Description for the general public

The functional organization of human brain, that is, the involvement of a specific brain structure in a specific task, is a consequence of the balance between genetic factors and sensory experience. Language processing is an example of such a task, and its localization in certain brain regions is an effect of this delicate balance. Functional magnetic resonance is a technique which enables us to see which brain structures are active when we are performing a cognitive task. Research using this method has shown that activations evoked by language processing, both spoken and written, are very similar across different languages used for the task. In the majority of population they are located in the left rather than the right hemisphere. Lateralization of language processing depends on many different factors, one of them is the size of the corpus callosum – the biggest white matter tract connecting the two brain hemispheres.

Most of the research on language lateralization in the brain (the measurement of which brain hemisphere is more involved in language processing) has been conducted with sighted participants. Blind individuals use the Braille system for tactile reading. A recent study has shown that, despite activating very similar structures to sighted participants during reading, blind subjects engaged more right hemisphere structures, exhibiting decreased lateralization indices for this task. Up to date, there exists only one study focusing on direct measurement of language lateralization in the blind population, only during spoken language processing.

One of the goals of the current project is to examine whether the reduced lateralization of language processing observed in the blind subjects during speech processing is also present during tactile reading. Blind and sighted subjects will participate in a functional magnetic resonance study, during which they will be presented with spoken and written words in the modality appropriate for them modality – tactually or visually and will have to make a decision regarding their meaning. The images acquired during the study will be analyzed in order to estimate lateralization indices for reading and spoken language processing. The corpus callosum size will also be assessed using data from structural magnetic resonance imaging. We want to check if the size of corpus callosum correlates with the lateralization of Braille reading. Such a correlation has been shown in the sighted population, however our study will be the first to answer the question whether the mechanism governing language localization in the left rather than the right hemisphere is similar between sighted and blind individuals. Visually impaired subjects have been observed to have reduced size of the corpus callosum. If size of this structure is similarly connected to reading lateralization in the blind as in the sighted, this can suggest that reduced lateralization of language processing may be an effect of decrease in corpus callosum size, following vison loss. Additionally, the relationship between language lateralization and the structure of some other white matter structures – connecting the regions within one hemisphere only will be assessed. It will add to our understanding of which elements of language neurobiology are and which are not dependent on the modality of language processing, which are genetically determined and which can change with variable sensory experience.

This study will add to our understanding of the mechanisms governing written language processing in the brain and the relations between spoken and written language. It will also help develop research on Braille reading, the knowledge of which is still scarce.