

The new Mental Neuro-Chronometry (MNC) lab, headed by Prof Klaus Kessler, is a step-change in how cognitive neuroscience research is being conducted at the School of Psychology. It includes a high-density mobile Electroencephalography (EEG) system, a dual-coil neuronavigated transcranial magnetic stimulation (TMS) system, a high-definition transcranial electric current stimulation (tES) system, and two high resolution eye-tracking systems.

The ANT-Neuro eego mylab™ EEG system (<https://www.ant-neuro.com/products/eego-mylab>) augments previous EEG capabilities in the School, as it can be carried in a backpack during physical activities (indoors and outdoors) and can also be used in a standard lab-based configuration. It provides high signal-to-noise EEG recordings with up to 128 shielded electrodes (waveguard™) and can also be used as two (mobile) systems for parallel recordings (with 64 electrodes each), e.g., during interactive tasks and social interaction. Saline nets with 64 electrodes for infant research are also available (<https://www.ant-neuro.com/products/waveguard-net/available-sizes-and-specifications>).



The eego mylab™ EEG system is also compatible with TMS, which enables studies where the effects of TMS on neural functioning can be tracked as the mental processes unfold.

TMS-compatible



The MNC lab's non-invasive brain stimulation equipment (TMS and tES) represent a step-change in UCD's capabilities in human neuroscience by providing insights into causality and plasticity of neural processing in research and clinical applications. It allows pinpointing of the critical times and brain regions when mental processes and associated brain signals (e.g., characterised through EEG and/or eye-tracking) can be altered and interfered with, thus, ascertaining timing as well as causality of identified brain signatures and assumed psychological mechanisms.

TMS and tES are complementary techniques and are both employed in research and clinical interventions. TMS delivers precise and focal stimulation, while tES is more portable and flexible to administer in contexts outside the lab, complementing portable eye-tracking and mobile EEG in the MNC lab.

Our TMS setup employs advanced neuronavigation and coil design to precisely target up to two brain areas – even in the same hemisphere – allowing unprecedented insights into causal brain connectivity. The setup combines stimulators (<https://www.magventure.com/tms-research/products-overview/research-stimulators/products-6/stimulators-4-2/magpro-x100-w-magoption>) and coils (<https://www.magventure.com/tms-research/products-overview/research-coils>) by Magventure with visor2™ TMS-neuronavigation by ANT-Neuro (<https://www.ant-neuro.com/products/visor2>). The stimulators offer a wide range of stimulation protocols and waveforms (single and dual pulse, repetitive, etc.) that can be administered using a single coil or two coils in parallel, tracked by the visor2™ system for precise targeting of brain regions. A range of coils with different properties are available, incl. a placebo coil.



The MNC lab's high-definition tES system by Soterix (<https://soterixmedical.com/research/hd/mxn-33>) with 33 channels is a first in Ireland and the Archipelago. It is industry-leading in stimulation intensity and frequency and is unique in providing simultaneous multiple-region multiple-protocol targeting via dedicated software (<https://soterixmedical.com/research/software/hd-targets>). In other words, researchers can target different brain regions at the same time using different stimulation protocols (e.g., tDCS, tACS, tRNS, etc.).



Recent neuroscience research showing that pupil dynamics serve as a proxy to brain activity (complementing scalp-recorded potentials in EEG) has led to an explosion of research on pupillometry in conjunction with TMS and tES. The MNC lab's new eye-tracking systems, by SR Research (), augment existing eye-tracking capabilities in the School, by offering a fixed (lab-based: <https://www.sr-research.com/eyelink-1000-plus/>) and a portable (e.g., can be used in schools: <https://www.sr-research.com/eyelink-portable-duo/>) system, both, with industry-leading sampling frequencies and resolution, enabling precise pupillometry. The remote camera configuration (not head-mounted) further allows for easy integration with our EEG systems.



For any queries relating to the equipment please contact Prof Klaus Kessler (klaus.kessler1@ucd.ie) or the course directors.