Non-Invasive Brain Stimulation in persistent Developmental Stuttering: preliminary evidence of effects on speech fluency and brain functioning

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Developmental Stuttering (DS) is a neuro-developmental disorder affecting speech fluency, characterized by blocks/repetitions in the initial parts of words/sentences. DS is an idiopathic condition, usually appearing during childhood. It may persist in adulthood, influencing quality of life of the affected people, especially in the most severe cases. DS is characterized by impairments in cortical and subcortical neural networks, especially those useful for sensorimotor programming of voluntary motor sequences (e.g., related to speech). These networks comprehend regions such as the supplementary motor area (SMA), inferior frontal regions, and basal ganglia.

DS treatment is usually applied by means of "fluency-shaping" techniques, working on modification of sensorimotor speech patterns. However, in adults with persistent stuttering, relapse of dysfluencies are very common. As a consequence, no "definitive" intervention is available for recovering complete fluency, in DS. In this context, research is working in order to i) improve the understanding of the causal relationships related to DS, and ii) individuate more advanced/effective treatments for this condition. Compatibly, Non-Invasive Brain Stimulation (NIBS) is an option that is currently investigated in DS, useful to modulate the activity of brain regions that are involved in stuttering. However, the most effective protocol (i.e., individuation of the neural target, type and characteristics of stimulation) has not yet been defined.

In our project, we are using NIBS (transcranial random noise stimulation -tRNS- and transcranial direct current stimulation -tDCS-) to investigate effects on speech fluency and brain functioning of adults with persistent DS, while augmenting neural activity of SMA. More specifically, when applied in concomitance with speech training for reducing dysfluencies (i.e., utilization of a metronome), single sessions of tRNS and tDCS seem to be different than sham stimulation in modulating brain activity, as measured by EEG, in alpha and beta bands. In fact, while post-exercise activity is physiologically "rebounding" after the training phase toward higher levels of cortical inhibition when applying sham, this is not evident when applying tDCS and tRNS. This mainly suggests that real stimulation allowed participants to train with lower levels of "neural effort": this evidence could have interesting consequences in improving training-related neural plasticity in DS, as well as in the effectiveness of training interventions for stuttering. Importantly, these observations allowed to realize a case study in which tRNS treatment on SMA has been applied (in concomitance with behavioral speech fluency intervention): findings will be reported, permitting to start with a wider clinical trial phase (https://clinicaltrials.gov/ct2/show/NCT05306782).

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