Non-invasive brain stimulation: how reliably can we change your mind?

Non-invasive brain stimulation is becoming increasingly popular within scientific research. This is because it has the ability to painlessly influence targeted regions of the brain, without the side effects associated with many medications. At first glance, the existing research suggests that it is a promising research tool and a potentially useful treatment for a range of neuro-psychiatric conditions such as depression. However, the exact biological mechanisms responsible for the effects are often not fully understood, and little is known about how reliable these effects are. In this piece of research, the reliability and stability of a non-invasive technique known as transcranial direct current stimulation (tDCS) was explored.

What is transcranial direct current stimulation (tDCS)?
tDCS works by applying a *very* low voltage current between two electrodes which are attached to the head. Some of this electrical current is able to penetrate through the skull to reach the surface of the brain known as the cortex. The presence of an electrical current at the cortical surface can then cause a change in the excitability of this area; this is often referred to as a change in '*cortical excitability'.* tDCS induced changes in cortical excitability can last for a number of hours and are related to temporary changes in the chemical balance of the brain.

How were the effects of tDCS studied?
The aim of this research was to test the reliability and stability of the immediate after effects of tDCS.
Change in cortical excitability was measured using a technique known as transcranial magnetic stimulation (TMS). Using TMS it is possible to see how much the brain responds to a specific input, and so, by measuring responses to TMS before and after tDCS it was possible to test if cortical excitability had increased (more response to TMS) or decreased (less response to TMS).

What were the results and what do they mean?
It was found that when the current was run between the two electrodes in a particular direction ('*anodal stimulation'*) the brain became more excitable in most participants. However, running the current in the other direction (*'cathodal stimulation'*) didn't result in any clear changes. *This finding shows that tDCS can successfully change cortical excitability, and that it depends on the direction in which the current is run***.** Previous research has reported effects using cathodal stimulation, so the failure to replicate this could suggest that anodal stimulation is more reliable.

The effects of anodal and cathodal stimulation were each tested four times in the same participants. This was done to examine if the amount and direction of change in cortical excitability found after tDCS was stable. The results showed that the effects of both forms of tDCS (anodal & cathodal) differed across each testing session. *This is an important finding because it suggests that the effects of tDCS vary from day-to-day.* This implies that additional research is needed to find out

what factors influence the effects. Once these are identified it may be possible to control them, which could be very useful in helping to develop tDCS as a treatment.

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Publication

Intra-Subject Consistency and Reliability of Response Following 2?mA Transcranial Direct Current Stimulation.
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