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Laterality mediates the benefits of neurostimulation on new language learning

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New word learning paradigms in healthy adults have become popular in recent times as this allows consideration of the mechanisms involved in relearning amongst aphasic patients with tight experimental control (Breitenstein et al., 2007). Anodal transcranial Direct Current Stimulation (tDCS) has been used to facilitate the acquisition of novel labels for familiar items (Flöel et al., 2008). To date, however, the impact of site and polarity of stimulation on new language learning in healthy adults has yet to be explored. Current neural theories of speech processing suggest that speech production is a strongly left lateralised ability, whereas comprehension involves more bilateral processing (Hickok & Poeppel, 2007). These models make clear predictions for the impact of neurostimulation upon new word learning. When stimulating speech production areas, this should only impact upon acquisition of novel object labels if applied to the left. In contrast, when stimulating areas involved in speech comprehension, comparable effects should be observed whether applied to the left or right. These predictions were tested in the current study in two experiments. Firstly, anodal (positive), cathodal (negative), and sham (neutral) tDCS were applied a left or right frontal region corresponding to Broca's area and its homologue, as this left hemisphere area has been implicated in speech production in stroke aphasia (Fridriksson et al., 2010). In line with predictions, acquisition of novel labels for known objects was enhanced only for left anodal frontal stimulation, and this generalised to a different view of the object and persisted a week later. Secondly, anodal, cathodal, and sham tDCS were applied to a left or right anterior temporal region. These areas are implicated in speech comprehension given the deficits seen in this domain amongst semantic dementia patients, who are characterised by bilateral damage to the anterior temporal lobes (Ogar et al., 2011). Again in line with predictions, acquisition of novel labels for novel objects was enhanced by both left and right anodal anterior temporal stimulation up to a week later, although this effect did not generalise to a different view. Taken together, these results clearly illustrate the task dependent lateralisation of the speech processing system, suggesting that careful consideration needs to be given to both the site of stimulation and nature of the task in application of tDCS to treatment of word finding difficulties in aphasic patients.

References

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