Report on the TMS study over right cerebellum

During this internship, I hoped to learn how to run an experiment using TMS (Transcranial Magnetic Stimulation). The TMS is based on the principle that a coil placed over the head of a subject can produce a short-lasting and painless perturbation of a small zone of the underlying brain tissue. A short-duration, high-intensity, current flowing in the coil generates a magnetic field which diffuses through the scalp and bone and induces an electrical field. This field generates a brief disruption of the activity of the neurons located underneath the coil.

I first learnt to localize the motor cortex of my subjects and to define the motor threshold intensity for each of them. The motor threshold is the minimal intensity responsible for 5 out of 10 reliable movements of the thumb. I could practice this on 23 subjects and repeated it several times on each of them. This motor threshold can give you an idea of the cortical excitability and is necessary for most of TMS studies. A lot of practice allowed me to feel more confident and determine this threshold quickly after a few trials. This threshold was then used to determine the intensity of stimulation to apply to the cerebellum: I stimulated the cerebellum of my subjects at 90% of the motor threshold as done in many previous studies.

The second thing I learnt during my stay in the Netherlands was to use a neuronavigation system to target precisely the right cerebellum. This neuronavigation system has been developed at the Rudolf Magnus Institute, department of Psychiatry by S.F.W. Neggars (Neggars et al., 2004, NeuroImage). It allowed me to load the MRI brain scan of each of my subject and to look at their cerebellum. I had to check if the occipital cortex was not too close to the area I wanted to stimulate to be sure that I would not interfere with visual processing. Subjects were rejected from the study if their occipital cortex was located less than 8mm far from the targeted area in the cerebellum. Furthermore, I also checked if the targeted area was not deeper than 2.5cm under the scalp, to be sure that the TMS pulses would reach the cerebellum.

To target the cerebellum with TMS, I had to dive in cerebellum anatomy in order to find where to stimulate and how to recognize this site on an MRI scan. Thanks to the MRI atlas of the Human cerebellum (Schmahmann et al., 2000), I have now a strong knowledge of the fissures and lobules of the cerebellum. As it has been shown previously that the cerebellum plays an important role of saccadic adaptation, this knowledge on its anatomy will be really useful for the following of my PhD.

Now that I’m back in France, I’m about to start a new TMS study in my lab. The goal of this study is to determine if the PEF (Parietal Eye Field) is involved in the adaptation of saccadic eye movement. I will then have to localize the motor cortex of new subjects as well as to determine their motor thresholds. Thanks to the practice I had in the Netherlands, I will localize the motor cortex easily and teach how to do this to an intern that will collaborate with me on this TMS study. To target the PEF, I will use a different neuronavigation system (Softaxic, EMS, Italy) than the one I used in the Netherlands. However, the practice I acquired there will permit me to be faster in the use of this neuronavigation system.

In conclusion, this training stay in the Netherlands taught me how to run an entire TMS study. I learnt the basis of TMS (motor threshold, neuronavigation…) and now, I’m about to use this knowledge to begin on my own a TMS study in my lab in Lyon.