Good practices in TMS-EEG: an example of the preregistration approach

Agnese Zazio

IRCCS Istituto Centro San Giovanni di Dio Fatebenefratelli, Brescia, Italy

The combination of transcranial magnetic stimulation and electroencephalography (TMS-EEG) generates complex multi-dimensional datasets that allow to investigate the spread of cortical activation from the stimulated area to connected ones with an excellent temporal resolution. However, many preprocessing steps are needed in the TMS-EEG data analysis to remove the TMS-induced artifacts and obtain a clean neurophysiological signal. For each preprocessing step, a variety of options and methodological choices exist, which are far from being standardized and that can eventually lead to significantly different TMS-evoked potentials. This issue is known as “undisclosed analytic flexibility” and is a critical aspect that may affect the reproducibility in the TMS-EEG field.

A possible approach to overcome or at least to mitigate this problem and improve reproducibility is represented by the preregistration, in which the research plan containing information on the hypotheses, methods, preprocessing steps and statistical analyses is defined and drawn up before data collection. However, up to date the preregistration is not (yet) a popular strategy in the TMS-EEG community.

In my talk, I will present three recent preregistered TMS-EEG studies aiming at investigating the cortico-cortical effective connectivity pattern in the motor and somatosensory systems. I will discuss the advantages and the drawbacks encountered in the different stages of the process. Finally, I will suggest that even greater benefits may be obtained when the preregistration is combined with a large-scale collaborative effort, by presenting a recently developed initiative for the TMS-EEG community.

Overall, I will show the feasibility of the preregistration approach as an example among the good practices to promote reproducibility in the TMS-EEG field and specifically as a *“hard, and worthwhile”* strategy (Nosek et al., Trends in Cognitive Science 2019) to increase methodological rigor and transparency.