Our ability to learn allows us to function efficiently in a changing environment. Thanks to the mechanisms involved in the learning processes, we can detect inadequate, maladaptive behaviors and replace them with new ones, better suited to the requirements of the environment.

How efficient will be the learning process and whether it will bring the expected results depends on the type of feedback we receive from the environment. It can be usually classified into one of two categories: "Do what you have been doing so far because it brings the expected results." or " You made a mistake! Try other behavior next time. " There is also a different degree to which we should trust such information because we can distinguish at least two types of learning conditions:

1. predictable (deterministic) when feedback always informs correctly whether our behavior was correct, and

2. partially predictable (probabilistic) when we cannot be sure if the received feedback is adequate.

Using the example: when we play tennis, the place where the ball falls clearly informs us whether we score a point (if the ball falls within the inner sideline), or the point is scored by the opponent (when the ball falls beyond the inner sideline) - adequate feedback allows us to make adjustments during the next game. We have to deal with a different situation when we decide whether to take the umbrella for work in the morning - observation of cloudy sky can provide us with the basis for making this decision because we remember that usually when the sky looked like that, it was raining - usually, but not always! Hence, we estimate the correct behavior based on the probability resulting from our previous experiences. These two types of learning differ in the level of difficulty and the type of information used.

In this context, the question about the neural basis of learning processes taking place under predictable and less predictable conditions seems particularly interesting. The current state of knowledge does not allow us to draw coherent conclusions about the possible diversification of the underlying neuronal processes. The main reason may be the multitude of applied experimental paradigms and methods of analyzing the collected data and concentrating during the research only on one - usually probabilistic - learning environment.

The presented project aims **at analyzing neural processes underlying learning in deterministic and probabilistic conditions, using contemporary neuroimaging methods - electroencephalography (EEG) and functional magnetic resonance imaging (fMRI)**. In the research, we will use the data from two experimental tasks, in which participants will be required to learn rules and associations. Based on the obtained data, we will check how the dynamics of brain activity changes during acquiring knowledge about the rules of tasks, which brain structures communicate with each other during learning, and whether the type of environment in which learning occurs will affect the durability of learned rules. All of these processes will be described using EEG data, fMRI data, and a combination of these two methods. Research that will be carried out during this project is essential for several reasons. First of all, it will allow us to understand the neuronal basis of processes that are crucial to our everyday functioning. Secondly, describing these mechanisms will shed light on the various learning difficulties that people face as a result of brain damage or natural aging processes. Finally, long term, understanding the mechanisms that govern the learning processes may contribute to designing optimized learning methods, aimed at facilitating this process both in everyday life and for populations with special needs.