The role of neural sensorimotor activations during audiovisual speech perception in infants

Before the infant utters its first words, it gathers information about the world around it. Every day, parents and relatives talk to their children, often interacting face-to-face, so that babies are exposed to speech and the accompanying mouth movements from the very first days. This allows infants to collect and integrate information about speech using various senses, and the acquired knowledge will enable them to later recognize speech sounds, understand words and pronounce them. Specialists in integrating this data are adults who combine information from many senses, which proves to be helpful, for example, in noisy environments where looking at the speaker's mouth facilitates the understanding.

Research using neuroimaging techniques show that when viewing and listening to speech, not only areas of the brain related to hearing or vision are activated, but also parts of the motor cortex. This area of the brain is activated when we make movements, such as writing or running, and therefore it is also involved when we speak because we coordinate the work of the appropriate muscles and parts of the speech apparatus. The stimulation of sensorimotor areas was also observed during passive listening to speech, but this phenomenon is still little understood so far. It is assumed that activation of this area may be related to the growing experience in pronouncing words.

The best way to understand the role that experience plays in articulating syllables or words is to compare the brain activations of infants who are just starting to acquire their mother tongue. The main goal of the project is to investigate whether watching recordings of speaking people will result in the activation of motor areas in infants, as well as to check what role experience in producing speech sounds and experience with listening to the mother tongue play in the activation of the motor system.

To understand the role of these factors, it is necessary to examine infants at two stages of development, namely before and after the period in which they specialise in their native language and begin to pronounce the first syllables. Specialisation in the native language begins around eight months of age. The universal ability of infants to distinguish speech sounds from other languages is then lost. At the same time, babies gradually learn to produce their first vocalisations and syllables as they focus their attention on the lips, which are the source of the speech sounds they hear.

Taking into account the discussed transitions, the project planned to study infants aged 5 and 10 months, and a control group in the form of adults. All project participants will be presented with two tasks on the screen: (1) the first involves watching actresses pronounce syllables from a foreign language and Polish. During the task, brain activity will be measured using a non-invasive electroencephalograph; (2) during the second task, we will track eye movements and check what part of the face they are looking at when they watch recordings of native and foreign speakers.

As a result, these studies will directly determine the role of experience in pronouncing syllables for activation of the sensorimotor cortex during speech perception in infants. We will also check whether the mentioned neural activity is related to the increased looking at the mouth and we will also find out if these two processes are related to each other. The obtained results will contribute to understanding how information from different senses supports the perceptual processes related to speech and under what conditions they activate. More broadly, the project's results can contribute to the process of detecting atypical patterns of activity and behaviour in infants, and thus support early intervention in this regard.