The viewing consists of saccades, i.e., fast eye movements, and fixations, i.e., periods of gaze stabilization. Fixations are very brief, lasting 200-300 milliseconds, and frequent, we make in average three of them every second. During fixations, visual information gets to the brain where they are further processed. If nothing restricts the direction of our gaze, the movements of the eyes reflect the shifts of the focus of attention. When we look at scenes or images, our gaze is more likely to be directed towards important information, staying there for longer. One of the categories that particularly draws our attention is emotional content, both positive and negative. Our previous eye-tracking studies have shown that fixations fell more often in the key objects, that is those determining the meaning of a scene, while viewing emotional compared to neutral scenes. The Emotional Objects Database, which we created during our previous studies, allows us to precisely determine whether a given visual fixation fell on the objects or on the background, making it a useful tool for investigating the process of directing attention to relevant information.

In this project, we plan to investigate the neural basis of fixations falling on the object and on the background in the case of negative, neutral and positive images. It will allow determining which brain structures are associated with attracting attention by the important elements of the environment and whether the emotional valence of these elements modulates brain activity. Besides the content of a scene, attention can be attracted by regions being visually salient due to for example brightness or contrast. Therefore, we will carefully control these features, both for the object and the background, using a dedicated mathematical model. In the second phase of the project, we will manipulate the physical features of the objects to examine how basic physical features affect the probability of fixations falling on the object and fixation duration, as well as the fixation-related brain activity. We will be showing images of high and low emotional intensity, measured as the ability to induce emotional arousal. This study will serve to determine whether the effect of basic physical features differs depending on whether the image produces high or low emotional arousal.

Until recently, addressing research questions mentioned above was unfeasible, since visual fixations, as very frequent and brief events, were not suitable for use in traditional methods of functional magnetic resonance imaging (fMRI) data analysis. It has become possible thanks to the recently developed a fixation-based event-related (FIBER) method. The results of the planned research, which will be performed with fMRI, on the neural basis of attention towards the important elements of the environment may contribute to a better understanding of the complex mechanisms of human visual perception and attention.