Stimulating Music: Combining Melodic Intonation Therapy with Transcranial DC Stimulation to Facilitate Speech Recovery after Stroke

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Summary. It may be strange to think that singing could help a stroke victim speak again, but this is the goal of Melodic Intonation Therapy (MIT), a speech therapy that emphasizes musical aspects of language. The positive effects of MIT on speech recovery may be mediated by a fronto-temporal brain network in the right hemisphere. We investigated the potential for a non-invasive brain stimulation technique, Transcranial Direct Current Stimulation (tDCS), to augment the benefits of MIT for patients with severe non-fluent aphasias. The tDCS was applied to the posterior inferior frontal gyrus (IFG) of the right hemisphere, under the assumption that the posterior IFG is a key region in the process of recovering from aphasia. The stimulation coincided with an MIT session, conducted by a trained therapist. Participants’ language fluency improved significantly more with real tDCS + MIT, compared to sham tDCS + MIT. These results provide evidence that combining tDCS with MIT may enhance activity in a sensorimotor network for articulation in the right hemisphere, to compensate for damaged left-hemisphere language centers.

Key words. Melodic Intonation Therapy, Transcranial Direct Current Stimulation, tDCS, Stroke, Recovery, Neurorehabilitation, Singing, Music Therapy
1 Introduction

Approximately 20% of stroke victims suffer from aphasia, which is a loss of speech and language ability (Schlaug et al., 2008a). Though behavioral therapies for recovery from stroke can have a beneficial effect (Robey, 1994; Holland et al., 1996), recovery is most often incomplete, particularly for patients with large left-hemisphere strokes. Relatively few speech therapy techniques are available to help these patients. An intonation-based speech therapy, Melodic Intonation Therapy, may be particularly suited for patients who suffer from severe non-fluent aphasia (Schlaug et al., 2008a,b). Another line of research has recently emerged which shows that combining behavioral therapies with non-invasive brain-stimulation might enhance the potential for recovery (Schlaug, Renga, Nair, 2008). Indeed, the future of stroke-recovery therapy may lie in combining behavioral therapy with complimentary non-invasive brain stimulation to maximally engage brain areas that are important for recovery. We explored this promising frontier of rehabilitation by investigating the effects of combining non-invasive brain stimulation with a behavioral intonation-based speech therapy.

1.1 Aphasia and Music in the Brain

Because some language processes are largely lateralized to the left hemisphere, left-hemisphere damage can lead to devastating forms of aphasia. A stroke affecting the left frontal lobe can cause a non-fluent aphasia with relatively unimpaired comprehension – Broca’s aphasia (Luria, 1970). Broca’s aphasia hinders the ability to organize elements of speech (e.g., phonemes) into meaningful utterances. Previous research suggests that there are two neural pathways to recovery from Broca’s aphasia. One pathway involves the re-activation of peri-lesional cortex in the left hemisphere; generally, this is only possible for patients who have smaller lesions that do not completely destroy Broca’s area. The second pathway utilizes the right hemisphere, and may be the only option for patients with large left-hemisphere lesions (Blasi et al., 2002; Mimura et al., 1998; Pizzamiglio et al., 2001; Schlaug et al., 2008b; Thiel et al., 2001; Winhuisen et al., 2005). These studies provide evidence that language-capable centers in the right-hemisphere may compensate for damaged left-hemisphere “eloquent” areas to help patients recover language skill, particularly when damage to the left hemisphere is extensive.

An increasing number of studies point to common neural substrates for language and music (Maess et al., 2001; Koelsch et al., 2002; Patel et al.,