

**Motor learning in healthy and Parkinsonian adults:
The combined effects of multimodal experience and neurostimulation**

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Abstract italiano

L'obiettivo principale del lavoro è stato di valutare il ruolo della neurostimolazione e della multimodalità (intesa come la presentazione visiva di un modello che esegue un movimento assieme a una musica sincrona) nell'apprendimento motorio, indagando sia gli effetti sugli adulti sani sia su pazienti affetti da Morbo di Parkinson (MP). Per raggiungere tale obiettivo, sono state condotte tre ricerche sperimentali e longitudinali, utilizzando diversi strumenti, come tDCS, biofeedback e Kinect™.

Partendo da una sistematica revisione della letteratura nel campo della riabilitazione neuromotoria, sono state identificate tre forme di trattamento che sembrano efficaci contro i sintomi motori del MP. Tuttavia, pur riconoscendo la loro efficacia, non sono mai stati combinati nella pratica riabilitativa: l'Action Observation Learning (basato sulla teoria del sistema dei neuroni specchio), la neurostimolazione anodica non-invasiva sulla zona motoria primaria e l'uso della musica.

I risultati dimostrano un chiaro sostegno della multimodalità e della neuro stimolazione nella fase di encoding e un loro supporto nel migliorare le funzioni motorie, anche a distanza di un mese. Questo lavoro offre nuove indicazioni per lo sviluppo di approcci innovativi ed efficaci nel campo dell'apprendimento motorio.

Abstract inglese

The main objective was to assess the role of neurostimulation and multimodality (namely the presentation of a visual model together with a synchronized musical track) in motor learning, by considering both healthy adults and Parkinsonian patients (PD). In order to achieve this goal, three experimental and longitudinal studies were carried out, using different tools such as tDCS, biofeedback and Kinect™.

Starting with a systematic review, three innovative approaches which seem to be effective in treating the motor symptoms of PD, were identified. However, while recognizing the effectiveness of these three promising approaches, they have never been combined: Action Observation Learning (based on the theory of mirror neuron system), the non-invasive anodal neurostimulation on the primary motor area and the use of music. The results showed a clear support of multimodality and neurostimulation during the encoding phase and in improving motor functions, even after one month. This work provides new suggestions for innovative and effective treatments in motor learning field.

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