LETTER

From bench to clinic to community: The far reaching implications of basic research

In their recently published study, Wefelmeyer et al. (1) found that the region of the neuron where action potentials are generated, the axon initial segment, relocated further down the axon, away from axo-axonic synapses, in response to chronic excitation. The authors conclude that this process allows the neuron to raise its current threshold and thus homeostatically reduce its excitability. These basic science findings clearly have implications for understanding brain function and models of plasticity; however, we believe they also have relevance to the intensifying debate around the use of brain stimulation to enhance cognition in the healthy population.

Interest in this particular application of brain stimulation has greatly increased over the last few years. Transcranial direct current stimulation (tDCS) in particular has garnered a considerable degree of attention in the press, which has led to a concurrent rise in do-it-yourself (DIY) brain stimulation (2). Both the excitement and concerns regarding the application of tDCS in the healthy population are contingent upon its ability to consistently and substantially enhance brain activity and improve cognition in this group, yet there is growing evidence that this may not be possible. Our published data show that, although there is some cognitive improvement following tDCS in the healthy population, it is limited in a way that we did not see in a patient group, such as those with schizophrenia (3, 4). Specifically, in separate studies we found that increasing stimulation dose in healthy people was not associated with improved performance (3), whereas patients with schizophrenia did show improvement at the higher dose (4). We hypothesize that this was likely because of a homeostatic response in the healthy brain reducing the likelihood of increasing neural firing with increasing degree of electrical stimulation, and Wefelmeyer et al.'s (1) findings certainly lend support to this theory.

The type of cellular homeostatic response described by Wefelmeyer et al. (1), elements of which have been suggested to be impaired in neuropsychiatric conditions, including schizophrenia, may explain the limited effects seen following tDCS stimulation in the healthy population. In this case, increasing the dose or duration of stimulation would not result in enhanced gains in the healthy brain; in contrast, it would likely further reduce the possibility of receiving any benefit and, depending upon the dose/duration used, could also increase risk. Of concern, in the only survey conducted to date, DIY tDCS users report pushing the boundaries of established stimulation parameters: that is, stimulating for durations longer than 20 min (up to 61+ min) and at currents greater than 3 mA (5). Not only is longer and higher stimulation likely to be less effective, pushing the boundaries of established scientific parameters for home use is unsafe. Welfelmeyer et al.'s (1) findings provide an important potential explanation for the behavioral effects seen in the research to date, and lend considerable weight to the discussion around the efficacy, safety, and ethics of DIY tDCS.

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Kate E. Hoy*[1] *and Paul B. Fitzgerald
Monash Alfred Psychiatry Research Centre, Central Clinical School, Monash University and Alfred Health, Melbourne, VIC 3004, Australia

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[1]To whom correspondence should be addressed. Email: Kate.Hoy@monash.edu.