**

**Transcranial Magnetic Stimulation (TMS) Information**

**DESCRIPTION**

TMS is a stimulating technique able to non-invasively activate neurons within the cortex. It can be used to induce brief and transient inhibition or facilitation in a specific region of the brain or in some cases it can be used to elicit small muscle contractions in the muscles of the hand. TMS has been used in a growing number of laboratories worldwide since 1985. It is a widely used technique that excites brain tissue in humans for both experimental and clinical purposes.

A)  B) 

Figure 1: A) Picture of Figure of 8 Coil commonly used to stimulate over hand area of motor cortex. B) Picture of Double Cone Coil commonly used to stimulate the leg area of the motor cortex.



Figure 2: Picture of the transcranial magnetic stimulation machine that outputs the stimulus through the coils seen in Figure 1.

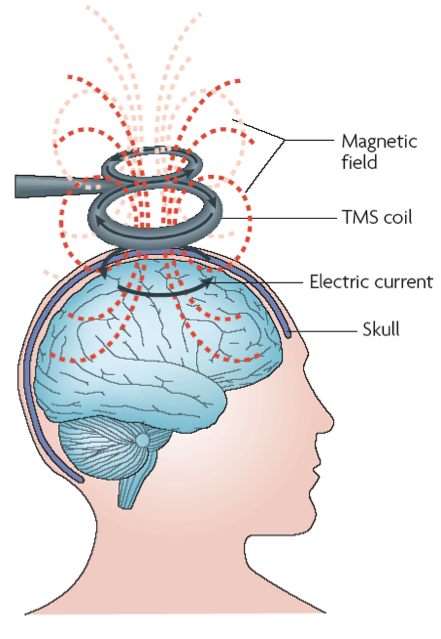


Figure 3: Illustration of TMS being applied to the motor cortex with a Figure of 8 coil. The red dotted lines represent the magnetic field that passes unimpeded through the skull and generates a current in the brain (represented by the black curved arrows).

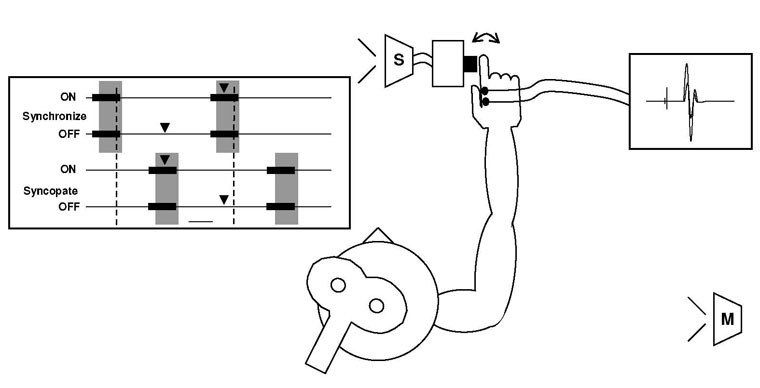


Figure 4: Illustration of TMS stimulation of the hand area of the motor cortex demonstrating the output measure, a single muscle twitch in the finger, as displayed on the computer screen to the right.

**TMS THRESHOLD TESTING**

You will be sitting in a chair with your feet on the floor and your legs 90 degrees to the floor. While in this position, transcranial magnetic stimulation (TMS) threshold testing will be performed. TMS allows us to stimulate neurons in your brain with an insulated coil that we place on your head. You will be in this seated position while a single stimulus of TMS will be applied to the region on your head that will cause a muscle twitch in your lower leg muscles. You will be asked to wear a swim cap so that the location of stimulation can be marked. Once the appropriate region to activate your leg muscles is established, you will be asked to stand to determine the stimulation intensity of testing (a percentage of the Maximal Output of the Machine; MOM). Stimulation will begin at a level thought to exceed what is necessary to evoke a muscular response (termed a Motor Evoked Potential; MEP), which is approximately 45% MOM for women and 50% MOM for men. The intensity level will be gradually increased until your muscle response reaches amplitude of 1 mV for 3 out of 5 trials (Perez et al. 2014).

**SINGLE AND PAIRED PULSE TMS**

Once the appropriate TMS intensity is determined, you will experience single pulse and paired-pulse stimulation over the leg area within the primary motor cortex for the experimental trials. For these trials, you will be wearing a light backpack, which will house the coil for the TMS machine. The coil will be strapped to your head using comfortable elastic Velcro straps. Single pulse TMS involved applying one stimulus at threshold level. Paired pulse TMS is a specific type of TMS that involves applying two stimuli to cause a muscle response. The first stimulus is applied at a level slightly below threshold and the second stimulus is applied 2-15 ms later at a level slightly above threshold.

**SAFETY AND RISK MANAGEMENT**

TMS will be used in the study to induce excitability in a specific region of the brain. In some cases it can be used to elicit small muscle contractions in the muscles of the leg. These muscle contractions are mild and should not provide any discomfort. A series of adverse effects that can be induced by TMS have been identified. There is no evidence that the procedure is harmful if appropriate guidelines are followed. There are no known short or long term effects of receiving multiple bouts of TMS.

The following are **risks and discomforts** that are possible when undergoing TMS:

1. The procedure is painless, although it can cause muscles to contract immediately following stimulation, which may lead to residual soreness, caused by muscle fatigue, over the duration of the study session.
2. Approximately 1 in every 10 participants undergoing TMS experience headaches or dizziness, which are believed to be due to excessive muscle tension. You may choose to withdraw or rest for several minutes before resuming testing. If the headache or dizziness persists you will be directed to on-campus Health Services, to a walk-in clinic or family doctor. Please notify the study team if you experience any of these symptoms.
3. Approximately 1 in every 100 participants undergoing TMS experiences neck stiffness and pain. This is believed to be due to the straight posture of the head and neck during the application of TMS. You will be asked to inform the researchers as soon as you begin to experience neck stiffness or pain. You may choose to withdraw or to rest and change posture for several minutes before resuming the procedures. If neck stiffness and pain persist you will be directed to on-campus Health Services, to a walk-in clinic or family doctor. Please notify the study team if you experience any of these symptoms.
4. TMS produces a loud clicking noise when stimulating. This loud click can result in “ringing” in the ears and brief decreased hearing if no ear protection is used. Animal and human studies have shown that earplugs can effectively prevent the risk of hearing disturbances. You are therefore required to wear earplugs for hearing protection. New earplugs will be supplied for each participant.
5. TMS can induce a convulsion even in the absence of brain lesions, epilepsy or other risk factors for seizures. Only 7 cases of convulsions have been reported using single pulse TMS in patients with pre-existing brain damage despite extensive use in both the healthy and patient population. The use of single, and paired pulse TMS has never induced a seizure in a healthy participant. The overall risk for seizures during TMS is thought to be in the order of 1 in 1000 studies. In the event that convulsions do occur they can result in longer-term quality of life changes, including suspension of drivers license until it has been confirmed that the convulsions will not re-occur. However, the forms of magnetic stimulation used during this study have never been reported to induce a seizure and are well within the limits recommended by the guidelines.

**If you have any further questions or concerns about TMS or the study, you may contact the researcher at any time.**

**<<add research team contact information>>**