

NEUROSCIENCE

Brain stimulation in children spurs hope — and concern

Treatment of developing brains offers greater scope for improvement but also intensifies risks.



Studies aimed at enhancing learning in children are generating controversy.

BY LINDA GEDDES

Jack struggled in regular school. Diagnosed with dyslexia and the mathematical equivalent, dyscalculia, as well as the movement disorder dyspraxia, Jack (not his real name) often misbehaved and played the class clown. So the boy's parents were relieved when he was offered a place at Fairley House in London, which specializes in helping children with learning difficulties. Fairley is also possibly the first school in the world to have offered pupils the chance to undergo electrical brain stimulation.

The stimulation was done as part of an experiment in which twelve eight- to ten-year-olds,

including Jack, wore an electrode-equipped cap while they played a video game. Neuroscientist Roi Cohen Kadosh of the University of Oxford, UK, who led the pilot study in 2013, is one of a handful of researchers across the world who are investigating whether small, specific areas of a child's brain can be safely stimulated to overcome learning difficulties. "It would be great to be able to understand how to deliver effective doses of brain stimulation to kids' brains, so that we can get ahead of developmental conditions before they really start to hold children back in their learning," says psychologist Nick Davis of Swansea University, UK.

The idea of using magnets or electric currents

to treat psychiatric or learning disorders — or just to enhance cognition — has generated a flurry of excitement over the past ten years. The technique is thought to work by activating neural circuits or by making it easier for neurons to fire. The research is still in its infancy, but at least 10,000 adults have undergone such stimulation, and it seems to be safe — at least in the short term. One version of the technology, called transcranial magnetic stimulation (TMS), has been approved by the US Food and Drug Administration to treat migraine and depression in adults.

Interest is growing, however, in whether such technologies might have even greater benefits in children. Particularly promising is TMS's cheaper and more-portable cousin, transcranial direct-current stimulation (TDCS).

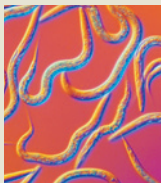
Researchers say that the stimulation effects are likely to penetrate deeper in children because their skulls are thinner than adults', and might have more of an impact in brains that are still growing. However, the same factors that intensify the potential benefits are also cause for concern. "It's like when you build a house: if you think things are going wrong, it's much easier to fix things at the beginning rather than later on, but it's also much easier to ruin them," says Cohen Kadosh. "We don't know how electrical stimulation interacts with the developing brain."

Cohen Kadosh also worries about abuse of the technology. Although devices prescribed for medical treatments must meet certain safety standards, there are currently no laws in either Europe or the United States to regulate the use of TDCS in people merely hoping to enhance their cognition, and companies now sell the TDCS headsets online. So parents, say, might feel tempted to try to boost the cognitive abilities of their children outside the controlled conditions of a lab. After weighing up the pros and

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cons, however, Cohen Kadosh decided to approach Fairley House about doing a trial. He also had to seek ethics approval, which he received. “We were very worried about putting brain stimulation into place, because as a school we knew nothing about it, but we were reassured about the ethics and safety,” says Jenny Lim, an occupational therapist who works with children at the school.

LEARNING ENHANCER

The study follows on from one in which Cohen Kadosh showed that a variant of TDCS called transcranial random-noise stimulation (TRNS) could boost mathematical ability in adults (A. Snowball *et al.* *Curr. Biol.* **23**, 987–992; 2013).

In the Fairley House study, his team gave the 12 children with mathematical learning difficulties nine 20-minute training sessions. Half of the volunteers received TRNS, targeted at the brain area responsible for processes such as planning and abstract reasoning; the other half wore a TRNS cap but did not receive any stimulation. TRNS is thought to work by modulating brain signals during learning: in this case, the children moved their bodies from side to side to guide a ball on a screen to land at a certain point on a number line, with the difficulty increasing as they progressed.

The children who received stimulation showed greater progress in performance than did the controls — reaching level 17 on average, compared with level 14 — as well as significant improvements in general mathematics test scores. Cohen Kadosh presented the analysis at the British Association for Psychopharmacology meeting in Bristol in late July and has submitted the results for publication. He now plans to further this line of research.

But neuroscientist Vincent Walsh at University College London’s Institute of Cognitive Neuroscience thinks that studies of brain stimulation in children are premature. The benefits observed in young adults are not always seen in older people, he says, and many electrical-stimulation results have yet to be replicated. “There is simply no sound scientific basis for extending such poor work to children,” he says.

Davis, by contrast, thinks that such experiments are justified, but is concerned about the trend to use the techniques outside formal studies. He estimates that at least 1,000 children around the world have received some kind of brain stimulation as part of clinical studies, and expects more in future. He stresses the importance of publishing the results of any work done in children. “I would urge all scientists to share their results when children and young people are given brain stimulation, to allow other scientists to learn from ‘failed’ trials and to adapt the protocols if needed.” ■

POLITICS

Science vies for notice in Canadian election

Current government has cut funding and limited researchers’ influence over policy, critics say.

BY NICOLA JONES

Canadians will head to the polls on 19 October in a federal election that many scientists hope will mark a turning point after years of declining research budgets and allegations of government censorship.

Prime Minister Stephen Harper, who has been in office since 2006, now finds his right-leaning Conservative party in a tight three-way race with the left-leaning New Democratic Party (NDP) and the middle-left Liberals. Although science has not emerged as a top issue during the campaign, researchers are fighting to make their concerns heard.

In an unprecedented move, the Professional Institute of the Public Service of Canada — a union in Ottawa that represents more than 57,000 government scientists and other professionals — is campaigning in the federal race. “Here’s how we do things in the Harper government,” declares one of the union’s radio advertisements. “We muzzle scientists, we cut research and we ignore anyone who doesn’t tell us what we want to hear.”

The group estimates that the Harper administration has eliminated jobs for some 2,500 scientists. And the government’s own data show that Canada’s ranking for research and development spending dropped from 16th among 41 comparable nations in 2006 to 23rd in 2011 (the most recent year for which government figures are available). Harper has also been accused of limiting government scientists’ ability to communicate with the press and public; Canada’s information commissioner promised to investigate this in 2013, but has not yet released any findings.

“The Harper government has had complete disdain for federal government science,” says Peter Wells, a marine biologist at Dalhousie University in Halifax, Nova Scotia.

Kai Chan, an ecologist at the University of British Columbia in Vancouver, is similarly glum. “I have been continually surprised by how bad it has gotten in Canada,” says Chan, who co-founded a group called ‘scienceinpolicy’ in the United States during George Bush’s presidency. “It’s worse than I could have imagined, having closely scrutinized what I thought was the worst in North America.”

Although the Conservative party has done little to address such criticisms, members of the two opposition parties have called for a stronger role for science in government. Dozens of NDP and Liberal candidates for parliament have declared their support for evidence-based decision-making by signing a ‘science pledge’ developed by Evidence for Democracy, a non-profit science-advocacy group in Ottawa.

These issues were not discussed at a debate in Calgary on 17 September that pitted Harper against NDP leader Thomas Mulcair and Liberal leader Justin Trudeau, and focused on the state of Canada’s economy. But concerns about the condition of Canadian science

“The Harper government has had complete disdain for federal government science.”

have nevertheless influenced party platforms.

The Liberal Party has made scientific integrity part of its election campaign, proposing the creation of a central

public portal for disseminating government-funded research. The party is seeking to appoint a chief science officer to ensure the free flow of information.

By contrast, Harper’s government phased out the position of national science adviser in 2007–08, replacing it with the Science, Technology and Innovation Council (STIC), a body that has drawn criticism from scientists for operating behind closed doors. STIC reviews issues at the request of the federal government, and many of its reports are confidential. “It doesn’t even have many scientists on it,” says Graham Bell, a biologist at McGill University in Montreal and president of the Royal Society of Canada, who would like to see the science adviser’s post re-established.

Similarly, the NDP has called for a parliamentary science officer, a position that would be independent of the majority party or a coalition leading the government.

Katie Gibbs, executive director of Evidence for Democracy, says that Canada could benefit from either a science adviser or a parliamentary science officer. “They’re different visions,” she says. “You could easily have both.” ■