SESSIONE: *Neuroscience*

Anodal tDCS enhances decision precision during biological motion perception: A computational Active Inference Perspective

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Introduction: Recognizing biological motion from visual input (Point Light Displays, PLD) can be associated with the brain's ability to minimize prediction errors under uncertainty. While transcranial direct current stimulation (tDCS) has been shown to modulate social perception, the underlying computational mechanisms remain unclear. Using Active Inference, we examined whether tDCS modulates perceptual learning rates or decision precision.

Methods: Fifteen healthy participants performed a Signal Detection Task involving PLD stimuli (Biological/Non-Biological, Goal/Non-Goal oriented) with varying levels of noise. Each sub-ject underwent four randomized tDCS sessions: Baseline, Sham, Anodal, and Cathodal. We modeled trial-by-trial behavioral data using a two-stage Bayesian framework. In Perceptual Model a Hierarchical Gaussian Filter (HGF) simulate belief update with dynamic precision-weighting based on noise levels. In response Model a stochastic decision function estimates two parameters: Decision Threshold (τ, bias) and Sensitivity (ζ, decision precision/inverse temperature). Additionally, we analyzed Response Times (RT) as a function of the Shannon Entropy of the trial-wise belief**.**

Results: Computational modelling revealed that tDCS did not alter the perceptual belief trajectory or the decision bias ($\tau \approx 0.5$ across all conditions). However, Anodal tDCS induced a specific modulation of the decision stage. Compared to Sham, Anodal stimulation increased. Decision Sensitivity (ζ), suggesting a higher signal-to-noise ratio in the transformation of beliefs into actions. Furthermore, RT analysis showed that Anodal tDCS reduced baseline processing latency (lower intercept) while increasing the dependency of RT on decision uncertainty (steeper slope), indicating a more adaptive regulation of the speed-accuracy trade-off.

Conclusions: Our findings suggest that Anodal tDCS does not change the content of perceptual learning ("what we see") but enhances the precision of action selection ("how confidently we respond"). By increasing the gain of the decision function, Anodal stimulation reduces stochasticity in perception tasks, consistent with a neuromodulatory effect on synaptic gain control mechanisms proposed by predictive coding theories.