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# Prefrontal noninvasive brain stimulation as a tool to modulate executive control of language

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Several models suggest that both mono- and bilingual language production are supported by executive control areas beyond the classical language network. This thesis investigated the role of the left dorsolateral prefrontal cortex (DLPFC) in the executive control of speech production. Three studies were conducted investigating the effects of noninvasive brain stimulation (NIBS) over the left DLPFC on word production in healthy and aphasic subjects.

In a first study, we investigated whether left prefrontal anodal transcranial direct current stimulation (A-tDCS) can improve language production in people with chronic post-stroke aphasia. As compared with sham tDCS, A-tDCS improved verbal fluency as well as the speed of naming pictures of high-frequency words, but not word repetition.

In a second study, we examined whether the involvement of the left DLPFC is more strongly required when speaking in the non-dominant language (L2) compared to the mother tongue (L1) due to higher executive control required. Therefore, we compared inhibitory TBS (cTBS) versus sham TBS on picture naming in L1 and L2 as well as on forward (L2->L1) and backward (L1->L2) translation. Independent of language, response times were longer after cTBS compared to sham TBS in the picture naming tasks, while response times were not affected for the word translation tasks. These results were mirrored on the electrophysiological level, showing an effect of stimulation in the picture naming tasks starting at 547ms post-stimulus onset, but not in the word translation tasks.

In a third study, we added a language-switching block, in which participants had to name pictures alternating between L1 and L2. On the behavioral level, we found no effect of TBS. However, the event-related potential- analysis revealed an effect of stimulation for the picture naming tasks at 20-72ms post-stimulus onset, characterized by alterations in the left DLPFC, and at 533-600ms, characterized by engagements of executive control networks associated with conflict resolution and self-monitoring. However, these effects were not increased in the switching compared to the non-switching block.

Taken together, NIBS over the left DLPFC slightly modulated word production both in healthy and brain-damaged patients, independent of the language in use. The electrophysiological results moreover suggest that the left DLPFC contributes to an enhancement of self-monitoring processes during speech production.

Jury:

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