

## NIBS TECHNIQUES FOR THE INVESTIGATION AND TREATMENT OF COGNITIVE, EMOTIONAL, AND BEHAVIORAL ABNORMALITIES OF CHILDREN AND ADULTS WITH AUTISM SPECTRUM DISORDER

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Autism spectrum disorder is a highly prevalent neurodevelopmental disorder characterized by a major impairment in social communication and interaction as well as by behavioral abnormalities that, taken together, can lead to severe disability. No specific biological therapy is commonly used to treat ASD, despite its well-known neurobiological and neurophysiological underpinnings. In recent years, transcranial direct current stimulation (tDCS) and repetitive transcranial magnetic stimulation (rTMS) have been used in research settings to treat the symptoms of ASD. Among these two techniques, tDCS appears more suitable for the clinical use in ASD patients, being safer and associated with smoother side effects. Moreover, it is easier to administer with an easily portable equipment, which opens wider scenarios of treatment, such as the home-based application with the concomitant administration of behavioral therapies. These advantages appear particularly relevant for ASD patients, who are often hyperactive and attached to their routines and environments. In research settings, tDCS has also the advantage of being easy to use in double-blind or sham-controlled studies. In studies involving ASD patients, tDCS has been targeted to different brain areas with different treatment protocols, depending on the specific symptom domain addressed. Our first two studies addressed the behavioral disturbances of severe low-functioning adult ASD patients. We applied cathodal (inhibitory) tDCS over the left dorsolateral prefrontal cortex, with the aim of compensating for the shortage of inhibitory interneurons detected in this area of post-mortem brains of ASD patients. This treatment induced a clinically and statistically significant improvement of problem behaviors. In the following studies, we have enrolled ASD children and have implemented a different treatment protocol, concomitantly targeting the left dorsolateral prefrontal cortex and the right cerebellum, with anodal (excitatory) and cathodal (inhibitory) stimulation, respectively. The rationale for this new electrodes montage lies in the disruption of cerebro-cerebellar circuits and in the numerical reduction of cerebellar inhibitory cells that have been consistently found in ASD subjects' brains. We applied this protocol in three different studies, i.e., an open label pilot study, a randomized controlled trial, and a home-based naturalistic study. In the first two, taken together, we detected a reduction in hyperactivity, irritability, social withdrawal, and sleep disturbances, but not in stereotypies, language disorders, and parental stress. Preliminary results from the third study suggest that the home-based application leads to long-lasting beneficial effects on most problem behaviors, while allowing a more suitable treatment setting for both ASD patients and their caregivers.