Brain Stimulation xxx (2012) 1–2

Contents lists available at SciVerse ScienceDirect

Brain Stimulation

journal homepage: www.brainstimjrnl.com

Editorial

Introduction: Brain stimulation in cognitive neuroscience

It is a privilege to have been invited to commission articles for this special issue of *Brain Stimulation*. Under the guidance of Mark George and the deputy editors, the Journal has rapidly become the publication of record for all aspects of electromagnetic brain stimulation. Part of the success lies in bringing together diverse approaches to brain stimulation that necessarily exposes cognitive neuroscientists to clinicians, experimenters to modellers and all the brain stimulation communities to new technical and methodological developments. One of the goals of this issue is to illustrate the connection and value of cognitive neuroscience to other branches of brain stimulation science. The quality of the papers we have attracted and accepted bears testimony to the range and maturity of brain stimulation work relevant to cognitive neuroscience and we are grateful to all the authors for their efforts.

Perhaps one of the most salient new fields to emerge in cognitive neuroscience in the past decade is that of social cognition, an area in which brain stimulation studies have made significant contributions ever since the early studies of Luciano Fadiga and Salvatore Aglioti. Three papers in this issue show the impressive breadth and depth, which we now have in this field. Hetu & Jackson, provide a comprehensive review detailing the ability of stimulation studies to parse the elements of empathy such as resonance, discrimination between oneself and others and mentalizing. They look forward as well as back and challenge the field to embrace and reify ecological validity in experiments and propose advances that may have clinical relevance. Borgomaneri et al., investigate the effects of action observation on emotions. This might sound as if it is at the "high-end" of cognition, but the dependent variable of interest is the motor evoked potential (the warhorse of TMS). This is a perfect illustration of the mission of this journal – to promote the necessary link between understanding basic physiology, the effects of brain stimulation and human behaviour. Whereas Borgomaneri et al., used the MEP as an outcome measure of emotional processing, Grosbras et al., take an interference approach using TMS to change people's perceptions of the emotional content of dance. The stimuli in this experiment certainly meet Hetu and Jackson's challenge of ecological validity.

Another field, like social cognition, that has completed the journey from being a nascent field to being a buzzword is decision-making. Here too, brain stimulation studies have made contributions from the very outset. Levasseur-Moreau and Fecteau critically assess this contribution and demonstrate its relevance in clinical settings and in every day behaviours which raises new ethical problems for the field. Decision-making includes one's assessment of risk, drive for reward, impulse control and views of fairness. Direct Current (tDCS) studies seem to be in the ascendancy here and the method seems capable of changing the behaviour of both patients and non-pathological control subjects. The most promising area was seen to be in the potential to treat addictive disorders. Juan & Muggleton take a physiological approach to understanding impulsivity and survey the role of different cortical areas in inhibitory control. Their contribution illustrates the close ties between anatomical and physiological findings and the need to test them with interference techniques.

One of most difficult aspects of brain stimulation studies for people to understand is how an interference method can sometimes disrupt behaviour and at other times enhance behaviour. Sometimes this leads authors to confuse improvements in behaviour with excitation of neural circuits and disruption of behaviour with inhibition of neural circuits. The three examples in this issue of brain stimulation would be a great place that anyone starts reading about enhancements. Manenti et al., provide exactly the kind of measured review that the field needs. They concentrate on studies of memory and the prospects of using human brain stimulation to advance clinical interventions. The review is sophisticated and has lessons for anyone who has unexpected behavioural improvements as a consequence of brain stimulation in their studies. Explaining enhancements adequately, rather than by post-hoc magic, requires an understanding of the anatomy of the system being stimulated (the brain stimulation is not an organised signal and there will always be costs as well as benefits), and appreciation of the different elements of the tasks and responses used in the experimental setting. Enhancements have been subject to more hype and poor explanation than any other area of human brain stimulation studies in cognition. We would be well served to remind ourselves of the distance between the transient millisecond and small percentage gains that excite us to publication and the sustained demands of real-life situations. The papers by Metuki et al., and Pope and Miall pass these tests and show how the understanding of facilitations is healthily constrained by cognitive and physiological hypotheses. Metuki et al., explore the role of dorsolateral prefrontal cortex in problem solving using tDCS. Left DLPFC DC stimulation enhanced solution generation of difficult problems but not for easy problems. Their understanding of the improvements induced by DC stimulation is cleverly placed within a framework built of prediction based on combined cognitive and anatomical hypotheses. Task difficulty is also a feature of Pope and Miall's contribution. Cathodal cerebellar stimulation improved performance on difficult items in the serial subtraction task. Again, an understanding of anatomy is necessary to the interpretation and it is argued here that the inhibition of

1935-861X/$ – see front matter © 2012 Published by Elsevier Inc.
doi:10.1016/j.brs.2012.04.001

cerebellar activation results in disinhibition of prefrontal areas necessary for this task.

A distinct challenge for brain stimulation studies of cognition has been to integrate the methods with imaging techniques. Part of the difficulty has been in dealing with the different limitations of the respective methods. Two papers in this issue deliver master classes in how to deal with these issues. Taylor and Thut's article surveys the use of TMS and EEG in studies of visual perception and attention. They show how the problem of deriving conclusions when combining these two methods can't be solved by a combination of a clear understanding of the stimuli and the task, possible distribution of current delivered by TMS, anatomical connectivity between areas involved in the task and the basis of the generation of the EEG signal. Cho et al., grace the issue with a paper that encapsulates everything we have discussed above. They take a key area of cognitive neuroscience, decision-making, and generate a hypothesis based partly on their previous work on the dopamine system, partly on neuropsychology and partly on an understanding of the components of the decision-making task (delayed discounting in this case). They then use a magnetic stimulation paradigm derived from stimulation work in the rat (theta burst stimulation) and combine this with positron emission tomography. The results are interpreted based on the anatomical constraints and an understanding of the roles of the areas of interest (BA46 and BA10) in other cognitive and perceptual tasks.

We hope this issue of the Journal will serve to consolidate its position in the field and encourage even more cognitive neuroscientists to submit their best work on brain stimulation to the most appropriate and challenging readership covering the field.

Shirley Fecteau[a], Vincent Walsh[*,b]
[a] *CRULRG, CIRRIS, School of Medicine, Laval University, Quebec, Canada*

[b] *University College London, ICN & Psychology, 17 Queen Sq, London WC1N 3AR, United Kingdom*

[*] Corresponding author.
E-mail address: v.walsh@ucl.ac.uk (V. Walsh)

Available online xxx