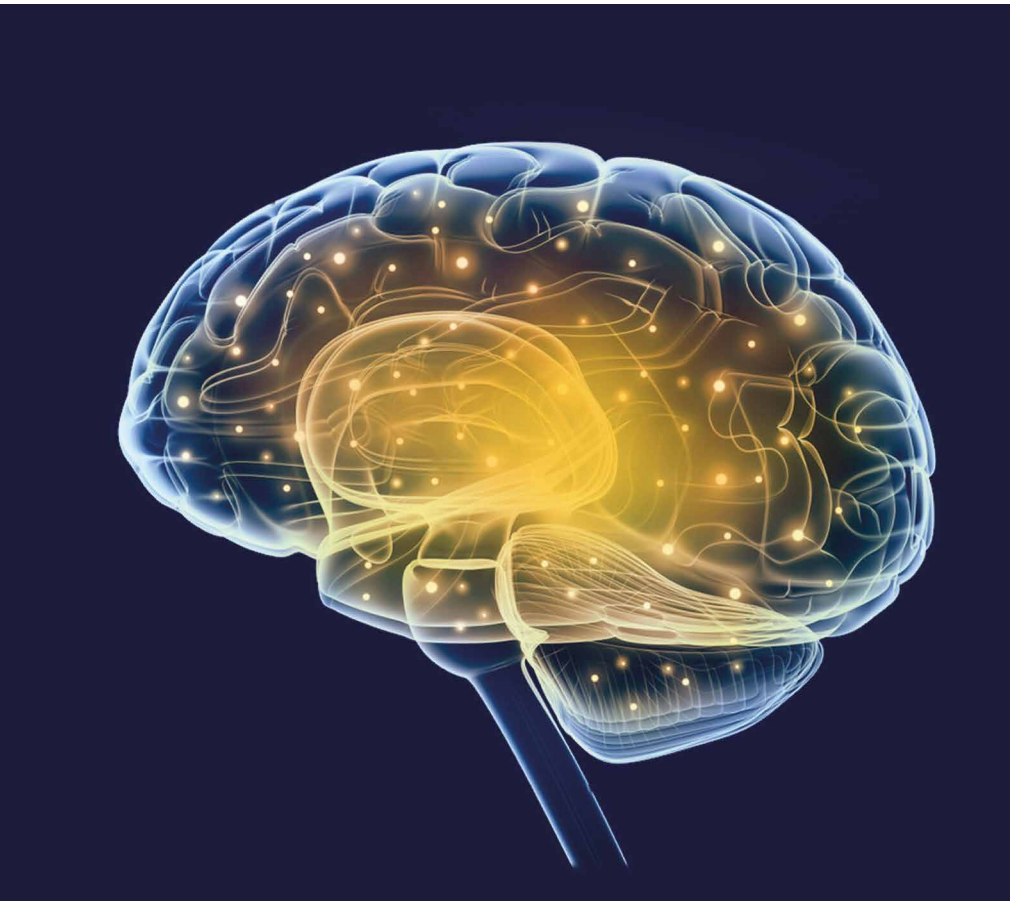
STUDYING MEMORY PROCESSES IN THE BRAIN

Let us imagine that we meet a person on the street who looks familiar. We feel as if we met before, but we cannot recall the details of this relationship. What is happening in the brain in such a moment? What are the differences in the cognitive process when we merely think we know someone and which differences are there when we actually meet our colleague, friend, or neighbor?

Although scientists have been trying to uncover all the secrets of our brain for years, we still know little about this part of our body. How we learn, how the process of remembering and forgetting occurs, how all life activities are controlled – these are examples of just a few fundamental issues.
Knowledge of the processes taking place in the body of a healthy person can provide inspiration to look for ways of treating people with various neurological disorders and inhibiting disease processes. Knowledge from the field of neuroscience is also sometimes applied in sciences related to artificial intelligence, primarily in so-called machine learning. Sales specialists are also eagerly interested in the results of this research. Various analysis methods are already in use, such as electrooculography and eye-tracking. Thanks to this method, we learn, for example, where most people focus their attention when browsing e.g. websites. This is where advertising materials are placed.

Every day we are attacked by billions of pieces of information per second. Only a small part of them is registered by our consciousness. Therefore, certain processes must take place in the brain that allow us to select data and process it in a very short time. Each of these processes is studied by various groups of scientists with different specializations.
Memory processes and studies making use of specialist methods of analyzing the brain's electrical activity are of particular interest. Dr. Karina Maciejewska, a physicist from the University of Silesia, completed a research internship at the UC Davis Center for Neuroscience in California (USA), during which she began collaborating in the Dynamic Memory Lab research group led by Prof. Charan Ranganath. The stay abroad was an opportunity, among others, to learn about specialized methods of analyzing cognitive signals of event-related potentials (ERPs) and conducting scientific experiments in the field of memory research in humans.

In her scientific work, Dr. Maciejewska primarily analyzes the basic electrical activities of the brain (EEG and ERPs) as well as other biological signals in healthy humans. The researcher's aim is to deepen knowledge about the electrical activity of the human brain in various cognitive states, such as language comprehension, sensory perception, decision-making, and remembering. Such studies provide a better understanding of how the brain works in states of normal function. As a result of this research. the knowledge of the psychophysiological activity of the central nervous system (CNS) and its response to external stimuli is deepened.
At the time of her internship, Dr. Karina Maciejewska started a cooperation with a group of researchers who used three main measurement techniques to study long-term memory processes. They analyze the brain's electrical activity, use magnetic resonance imaging to monitor which areas of the brain become activated during a given process, and finally conduct behavioral



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research, that is, invite a group of volunteers and, following a study scenario, measure certain parameters, such as reaction speed, number of correct and incorrect answers etc.

"I learned about the research projects at the University of California and the techniques used to analyze some selected processes. Directly after my return, I continued to study the brain's electrical function using electroencephalography (EEG) and event-related potential (ERP) analysis," the physicist says. "I invite volunteers to the study who put on a special cap with 32 electrodes on their head. They then perform various tasks, and the device monitors the electrical activity of the brain. This examination is obviously painless and does not affect human functioning."

Subsequently, the data thus obtained is interpreted. Depending on the command being executed, areas of the brain are identified where significant activity can be observed. This is not easy.

"Every human reaction will be noted, a blink of an eye, a momentary lack of concentration, thinking about something other than the task... What do we do when someone asks us not to think about anything for a moment? This is usually when the most distracting thoughts patterns appear. Bearing all this in mind, we must properly interpret the obtained results in order to find those impulses that are actually responsible for the brain's work related to our memory," the researcher explains.

Prof. Charan Ranganath's group studies primarily processes related to long-term memory which allows humans to retain memories, to remember events that happened both yesterday and several years ago. However, American scientists focus on two recognition processes. The first is the assessment of familiarity that activates long-term memory, the second is recollection which "browses" information available in memory and compares the data with what is perceived. Both processes occur simultaneously and are known to independently contribute to assessing familiarity of an object or information, however, they are supported by different areas of the brain. Because of this, scientists are looking for an answer to the question of how these processes support recognition, which consists in matching information with data already stored in our memory.

Let us return to the question posed at the very beginning, i.e. how it happens that sometimes the person we meet merely seems familiar to us, whereas we recognize other ones without any problems, give their names and characterize the given relationship. Researching memory processes is a complicated process. There are many as yet unproven hypotheses explaining this phenomenon, since studies are still being conducted.

It is worth knowing, however, that the mere fact that we pay attention to two processes of recognition is extremely important, as it allows – through the use of various research techniques – to check how brain activity changes in different situations, and this brings us one step closer to unveiling another mechanism of how this complex organ functions.