The UNM Psychology Clinical Neuroscience Center

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Introduction. The mission of the UNM Psychology Clinical Neuroscience Center (PCNC) is the development of new knowledge regarding how normal and abnormal behavior and cognition arise from the function of the brain. This is accomplished by a balanced program of research and teaching, supporting the academic mission of the Department and the advancement of students and faculty, facilitating alliances of investigators with common research interests, identifying and supporting Psychology faculty recruitment, developing new, extramurally-funded projects and maintaining existing projects, and the acquisition, maintenance and supervision of PCNC core services including the application of brain imaging and stimulation technologies.

PCNC's focus is on developing methods to better understand brain structure, function, and human behavior, new methods for the diagnosis and treatment of brain and mental illness, and to enhance cognitive function in healthy people. The PCNC collects EEG data, and in combination with sMRI, fMRI, DTI, MEG, genetic data from research partners, uses this to identify biomarkers of brain function in health and disease (see figure). Most mental illnesses show clear effects on brain function, but currently lack definitive biological markers for diagnosis. Specific research includes using cognitive neuroscience methods to understand how the brain contributes to high-level 'executive' abilities like decision making and learning, developmental brain mechanisms involved in the etiology and heritability of Obsessive-Compulsive Disorder and Autism-Spectrum Disorder, brain correlates of mental disorders such as drug and alcohol dependence and schizophrenia, the use of brain stimulation methods to improve cognition and learning in healthy people and to treat symptoms of brain and mental illness, and modelling brain network activity.

Electroencephalography. EEG is used to identify the brain processes involved in all forms of human thinking and behavior. This method detects and amplifies the small electrical fields generated as a byproduct of brain activity. Using a variety of algorithms, the location and magnitude of brain activity can be inferred, allowing this information to be used to test hypothesis regarding brain organization and function.

Transcranial Electrical Stimulation. tES is a method whereby small electrical currents are applied to the scalp in order to alter brain activity and behavior. A large number of different types of tES are available, depending on the type of electrode and where electrodes are placed, and the temporal pattern and magnitude of electrical stimulation used, such as direct current (tDCS), alternating current (tACS) and random noise (tRNS), among others. tES does not induce neural activity, but can be used to modulate ongoing activity. tES can be used to alter activity in both superficial and deep areas of brain tissue. The PCNC has used this method to examine and enhance performance in a variety of cognitive processes, including attention, perception, long-term memory, learning, fluid intelligence, working memory, language, empathy, auditory hallucinations in schizophrenia, and for reducing smoking and alcohol use.

Transcranial Magnetic Stimulation. Like tES, TMS applies energy to the brain to change its activity, in turn affecting behavior. In the case of TMS, a very large and rapid magnetic pulse is delivered to target brain regions. Unlike tES, TMS can be used to induce brain activity or to suppress ongoing activity. TMS is limited to brain areas close to the scalp surface where it can be safely applied.