

Turning thoughts into actions, this computer is helping children with disabilities let their imaginations run wild

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Clifford Lester, 8, is non-verbal and requires assistance with most aspects of his life. Brain-computer interface technology can put a thought of his into action.

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Ahead of the recent Super Bowl weekend, eight-year-old Clifford Lester grew excited about making one of the game's most popular snacks: popcorn. Except in this case, Clifford made those kernels pop using only the power of his brain.

Clifford, who is better known as “Cliffy,” is non-verbal and requires assistance with most aspects of his life. Earlier this month, surrounded by his mom and staff at the John McGivney Children’s Centre School Authority in Windsor, Ont., Cliffy used a special technology that translates brain activity into commands. The software ties an action to an active thought, which means Cliffy could set the machine in motion by imagining a big smile.

As his imagination took shape, the headset attached to Cliffy sent information to the brain-computer interface (BCI) technology that then triggered the popcorn machine. And just like that, kernels turned into edible fluffy puffs – pop-pop-pop.

“Any time he gets to experience something that he generally doesn’t get to do, that’s filled with all kinds of joy and laughter,” said his mother, Rosemary Borland.

The Holland Bloorview Kids Rehabilitation Hospital in Toronto became the first pediatric hospital in the world six years ago to use BCI in a clinical setting. The technology and research evolved in its lab over 20 years to help children with disabilities play. A recent \$30-million donation from the Slaight Family Foundation to support people with disabilities – the largest investment in disability in Canadian history – means more supports for adults and children, including access to the cutting-edge BCI program.

The donation is being spread among 11 recipients, including Holland Bloorview and Empowered Kids Ontario, an organization that represents publicly funded rehabilitation centres, that are working to expand BCI to about 20 children’s treatment centres across Ontario.

Participants wear a lightweight sensor headset that feeds information into a computer system that measures brain activity. Susannah Van Damme, an occupational therapist who leads the BCI program at Holland Bloorview, explained that the software can tell the difference between the wearer’s neutral thoughts – or the “background noise of the mind” – and active thoughts such as envisioning clapping or jumping.

These active thoughts then set in motion preprogrammed games or activities, such as sending a remote control car down a racetrack, painting using a robotic ball,

turning on a bubble machine and watering plants using a BCI-enabled garden hose.

“We see a lot of teary-eyed parents, especially with our kids who have more severe disabilities who rely on an intermediary to interact with the environment,” Ms. Van Damme said.



Education co-ordinator Kelsey Smith says BCI technology is a life-changing tool.

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“It’s really powerful for kids to see that they can have that direct effect on the environment and for parents to see that, ‘You know what? My kid can do this. They can do this even though there are so many things that are not accessible to them.’”

The John McGivney Children’s Centre, where students from Cliffy’s school go for treatment and support services, is one of the sites getting access to BCI. The centre has been serving youth with physical, neurological and developmental needs in Windsor and the surrounding area for 45 years.

“We see play and recreation as a need to have versus a nice to have,” said Jennifer Jovanovski, the centre’s chief executive. “It’s incredibly powerful to know that our clinicians will have access to this technology that will open up a world of possibilities for our kids, so that they can be included and feel that they belong.”

In Cliffy’s school, six students between the ages of 7 and 16 have been able to access the BCI program since it was introduced two years ago. Education co-ordinator Kelsey Smith said it has been used in group and individual settings and has helped to strengthen children’s’ literacy, communication and numeracy skills. She described BCI as a life-changing tool.

During Cliffy’s BCI session earlier this month, Ms. Smith said they began with training exercises where he toggled between a neutral and active mind. He then listened to a video book that stopped every 20 seconds. When he thought about smiling, the video played again.

Cliffy has arthrogryposis multiplex congenita, which causes joint stiffness, and a rare neurological disorder called bilateral perisylvian polymicrogyria that has affected his ability to move on his own.

To make popcorn on that February morning, the popper was plugged into an accessibility device called a Powerlink that was then connected to the BCI. When Cliffy thought about his big smile, the machine started whirring. The Powerlink was also connected to another assistive device that was preprogrammed to sing *Popcorn* by the Barenaked Ladies while the kernels exploded.

But the fun didn’t end there. Cliffy used his active thought to bring a dinky car to the top of a switch-enabled Hot Wheels track where it whizzed down a ramp.

“Cliff being Cliffy, he was super, super curious by everyone around. He kept peeking back at me and grinning,” said his mother. “He is the happiest kid that you could ever imagine.”

Jennifer Churchill, president of Empowered Kids Ontario, said rolling out the BCI program to additional treatment centres will be a five-year project. The

implementation will be staggered so there is enough time for program development and training.

“Unless we put this training and education into the hands of our clinicians, we have no way of imagining how many kids across the province will be able to touch this technology,” she said. “That’s why we’re excited, so everyone has the chance to have a new clinical tool in their tool box.”

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