

Veracity Enhancement Using Non-Invasive Brain Stimulation: A Systematic Review

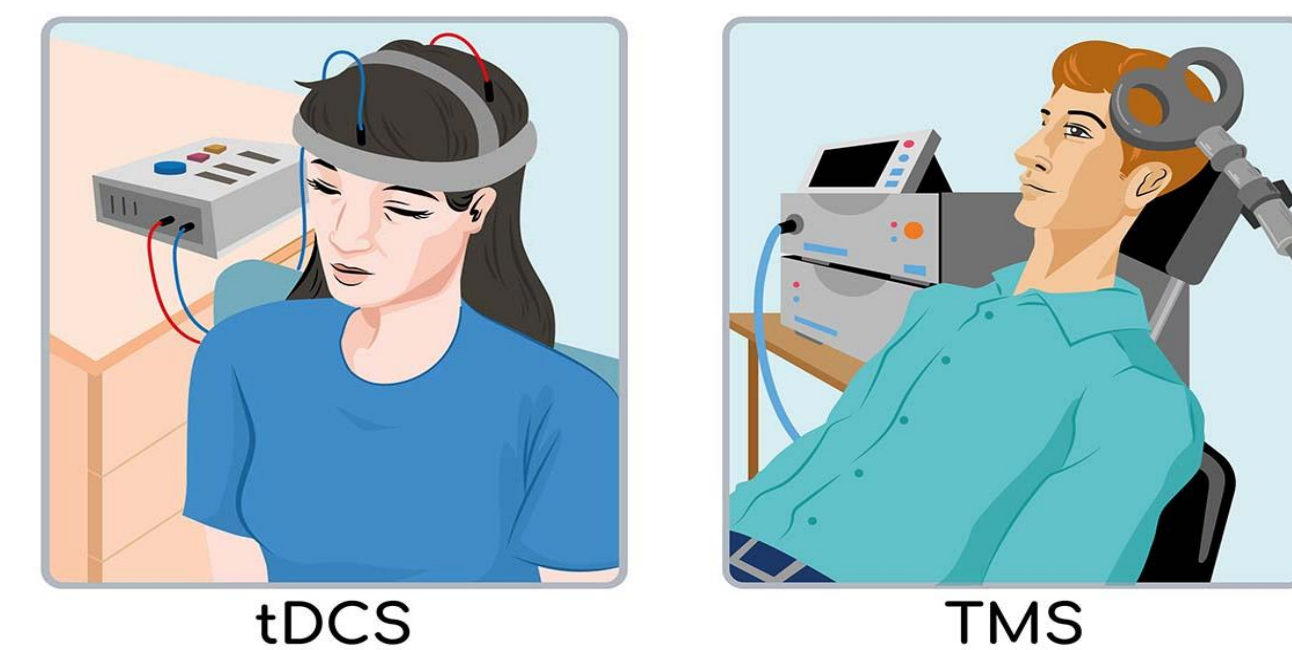


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INTRODUCTION

For decades, non-invasive brain stimulation (NIBS) techniques like Transcranial Magnetic Stimulation (TMS) and Transcranial direct-current stimulation (tDCS) have been used in clinical settings as forms of neuromodulatory treatment for depression and other neurodivergent disorders. In recent years, there has been increased research in utilizing the non-invasive techniques to enhance cognition beyond one's baseline, including language, memory, moral, and veracity enhancements. Due to the lack of systematic reviews in the growing field of veracity enhancement, we aim to provide a concise, summative overview of current research studying the impacts of NIBS on truthfulness, as well as its ethical dilemmas and future directions.



tDCS

TMS

METHODS

A systemic review was conducted according to PRISMA guidelines with use of PubMed, Web of Science, PsycINFO, and the Cochrane Library databases. We conducted separate searches for peer-reviewed papers utilizing each NIBS technique, using search terms:

For TMS → (TMS OR transcranial magnetic stimulation) AND (deception OR verac* OR lie OR truth* OR dishonest*)

For tDCS → (tDCS OR transcranial direct current stimulation) AND (deception OR verac* OR lie OR truth* OR dishonest*)

For each study, data related to the study type, groups/conditions, sample size, age, gender ratio, brain localization, stimulation intensity and duration, as well as significant findings were extracted and analyzed by two independent reviewers.

METHODS CONT.

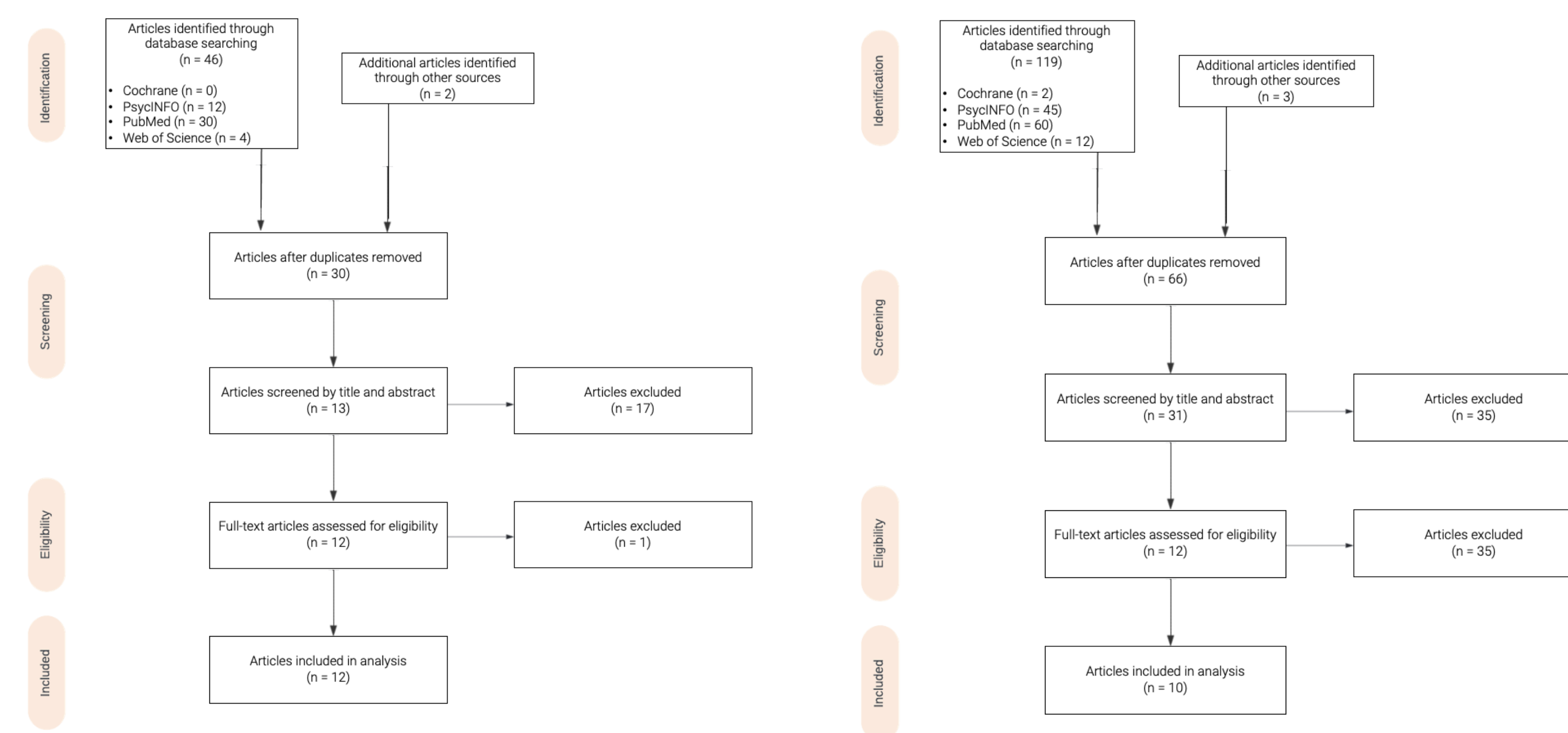


Figure 1. PRISMA Flow Diagram for tDCS Impact on Veracity (left), and PRISMA Flow Diagram for TMS Impact on Veracity (right)

RESULTS

12 papers utilizing tDCS and 10 papers utilizing TMS were found to meet the inclusion criteria. Studies selected were randomized controlled trials (RCTs), and involved a total of 1165 participants (60.8% female, 39.2% male), averaging 25.2 years old.

Veracity was tested using various methods, with 6 papers utilizing the Guilty Knowledge Test, a standardized psychophysiological procedure, and 6 papers using techniques ranging from providing false personal information on cue, reporting either truthful or untruthful information of a rolled die, or playing a "dictator game", which studies how people respond to situations where self-interest and equality are in conflict

Utilizing tDCS, veracity was increased after anodal stimulation of the anterior prefrontal cortex (aPFC; 1/1 study), temporoparietal junction (TPJ; 1/1 study), ventrolateral prefrontal cortex (VLPFC; 2/2 studies), and dorsolateral prefrontal cortex (DLPFC, 4/6 studies). Results were inconclusive in the other brain regions studied.

Utilizing TMS, many studies researched differences between the left vs right DLPFC, with follow-up studies focusing on the latter. Inhibition of the right DLPFC resulted in participants exhibiting more veracity, while stimulation of the right DLPFC resulted in more deception.

RESULTS CONT.

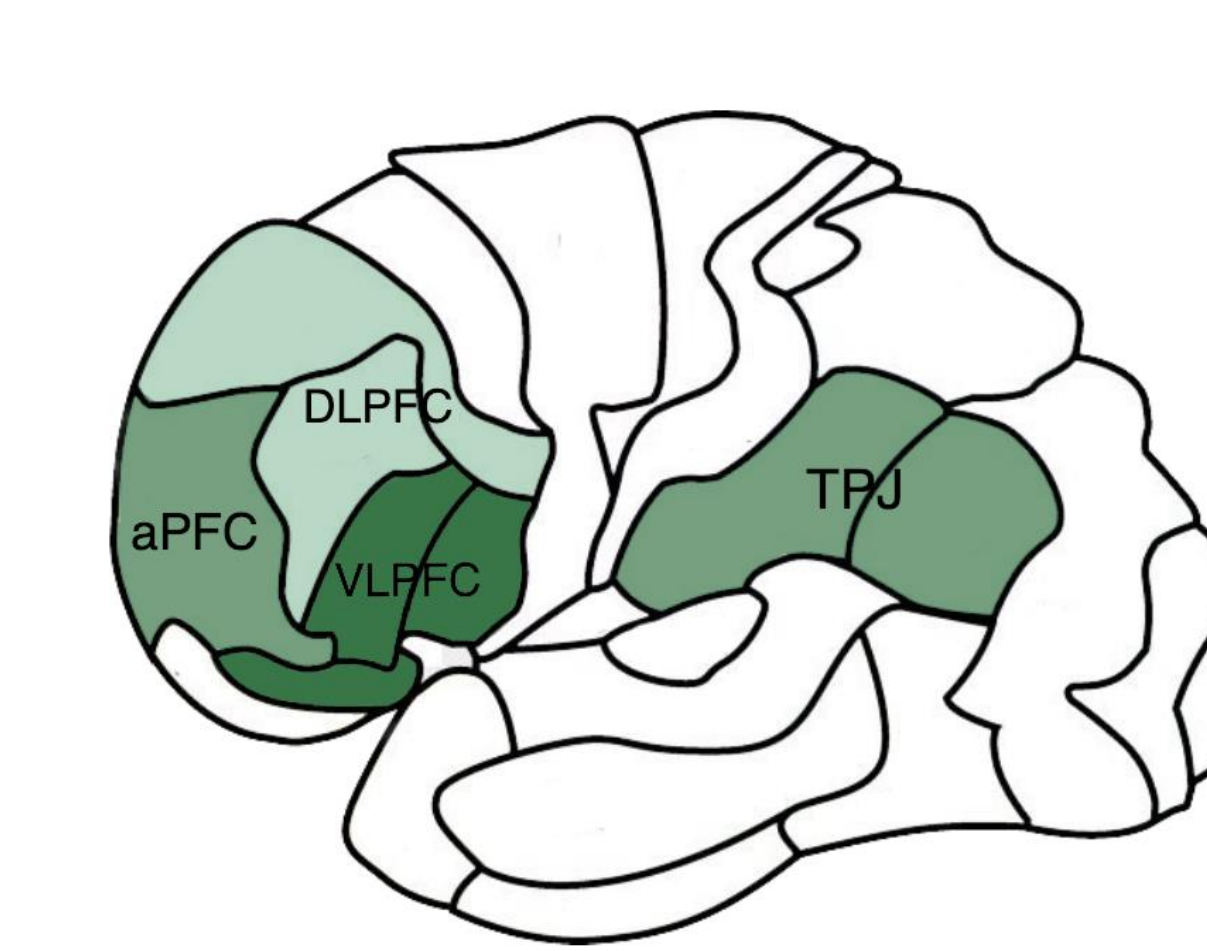


Figure 2. Brodmann map of tDCS stimulation and increased veracity, with darker green indicating stronger correlation

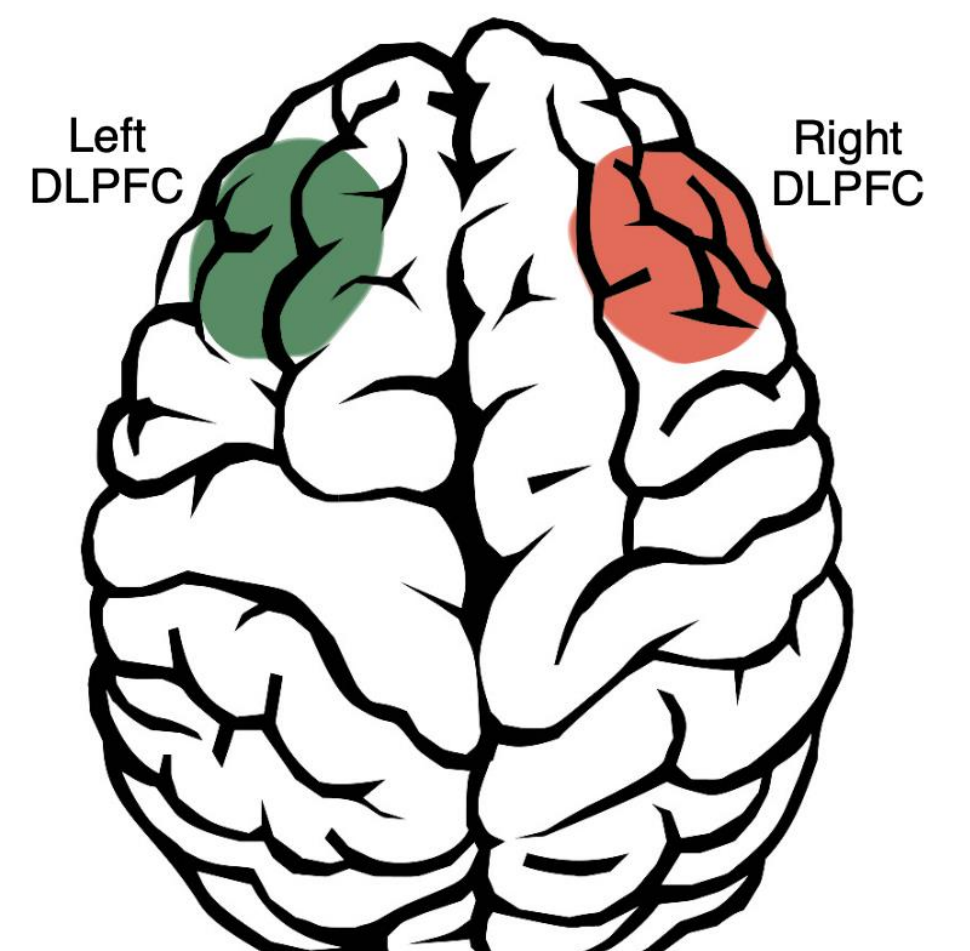


Figure 3. Image of TMS stimulation of DLPFC and veracity effect, with stimulation of right DLPFC increasing deception

CONCLUSION

Based on this systematic review, NIBS techniques show ability to pose distinct influences on veracity enhancement, with stimulation of different brain regions generating opposing effects. However, due to the small number of original articles on this topic as well as occasional inconsistent results, substantial further research as well as a more standardized methodology is still needed.

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