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Abstract: Imaging and Recording Imagined Movements from the Human Brain

Functional magnetic resonance imaging (fMRI) is a very popular and non-invasive method to record neural activity in humans. The fMRI signal is related to changes in blood flow, which correlates with changes in brain activity, but only indirectly. To better understand how the fMRI signal relates to the activity of single neurons we have developed methods to perform fMRI in animals and to also record the activity of single neurons under the same stimulus and task conditions. These studies have helped us to understand that the posterior parietal cortex (PPC) is essential in forming the intentions to act before actions are executed. Using this knowledge we have performed fMRI studies in paralyzed human patients in which they imagine making movements, even though they cannot actually move. We then implanted these imagined-action activated areas of the PPC in humans with arrays of microelectrodes and recorded from them over a period of years. The clinical goal of this effort is to design neural prosthetics that can assist paralyzed patients by controlling robots and computers with their imagined movements. From a scientific perspective we find that the imagined goals and trajectories of different parts of the body can be decoded, that the intent to move precedes conscious awareness of movement, and neurons are selective for the observed actions of others.