Description for the General Public

Learning is an unavoidable and crucial aspect of human functioning that permeates our lives from childhood to old age. We depend on it to survive and thrive in the world around us, and as the world continues its inexorable technological progress we are also increasingly met with new and unique learning challenges. To some extent this technological progress is limited by how complex its interface can become, can the limitations of the human mind. Despite these limitations humans have moved from an environment in which the learning of basic skills (such as hunting, farming, and tool-making) dominated our time to a digital world, a world full of information and technical innovations.

While our capacity to learn is unquestioned, as evidenced by the ease with which even the youngest of children settle themselves into our new reality, not much is known about how this process of learning takes place. We know that learning can happen gradually or rapidly, and that it depends in part on the complexity of what is being learned and the intelligence (among other personal characteristics) of the learner. We also know that learning a new skill is not an isolated process, in that learning how to ride a bike also teaches us much in general about balance and momentum. What we know little about is how these processes are represented in the human brain.

The brain has regions that are often specialized to perform certain tasks, and performing such tasks has a direct impact. Much of what we know about this is based on studies of learning how to perform simple tasks. For example, as little as two hours of learning new words for colors that we already know is sufficient to change brain volume in regions related to that processes. However, such tasks do not reflect the more impactful, real-world learning that we undergo when e.g. learning how to operate a computer system as an air traffic controller.

This project proposes to study the process of skill learning by training individuals in a difficult and complex task. While they are training, we will measure how their brain structure and functioning changes in response by using non-invasive brain imaging techniques like electroencephalography (EEG) and magnetic resonance imaging (MRI). By observing how changes in brain structure are related to complex skill learning, we hope to create knowledge that will carry over into creating more effective ways of training people to learn more quickly and efficiently, and also how to improve the performance of their brain in already learned tasks.