

Reading is the ability that allows preserving the fleeting spoken form of language. It is the invention that allowed us as a society to communicate across space and time, preserve our knowledge and develop the culture. The majority of people read visually so this ability develops with constant strong input through the sense of sight. In the absence of the ability to see reading has to rely on a different medium between the symbols and their meanings. The invention of the Braille alphabet provided such a medium using the sense of touch.

The brain works in a modular manner. Each area of the brain process different type of information and performs all the tasks needed to understand and use it. There is a part of the brain taking care of the visual input – the visual cortex. Because the majority of people read using sight, the areas responsible for this task are thought to be a part of the visual cortex. Recent research has shown that the regions that recognize letters and convert them into meaningful information are also active while Braille reading or in the listening of speech in the group of blind participants. That could mean, that although this region usually deals with the visual information it can perform the same task even with different modality input if needed. It could also mean that this region – because it is unused – takes on a new function.

These two opposite hypotheses are the two main interpretations regarding the plasticity of the human brain. The first is the rule of task-specific reorganization. It states that the main feature of brain regions is not the modality but rather the type of task being performed. In favor of this hypothesis stand results of experiments in which we can see that the “auditory” cortex is involved in the visual rhythm recognition or that the “visual” face recognition area is involved in the recognition of the voice. According to this hypothesis the “visual word form area” is not visual, but rather a word for area regardless of the sense through which we read. The second hypothesis is the rule of the pluripotency of the cortical regions. According to this interpretation, the cortex of the brain is able to take on new functions when it does not receive the preferred modality input. The cortex is built in a very similar manner all over the brain and there is no reason why it could not perform any function of a different kind. According to this hypothesis the “visual word form area” can do any other task for example higher language function.

In this project, we aim to investigate the function of the left visual occipito-temporal cortex (vOT) where the “visual word form area” is. This brain structure is pointed as the place in which the translation from visual symbols to meanings takes place. How does the function of this area change when it does not receive its’ preferred – visual information? A perfect opportunity to investigate this matter is to compare how this process is performed in the group of sighted participants that read print through sight and blind participants that read Braille through touch.

In this experiment, two groups of participants will be invited to the magnetic resonance scanner. The activity of their brains will be measured while reading. The first group, a group of blind participants will read Braille words, and a second group, of sighted participants, will read the same words in print. Firstly we will compare the words presented to the participants in three language aspects. We will compare the form of the presentation – how similar those words look, or how similar they are spatially arranged in Braille. We will compare their orthographic organization – how many letters they share. Last, but not least we will compare the semantic similarity - how similar are the meanings of those words. In the neuronal analysis, we will use novel methods of fMRI data analysis that will allow to calculate similarity of the neural activation patterns that particular words evoke in the brain. As the last stage, we will check if words that are similar on the linguistic level evoke similar activations in the brain, in the visual – occipito-temporal cortex. Using this method, we will be able to determine what is the function of this area in the blind group of participants. By comparing results of two groups, we will be able to reason about the nature of the development of this area.

We expect to find that the occipito-temporal cortex of the blind individuals keeps its’ usual function and switches the modality input as the hypothesis of the task-specific reorganization predicts. On the other hand, however, it is possible that we will see, that this area, due to the fact that it remains unused in case of blindness, takes on new functions, for example language processing. The findings of this experiment will advance understanding of the reading mechanism in the human brain, especially the mechanism of the translation from symbols into meaningful language information.