NENS Training Stay Stipend – Final Report

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My PhD research focuses on the developmental and neurocognitive mechanisms of behavioral mimicry. Behavioral mimicry, occurring during naturalistic interactions, is when interaction partners take on the postures and mannerisms of one another. What makes mimicry so relevant to social neuroscience, is that mimicry is socially sensitive. That is, a person only mimics another when they like this individual or want to be looked upon favorably by this individual. The puzzling aspect, though, is that mimicry comes about largely or entirely outside of awareness. Thus, in the translation from observing an action to producing this action (thought to be a fairly automatic process within the motor cortex by so-called mirror neurons), a socially-selective mechanism is at play, allowing these observed behaviors to become overt only in socially-desirable situations.

The primary goal of my internship in Professor Aglioti's Social and Cognitive Neurosciences Lab was to perform a TMS study investigating this aspect of behavioral mimicry. Our question was whether motor cortex activation caused by action observation is differentially affected by different social contexts. By using a novel-group manipulation, we intended for the participant to distinguish between two models, one as belonging to their ingroup, and one as belonging to their outgroup. We measured motor activity during observation of these video-models using Transcranial Magnetic Stimulation (TMS) above the motor cortex such that we could measure Motor Evoked Potentials (MEPs) in the targeted muscles. Importantly, MEPs have only once before been elicited using naturalistic stimuli like those we designed (Figure 1, left image; those involved in making the stimuli can be seen in the right image), but this past study importantly did not have a social manipulation (*cf.* Van Ulzen, Fiorio, & Cesari, 2013), and both my host and my own research group had not yet successfully implemented a novel-group paradigm.

Due to the novelty of this design, we decided to pilot this study in two parts. First, the TMS aspect of the study, without the social manipulation, and second, the social manipulation, without the TMS (but with using an SMI eye-tracker). In this manner, we hoped to establish whether we were able to reliably record MEPs elicited while participants observed our stimuli videos separately from establishing whether the social manipulation was effective in creating an in-group bias. Thus, during my internship I gained experience with both TMS and the SMI eye-tracking system. I will focus on the TMS as this was the primary goal of my internship.

The TMS-procedure of our study, and hence the steps I was trained on, is briefly described in the following. First, one of the experimenters explained how TMS worked to the participant and let her feel the effect of a low pulse administered to her palm. Next, the participant's right inside wrist (reference), index (first dorsal interosseous) and little (abductor digiti minimi) fingers, and foreleg (tibialis anterior) were cleaned using rubbing alcohol such that the electrodes could be placed. Electrodes were placed in a belly-tendon montage with the active recording electrode above the belly of the targeted muscle and the reference electrode above the tendon of the muscle. The muscle activity was displayed online for the experimenters, but out of view of the participant. Once it was established that the electrodes were placed correctly and the participant was sitting still, a swimming cap was placed on the participant's head (Figure 1, left image), which was then covered with masking tape. Then, the experimenter(s) determined the resting motor threshold of that participant. Starting with an intensity of 40% of the machine output, the figure-eight coil was placed 5cm to the left of the midline (left hemisphere; right hand) and 5cm anteriorly from the coronal midline, at an angle of 45 degrees from the midline. The coil was moved around this area, with 10 seconds in between pulses. If no MEPs were elicited, the power was increased by 5%. When a location was found that elicited an MEP, this was drawn on the masking tape, and the area directly surrounding this location, and slightly different coil angles, were tested in order to find the optimal scalp position, and the intensity was lowered by 1-2% at a time until the optimum was found. An optimal scalp position and threshold was defined as the location and intensity at which five out of ten pulses resulted in an MEP in the FDI that was more than 50μV in amplitude. Following this procedure, the experiment itself was started.

Data was recorded and analyzed using Spike software (CED). Per pulse, the peak-to-peak amplitude of the evoked potential was calculated. Trials with artifacts or other sources of noise were excluded by hand, but while blind to condition. Per condition, the average peak-to-peak amplitude and the standard deviation were calculated, and outliers were defined as trials below or above 2.5 standard deviations away from the mean. Per participant, the average MEP was calculated per condition as their final measure of excitability. Thus, each participant contributed one value per condition (e.g. behavior type, fixation cross) to the final analysis.

In short, the results indeed indicated that higher MEPs in the FDI muscle occurred while observing the model in the video performing hand actions versus performing no actions (i.e. the control condition). However, since the power of this effect was quite small and the data of only 12 participants could be included, we decided that I would spend the rest of my internship continuing the TMS-pilot, in order to be sure that our design was indeed effective in eliciting MEPs. Thus, I am planning on continuing this research project at my home institute. Thanks to the NENS Exchange Grant, I am now prepared to carry out a TMS – MEP study, a methodology my primary supervisor is not trained in. This provides me with the possibility of addressing my theory-driven research questions with the most applicable methodology possible, namely TMS, which I otherwise would not have been able to practically carry out. I look forward to continuing both the project and the collaboration with my host-institute and am curious about the final results.

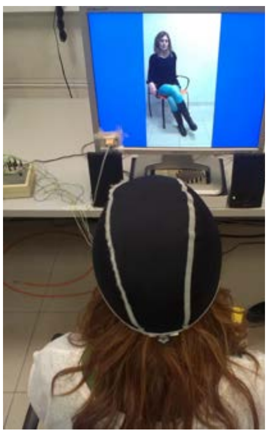

Figure 1. Experimental setup and individuals involved in the project. A participant positioned in front of the screen displaying an example stimulus video, on the left side of the table the EMG apparatus with the electrode cables that run to the participant's right hand and right leg (left image); from left to right, one of the stimulus video models, the author, the other stimulus video model, the research assistant, and the daily supervisor (Dr Sacheli; right image).