

We currently have very few therapeutic options to treat problems with memory and cognitive functions, which are impaired not only in brain diseases but also decline with natural aging. Emergence of recent technologies for electrical stimulation makes it possible to apply treatment in specific brain regions instead of affecting the entire body with drugs and their side effects. The problem with treating memory functions is that we know neither the brain regions nor the electrical activities that are responsible for making and retrieving our memories. Hence, the stimulation technologies have been more successful in treating movement and mood disorders that have well described regions and mechanisms in the brain. Our understanding of the brain regions and electrical activities involved in forming our memories for particular facts and events is much more limited, requiring implantation of electrodes inside the human brain. The project takes advantage of the latest technology for recording and stimulation in the human brain at the highest possible spatiotemporal resolution. These tools allow us to elucidate the electrical activities that underlie formation and remembering of new memories at the level of specific neurons in particular areas of the brain. Reading and modulating these activities with brain stimulation is the most direct way to improve memory and cognitive deficits in brain disorders. Our results will accelerate development of new brain-computer interface technologies and therapies for not only epilepsy but also degenerative, developmental and psychiatric diseases.