to them almost all the time, but we are not aware of this fact; just because they are so effective. Other animal species also succumb to illusions, but it can be said that their perception is tailored to their needs. Therefore, animal illusions are not always where we would expect them from a human perspective. This project should therefore allow us to better understand the natural circumstances in which illusions arise. Going beyond a purely mechanistic approach to the study of multimodal perception, this project should also contribute to a better understanding of the importance of illusion in communication.