a three-day hackathon & public event in Amsterdam

hack the brain - education

2015

Contents

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Hack the brain in a nutshell

Workshop at Hyperion College in Amsterdam
Three-day hackathon and public event from 5-7 June 2015 at Waag Society, Amsterdam

high school students cooperated with brain experts

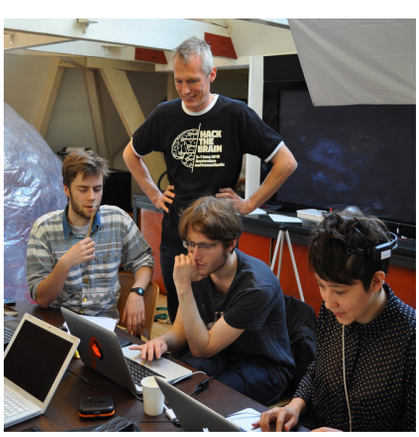
neuroscience in the classroom with actual brain tissues

public event

a brain-stimulating evening with brain food and thought

hackathon

experimental coding and open source tools



brain hacks

"children perform better when they know that their brain is flexible"

neuroscience and education

some hightlights from the three-day hackathon

Hack the Brain - education

An introduction by Karien Vermeulen (head of Creative Learning Lab) and Martijn Arts (founder of Total Active Media)

Solving math problems faster by stimulating your brain with electric shocks?
Measuring and visualising pupils' concentration using EEG headsets in the classroom?
Improving your brain while you sleep?
Could we outsource learning to computers or let them pre-process information for us?

In the second edition of Hack in the Brain, we focused on learning and education. Over the course of a weekend, along with over 40 participants and 100 visitors, we explored how currently available, neuroscientific knowledge and neurotechnologies can be applied to improve learning and the learning environment both now and in the foreseeable future.

WHY EDUCATION AND NEUROSCIENCE?

DIY brain hacking is no longer the stuff of science fiction—it's reality. After a successful first edition of Hack the Brain in 2014, we're digging deeper into the attics of our minds, and exploring new opportunities for learning with our brains.

"Teaching about neuroscience and the plasticity of the brain actually improves motivation and learning."

- Nienke van Atteveldt

This exploration is important because brain hacking could eventually cause a revolution in education. We are, however, not at all prepared for such an event. In this phase of exploration and innovation, we brought together a wild bunch of scientists, artists, educational professionals and hackers on this topic, which provided fertile ground for inspiration, new ideas, and critical reflection.

LESSONS LEARNED

One of the many lessons we learned was that teaching about neuroscience and the plasticity of the brain actually improves motivation and learning performance. We learned that exceptional memory skills could actually be trained in much the same way as we can train physical strength and endurance.

We learned that neurotechnology becomes cheaper and easier to use each year. We also learned that accepting any new technology leads neither to improvement nor impoverishment, but is more likely to lead to a re-evaluation of our standards and perspectives. Instead of asking what brain-related technologies will do for education, we should ask ourselves what they might do to our view and evaluation of education.

This year we expanded Hack the Brain internationally and entered into new relations with similar events in the UK and Canada. We are very proud that our team, lead by Pieter van Boheemen, established a live transatlantic human-to-human connection with Conor Russomanno (Open BCI) and Yannick Roy (BioWare) at the hackathon in Montreal.

We will continue our research and develop new projects on neuroscience and technology in education in the near future.

Next years' edition of Hack the Brain will, most likely, focus on the promise and application of DIY neurotechnologies in the domain of healthcare. One thing we know for sure? We're definitely not done with hacking the brain yet!

We would like to extend a big thanks to the Donders Institute and University Twente without whom this would not have been possible. And another big thank you to all our brain hacking participants, speakers, visitors, jury members, sponsors and partners!

We hope to see you next year!

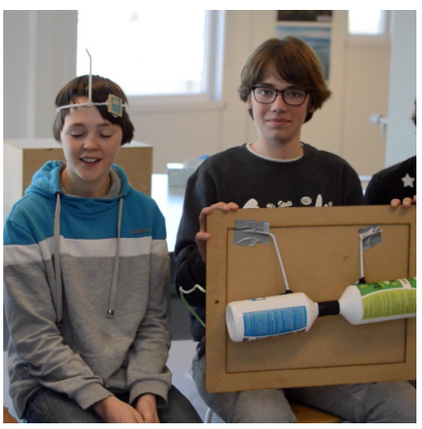
Martijn Arts and Karien Vermeulen

'In the days of Rembrandt, we explored the body. Now, we explore the mind'

In the future, will we be able to activate our creativity and concentration with the simple press of a button? Will we learn new languages in our sleep? Or map our strengths and weaknesses with the help of EEG equipment? Can learning processes be tracked in real-time and converted into usable data?

Students as inspiration

In search of the best ideas for the coolest brain hacks



ABOUT THE FOUNDING PARTNERS
Waag Society and Total Active Media are the founding partners of Hack the Brain.

Waag Society—institute for art, science and technology—is a pioneer in the field of digital media. Over the past 20 years, the foundation has developed into an institution of international stature, a platform for artistic research and experimentation, and has become both a catalyst for events and a breeding ground for cultural and social innovation.

Waag Society explores emerging technologies, and provides art and culture a central role in the designing of new applications for novel advances in science and technology.

Total Active Media are strategists, writers, designers, marketers, filmmakers, event-managers, information architects and programmers. Their work area runs from app development to boardroom consultancy and logo design to citizen participation. Their clients are among the top of the Dutch public sector and B2B companies. Total Active Media is part of the Total Identity group.

In Hack in the Brain – education, we explored how currently available, neuroscientific knowledge and neurotechnologies can be applied to improve learning and the learning environment both now and in the foreseeable future.

COLLEGE TOUR
With the help of students from the Hyperion Lyceum in Amsterdam North, a specialized Hack the Brain team, consisting of students from the Donders Institute and people from Waag Society, went in search of the best ideas for the coolest brain hacks for Hack the Brain 2015.

Everyone has preconceived notions about the grey matter inside their heads. Newspapers, commercials, and movies are all full of references to the brain. In science, neuroscience is an active field of research.

TEENS CONSIDER THE ULTIMATE BRAIN HACK
And, more and more, insights and techniques from neuroscience find their way into society not only through healthcare, but also through education.

To prepare for our brain hackathon in June, we wanted to know what the students from the Hyperion Lyceum thought of these developments and (in particular) the applications and hacks they want to see realized.

We were allotted 90 minutes per classroom to inspire students and challenge them to share their best ideas with us. Ambitious? Maybe. But, we were also visiting 15 year-old students whose brains are highly plastic—so they can still learn, connect, and invent many new things in a short space of time.

To prepare the students, we provided a number of informative and creative resources about the techniques of neuroscience and how the brain functions. For example, we screened episodes of the tv programmes ‘Klokhuis’ and ‘Tegenlicht’ about the brain and a film from the Cognitive Science Movie Index.

A WALK THROUGH THE BRAIN
The workshop started with a round of three inspirational learning stations. In small groups, the students rotated between:

- Calf Brains: Brain anatomy means more if you can slide your finger along the large bumps (gyri) and fissures (sulci) of the cerebrum, the ridges (small gyri and sulci) of the cerebellum, and the smooth white brain stem.

- A brain-computer interface (BCI) demo: Jan, a TOA (technical teaching assistant of the Hyperion Lyceum), demonstrated a brain-powered PacMan game and also showed students how to make a ball float through a track by tightening or relaxing their concentration. This was made possible by four BCI experts – students of the Donders Institute (Radboud University Nijmegen).

- Different tests from the lab to demonstrate the tricks and workings of your own brain. For example, using wooden skewers to measure the sensitivity of different body parts to draw a map of your sensory cortex. Or, place two different images in front of either eye to see what image your brain creates in your consciousness– two working eyes and a paper towel roll are enough to demonstrate this phenomenon.

GET BUSY!
After the stations, the students had to quickly connect all this new information to their own ideas about education. It was time for the students to build their own brain hacks! The students gathered in small groups to work with tubes, pipe cleaners, party hats, and the question "How do you want to use brain technologies to enrich your life as a high school student?" Sometimes, there were tough questions for us: "Why do we still not know how consciousness works in the brain? I want to make a wristband for measuring or artificial systems with a consciousness."

After flash presentations of the students' fantastic ideas about consciousness, we found that they also wanted to buy each other's products (at least if they get to choose the colour, that is). Five classes (with an average of 25 students each) delivered around 30 futuristic life-enhancing brain hacks. All these ideas were provided as inspiration to the hackers participating in the Hack the Brain hackathon.

A video can be found here: https://vimeo.com/128370295

To prepare the students, we provided a number of informative and creative resources about the techniques of neuroscience and how the brain functions.

Hack the Brain 2015 - the hackathon

Thanks to student's inspiration we were able to provide the participants of the actual brain hackathon with a great starting point. Before getting started, all the hackathon participants watched a five-minute video in which the students pitched their brain hack ideas. That was inspiration enough! But, how do you organize an actual hackathon—the moment wen all the magic theoretically happens? We use a work-format through which we stimulate creativity and encourage knowledge sharing.

Three days, two continents, 40 participants, six teams, more than ten nationalities, and seven working applications—let's look back at Hack the Brain 2015!

FRIDAY JUNE 5 | DAY 1

09.30
The first day of a hackathon is always exciting! We start early with an introduction by Waag Society's Creative Learning Lab. Why are we doing this again? What do we want to explore? And which technology are we going to use? Tip: provide good coffee. We need sharp minds.

10.30
It's time for the matchmaking session. All the participants are introducing themselves. It's nice to see that everyone has different backgrounds: from conceptual artists to dyed-in-the-wool software developers to interaction designers to neuro-PhD candidates. There's definitely enough expertise in house. But can they combine their skills and work on the ultimate brain hack together?

13.00
Everyone has shared their ideas and the first teams are made. From this point our hackers are focusing on concept development and get the hardware and software up and running.

17.00
The first hours of work are done. All the teams have to pitch their ideas in 1 minute to each other and give feedback. The brain hacks are surprisingly different from each other and ambitious. This does sound promising!

19.30
We are opening our doors to a bigger audience tonight! The programme? We will play with memory with the Donders Institute, watch a brain-performance by Arnon Grunberg, and challenge our thoughts about consuming brains with culinary columnist, Joel Broekaert.

A brain-stimulating evening

Element of the hackathon was a public event on Friday night on the promises and future of neurotechnology for learning and education. An evening full of interesting speakers, scientists, and artists to both inspire our hackers and bring neuroscience and neurotechnological knowledge to a diverse audience.

A report by our visiting-neuroscientist Wobbie van den Hurk.

In light of 'Hack the Brain 2015 – Education' the Waag opened its doors to the public on Friday evening, June 5th, for a brain-stimulating evening. The venue is the Waag, where in the days of Rembrandt we explored the human body, and where we now explore the human mind.

Many a curious soul withstood the hot weather (the first heatwave of the year) and the evening thunderstorms—we had a full house! And a full program with no less than eight speakers to share their ideas and expert knowledge on brains and education.

CAN WE EXPECT A REVOLUTION?

Our moderator of the evening was Waag Society's Frank Kresin, who took part in initiating the first occurrence of Hack the Brain in 2014 (developed from the notion that neuroscience and brain technologies are slowly creeping up on us).

This year's program leader and our first speaker, Karien Vermeulen, shared some of the neuroscience-inspired products and articles we find around us. She foresees that learning—which is, in essence, a matter for the brain—could soon be hijacked by neuroscience-inspired techniques. She hopes our speakers will teach us what is (or what can be) useful and what is pure nonsense. If we expect a revolution in our education system, we want to be at the frontier.

LEARNING IS ALL IN THE MIND

Our first speaker, Nienke van Atteveldt (VU), crammed the whole working mechanisms of the brain and the flexibility of its networks (known as 'neural plasticity') into a 20 minute talk. Interestingly, she ended her talk with a study demonstrating a profoundly positive effect on learning capacity simply by teaching students about neural plasticity—just like she did with us!

REVOLUTION OR EVOLUTION?

As an ethical reflection, Peter-Paul Verbeek (UT) reminded us that accepting any new technology doesn't lead to either pure improvement or pure impoverishment. It is more likely to lead to a re-evaluation of our standards. Instead of asking what brain-related technologies will do to education, he asked what they might do to our view and evaluation of education.

EXCEPTIONAL MEMORY SKILLS

Boris Konrad (of the Donders Institute) kicked off his talk by amazing us with his exceptional memory: he remembered all the names of the (60+) guests he'd welcomed into the Waag at the beginning of the evening. After this demonstration, he proceeded to give us our second brain-related skill of the evening: rapidly teaching us the names of all 14 Presidents of the European Commission by making us remember a funny story involving heavy rainfall, a marriage proposal by Santa, and a bar full of junk (can you recognize all five in this sentence?). He proved his point that names, facts, and orders are easy to remember when you employ a mnemonic strategy.

Boris was followed by his colleague Martin Dresler (also from the Donders Institute) who told us more about the memory tricks they call 'mnemonic strategies.' Dresler studies memory champions and, before Boris was his colleague, he acted as his research-subject. Martin's research shows the brain doesn't need anything special to behold exceptional memory skills. You only need the determination to practice. However, soon even that might not be necessary when Boris and Martin finish their Google-glass mnemonics application.

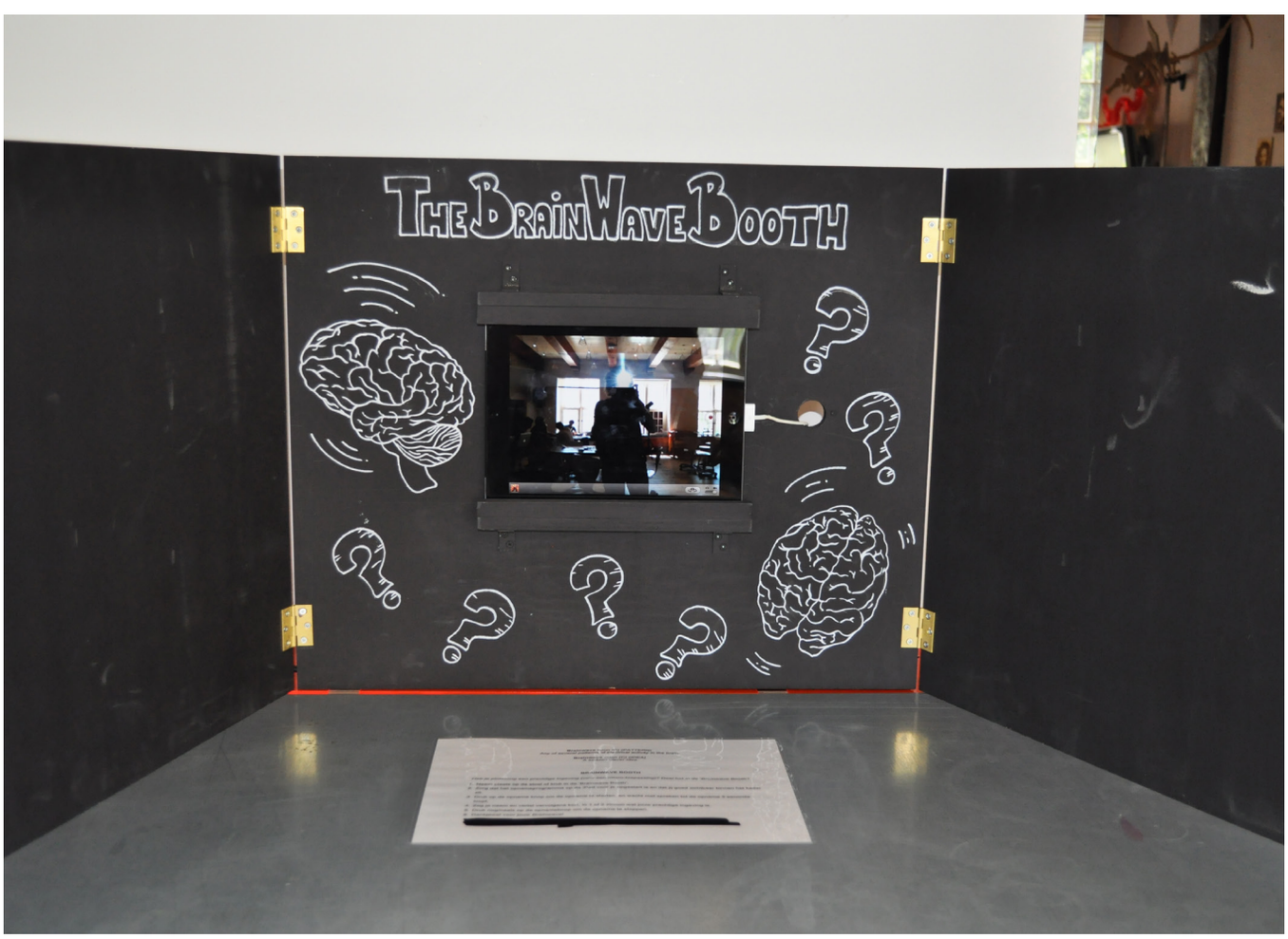
THE REAL DEAL

In the last performance of the evening, Ysbrand van der Werf (VUmc and NIN) and Arnon Grunberg (writer), discussed their experiments on creativity and a reader's perspective. Preliminary results are (1) measuring creativity in the brain will take some creative set-up (or at least more than a single-subject), and (2) Arnon's new book primarily induces disgust, fear, and empathy in the reader—which in turn does not induce any surprise in the writer himself.

After all these inspiring talks about the beauty and complexity of our brains, it was somewhat humbling to see Ysbrand picking up an actual brain and holding it in the palm of his hand. This bovine (cow's) brain is smaller, yet strikingly similar to the human brain. It is the structure in which it all takes place. Even so, it is difficult to describe it any differently than 'mushy,' 'wet,' and 'gooey.' We could, however, add 'nutritious' and 'tasty' since we all got to try deep fried brain-slices served by Joël Broekaert (a culinary columnist) with a delicious sauce of capers and lemon.

How's that for food for thought? I think our speakers might have brought more to the table than we could digest in one go. I heard lively discussions at the bar over a 'brain-wash' (alcoholic beverage) and a 'brain-freeze' (ice lolly). Hackers reminisced about the talks throughout the weekend, and I wouldn't be surprised if this evening formed a lasting memory in every brain present (excluding those from bovine origin).

All photos of the brain-stimulating evening can be found at this album online: bit.ly/htb-2015.



Participants share their thoughts

A high-schooler's perspective

By our Young Reporter Lola Spaan, 15 years
High school: the 4th Gymnasium.

I'm not bad in technical subjects, but for math help—don't look at me. In every math test, my brain lets me down. However hard I try to learn and however well I understand, my brains are just never able to see me through during a math test. I wonder sometimes if I could do something about this. Is this my fault? Or is it really in my brain? My conclusion time and time again is that I still had some more to learn. Your own fault, thick Lola. Yet, there seems to be another solution.

Last Friday night I was at Waag Society's Hack the Brain event. The theme of the three-day event was "the learning brain." During the event, software developers, artists, and neuroscientists devised new educational solutions. Friday night was a spectacle with many speakers who had the most interesting stories. They explained how brains work, what people do with this knowledge, and even how to hack your brain. There were several, already existing apparatuses shown, for example: headbands with mechanical earpieces that show the world how you feel and a device to help focus your brain. The latter, the brain stimulator, got me to thinking. If my endless failures really are to do with the focusing of my mind, a brain stimulator could be my hero. I think I'm definitely not the only one with the desire for a saviour like this. How glorious would it be to get passing grades in math?

Did you know that there are different kinds of types of mindsets in the field of learning? And that your mindset affects your performance and your ability to learn? There are fixed and growth mindsets. A fixed mindset is like a brain that is locked shut. Children with a closed mind have the idea that intelligence is fixed. If they excel in something, they just do what they do best are only too happy. But if something is difficult, they don't try because they're "not good at it." Challenges are too much for them.

Children who have a growth mindset, however, know that you can brush up your intelligence through learning. They are go-getters and they look for challenges. Personally, I find myself in the growth mindset. I am willing to take on challenges. Until just a short time ago, math was, for me, impossible. Now, I use the lessons more and my homework to keep track—that's a step in the right direction. So, I am, to my great joy, not hopeless without a brain stimulator. I can also learn on my own.

I am relieved. A device exists to help my unfocused brain, but—without it—I'm not a lost cause. Thanks to my very own mindset, it's possible to pull myself out of the fire by taking up my book once in a while and studying. Math test, here I come.

SATURDAY JUNE 6 | DAY 2

10.00
A collective start to the day. Most the participants didn't get much sleep after yesterday evening.

13.30
We're already at the halfway point in the hackathon. All our hackers have the entire Fablab at their disposal. Brain experts and technical guests are also available throughout the day to help everyone with creating the ultimate brain hack.

17.00
Most of the teams are eating their food behind their laptop. Without a prototype, they're not allowed to pitch at the end of the hackathon. So, the goal is really to develop ideas into useful applications.

21.00
It's time for some experiments: a brain-hacker from Canada managed to make a trans-Atlantic connection with another brain-hacker in the Waag.
The connection allowed the Canadian to move the hand of the hacker in Amsterdam using signals from his brain!

The hacker's perspective

As a participant of both Hack the Brain 2014 and this year's Education edition, Waag Society's developer Taco van Dijk shares his team's (technical) experiences with coding rapid prototypes using EEG data from the Muse headset.

MORE USER-FRIENDLY
Compared to Hack the Brain 2014, Muse has become a lot friendlier for developers. Last year, we spent almost a day just getting to the stage of being able to draw EEG signals onscreen. Part of the reason for this was unfamiliarity with the subject matter and the device. But this year, it was nearly a 'plug and play' experience. The Muse's battery also seemed to last longer. And pairing the headset with the Mac now works every time.

Furthermore, the muse.io software has been improved significantly. Last year we could only use the raw EEG signals, but muse.io now provides common calculations convenient for building brainwave applications.

EXPERIMENTAL CODING
Some of these elements are experimental, so the quality of these signals should be taken with a grain of salt. But, for quickly whipping up a proof of concept they are very helpful!

This year, we tried to use a setup that connected two Muses through OSC to Max/MSP, which in turn controlled to two iPhone apps. Within the span of a morning, we were up, running, and trying out different mechanics and experiences.

Max/MSP is designed for music programming. But, for a computer, there is no difference between an audio signal and an EEG signal—so it's a great fit. The defining feature of Max is that you can make changes to the program while it's running (no need for compiling, starting/stopping servers, etc.). Could this be the ideal setup for the kind of rapid prototyping needed during a hackathon?

OPEN SOURCE TOOLS

Also new during this edition was OpenBCI. It's great to see an open source alternative to the Muse and the Emotiv. There is a lot of potential in the platform, but the project is still young. Therefore, it's still missing the convenience of more mature, commercial brain-computer interfaces.

I think it's a nice challenge for the OpenBCI community to follow Interaxon's lead, and come up with an open source version of muse.io. That way, it will be possible to send OpenBCI EEG data and higher-level transformations through OSC. Maybe the OSC path scheme could be based on the one already defined by Muse, so that it becomes trivial to build applications that work with both interfaces.

And—to pressure Muse to keep up their innovative work—hopefully at next year's edition we can experiment with a full, open-stack of OpenBCI, OSC, and Pure Data (an open alternative to Max) that's as pleasant to use as the Muse & Max setup was this year!

The neuroscientist's perspective

What is it like for a scientist to join an experimental hackathon with artists and hackers? Merel Burgering, PhD student at department of Cognitive Neuropsychology at Tilburg University, reflects on her experience of Hack the Brain 2015.

"You should join Hack the Brain," said a college friend convincingly to me. The goal of this hackathon? Discover the possibilities of DIY brain hacks in collaboration with other scientists, artists, and developers. As a PhD student in neurobiology with a strong interest in neuro-imaging techniques, I already knew that brain devices 'escaped' the lab. Combined with my curiosity about science communication, I decided to join this event.

HAPPY HACKING

Friday morning at the Waag in Amsterdam. "Hack the Brain: education" has just started and it's as busy as an old stock market. Everyone has to pitch an idea for the three-day hackathon. It starts slowly and then, as if the currency is suddenly changing, a lot of competitors are standing up. A Russian girl jumps up immediately after a Brazilian guy shares his ideas. People seem to feel there's nothing too crazy to say.

Now, we have to link ideas. People try to recruit other group members by pitching their idea. Developers are the most wanted. Everyone realizes that a viable brain hack is impossible without technical skills.

Our group is soon christened with the name, "Seventh Sense." While refilling our coffees and pasting name tags on our chests, we're already starting to discuss ideas for the project. This attitude is characteristic for the kick-off day: we are here to build something in three days—there's no time to waste. We have a great brainstorm session and elevate each other to a level where certain ideas become impossible and everyone starts laughing.

Then, the real brainy business starts. Jason Farquhar, neuroscience and technology expert, tells us more about brainwaves and devices. Everyone tries out a Muse device. At first, a few people do not show activity in the alpha frequency band. Some people's alpha wave does what it is "supposed" to do, while others' alpha activity acts a bit like a rebellious teenager, doing exactly the opposite. We learn how to use the Muse properly and decide to stick with this fancy headband.

An inspiring evening program gives us more insights. Especially interesting for an educational aspect of the project is a study about increased performance of children who were taught that the brain is flexible. We finish a little past 11 in the evening, and it's time for bed and consolidation. But, some developers keep hacking until late that night.

On the second day, we're already walking around De Waag as if it's our daily work environment. The cornerstone of our concept is an interactive game that will teach schoolchildren how brain cells form networks. Kids will wear a Muse device. When everyone is concentrated, their alpha waves will be transformed into a visualization (namely a marble run) in which connections represent a synapse, the contact point of two brain cells.

Brainy developers optimize algorithms, neuroscientists examine brainwaves and read papers, and the creatives build the marble run and make a stop-motion movie. There is always someone walking around wearing a Muse headset. When I walk outside, I realize just in time that I am still wearing the headband.

Some disagreements come to light when we have to narrow down our ideas into brief pitches. Now, all the work from seven different people must form a single, coherent story and must also act as a business case. Inspired by the fact that humans have flexible brains, we work it out and our group gives two pitches.

The last day flies by. In between our work, we give interviews to the press. We are impressed by the creativeness and technical skill of the other groups. So, it's a big surprise to hear that we are, in fact, the winners. The hackathon proves you can make a lot happen—even in three days. We raise our champagne glasses and we cheer to happy hacking next year.

Looking back on this event, I was mostly surprised by the outcome of collaborations between scientists, artists, and developers. Starting from scratch and working with a lot of different people was definitely a challenge. The excitement when a brain-to-body hack worked out is something I will certainly not forget.

SUNDAY JUNE 7 | DAY 3

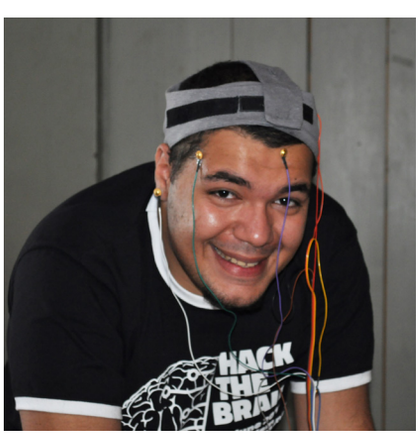
11.00
D-Day! Everyone is working really hard to finish the prototypes. Last tweaks are being made. Only a couple hours to go!

16.00
The first team is ready to give their pitch to the jury! They will be judged on validity (not just a crazy idea, but based on scientific evidence), level of maturity (more than a demo!), novelty, aesthetics, and marketability.

17.30
All teams managed to demonstrate a working prototype! It's now up to the judges to make the tough the decision.

18.30
Time for the award ceremony... Which brain hacks will win Hack the Brain 2015?

"There is always someone walking around wearing a Muse headset. When I walk outside, I realize just in time that I am still wearing the headband."
- Merel Burgering



The winning Brain Hacks

The winning team came up with "BrainED," a game in which children play with the elasticity of their own attention spans. It goes like this: as players concentrate, they work to "build" a visualization of a colourful skyline. If their attention (or one of the players' attention) starts to wander, the towers begin collapsing. Player concentration is measured with a "Muse," a headband that measures the brain activity by means of alpha waves.

Research has (repeatedly) demonstrated that children perform better when they know that their brain is flexible. In other words: if they understand that they can improve their brain through concentration and practice, this ultimately can affect their results. This is the difference between a "fixed" and "flexible" mindset (as the psychologists call it).

The jury had a tough job selecting the winner—and for more than one reason. First of all, for this year's competition, the teams all presented working prototypes. This in itself is quite an achievement since it's not unreasonable to think the hackers' ambitions could get in the way of building something that actually works. But, all the teams got their ideas working in time. Secondly, all the prototypes excelled on another point: they were all the result of bringing together an interesting mix of artist, hackers, and designers. Some were smart, others were bright, and others beautiful.

BrainED's runner-up was an artists' team that created a sort of inner experience. The team invited people to enter inside a huge inflatable floating sphere—one that resembled a head. Once inside and comfortably lying down, people were fitted with an Oculus Rift that brought them into certain emotional states. While participants' brainwaves were measured, the images projected by the Oculus Rift changed with their emotional conditions. The more relaxed a person was, the more relaxing the viewing experience. In this way, the team created a loop that strengthened the already existing mood. According to the jury, the team succeeded in creating a beautiful experience in an aesthetically interesting context.

Under a Brazilian flag (three hackers came all the way from Rio de Janeiro), a team built a prototype that made it possible to align your concentration with the colour of the surrounding light. Measuring concentration using a Muse, an apparatus that translates alpha waves in concentration states, people made the light softer when they were drifting off, and stronger when they sharpened their concentration. Thus, the light quality synchronizes with one's level of relaxation or (on the other end) arousal.

Two other prototypes were also built using the Muse hardware. There was a concentration app, for instance, that allowed your smartphone to buzz or ring only when the Muse registered that concentration levels were already low. But what if you're concentrating? The smartphone stays quite. In this way, the distracting effects of the ever-present social media are kept within limits and concentration spans are conditioned to become longer. Another hacker team used the Muse to provide teachers with direct feedback on his or her students' levels of concentration. That way, the teacher can intervene (e.g. take a break or change the subject) before attention disappears completely.

Led by the chief of the hosting Fablab, yet another hacking team dedicated its time to setting up a transatlantic brain-to-brain interface. Along with a Canadian team and the Open BCI founder, they built a prototype that enabled them to control each other bodies across the Internet (and a huge ocean). The teams wrote software that transcribed the output of an EEG headset (Open BCI) into electric signals at the other end of the connection. The electric signal contracted muscles, so on one end of the connection, when a team member triggered a signal by concentrating, the other team member's arm raised automatically on the other end.

The jury, consisting of Paulien Dresscher (Cinekid), Simon Haafs (i3b), Nick Jordan (young hacker) and Ester van der Geest (Waag Society), was especially excited about the possibility for actual application of BrainED. Jury chairman Jason Farquhar (from the Donders Institute for Brain, Cognition, and Behaviour): "This can really help kids," he said.

A video report of the Hack the Brain event can be found here: http://waag.org/htb-video

Observations by Radboud University Nijmegen

An innovative bottom-up process through creative mutual learning

Observations by Karlijn Ligtenberg and Winnie Toonders, Radboud University Nijmegen

In the room that was used as an anatomic theatre centuries ago, where surgeons explored the mysteries of the human body, a new generation of curious young people now dive into the human brain.

During recent years, a lot of relatively cheap neurotechnology has appeared on the market. The knowledge of how this stuff works stays mainly in hands of universities and industry—but that should be different, says the do-it-yourself community. And that is why, over the course of a weekend, they tried to hack the brain. We, the research team from the Radboud University Nijmegen, followed them throughout this journey to see how they think about "tinkering with the brain."

As part of a European Union-project called NERRI (neuro-enhancement, Responsible Research and Innovation) we want to explore peoples' perspectives on the use of neurotechnologies for non-medical purposes. Especially in this non-medical context, people are often reluctant and worried about the safety of this technology. This worry increases even more so when children are involved, as their brains are still developing and children often cannot decide themselves about applying a technology. The hackathon participants, however, were very open to this technology. At the hackathon, groups employed non-invasive EEG technology that records brain activity via electrodes on the skin. And they could work freely in an explorative way.

The first thing we found striking were the different interpretations of this year's theme: education. On the one hand there was education in the traditional sense, like in a school or other educational setting. Improving concentration played a big part in the concepts they developed. Others focused more on exploring possibilities using other non-traditional applications. Is there a way to visualize emotions or mental states? What would happen to your brain if you would find yourself in an isolated space surrounded by visualizations and sonifications of your own brain activity?

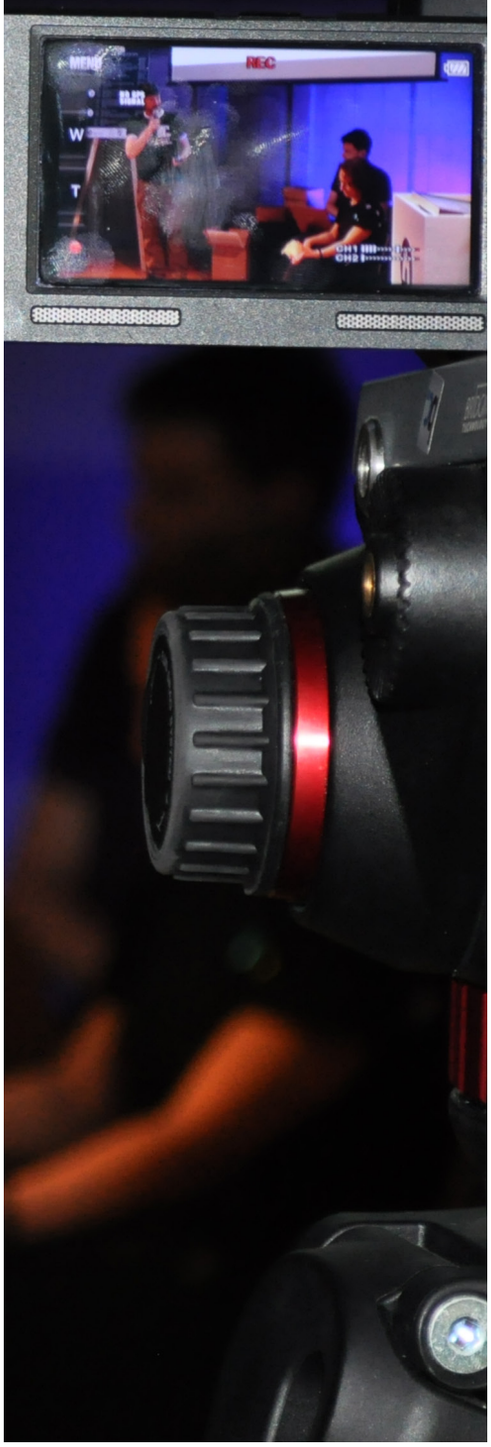
The groups with more applied ideas ran into various social controversies and dilemmas that might arise. They were challenged to think about how the design of the prototype could be adjusted to make it more acceptable for parents and teachers. How can such a device be safe and non-disturbing for the development of a young scholar? The winning team for example developed a visual game that showed the average brain waves of the entire group. This group application prevents one student becoming an outcast. Questions such as "Who will have access to the recorded brain data?" arose. Should it only be available, as a kind of feedback, to make you aware of your own focus? Or should it also be available for teachers and, via them, be entered into the school file? Or could this lead to misuse when they are linked to the students' level of performance?

The application of the winning team was especially innovative because it aimed to counteract individualizing tendencies in contemporary society. Most of the other prototypes did try to meet individual needs. The so called Focus Guard application, for example, was designed to postpone incoming messages on your phone during a very concentrated work period (measured with the help of EEG) or the tool to measure concentration of an individual student in order to adjust the lesson to the student's specific needs.

Another interesting aspect we observed was how these interdisciplinary groups worked together. In our NERRI project, mutual learning is a central theme. This event was exemplary for its mutual learning level. People with various backgrounds worked together and learned from each other. We also saw that the organizers and the researchers were not prescribing what to do (they did not limit participants to scientific rules for instance), but encouraged knowledge sharing across groups instead. Such sharing of knowledge is the basis of a hackathon and leads to a bottom-up approach for innovation.

Even after three days of exploration, we have to conclude that our brains are still one big mystery. What do these alpha, beta, and gamma waves mean? Participants have the same kind of questions as they search for the origin of emotions, feelings, and metal states in the brain. The real difference is the way in which these DIY-ers approach the issue: by developing applications and prototypes using combinations of art, science, and ICT. It is, therefore, very important to include these groups in endeavours to explore society of the future.

Hack the Brain in the media



Brain hacking is a hot topic! The first edition of Hack the Brain (in 2014) was reported on live by the Dutch science television programme, 'De Kennis van Nu' (NTR). They covered the entire weekend with a dedicated team, housed in the Waag.

Want to know more about the very first Hack the Brain? Here, you can re-watch the spectacle in its entirety:
[http://www.npo.nl/de-kennis-van-nu/25-05-2014/NPS_1241278]

At Hack the Brain 2015, several national and international media outlets were once again present for both the public event and the actual hackathon.

De Correspondent.nl
Online Dutch news platform, De Correspondent, wrote the article, "Met je brein een arm aan de andere kant van de wereld besturen, wat denken jullie daarvan?" (Control an arm at the other end of the world with your brain, how do you think about that?). An account is required to view this content.
[http://decorrespondent.nl/2940/Met-je-brein-een-arm-aan-de-andere-kant-van-de-wereld-besturen-wat-denken-jullie-daarvan-/]

Kennislink.nl
Science news website, Kennislink, wrote the article, "Hacken voor het onderwijs van morgen" (Hacking for tomorrow's education)
[http://www.kennislink.nl/publicaties/hacken-voor-het-onderwijs-van-morgen]

De Kennis van Nu
The Dutch television show, De Kennis van Nu, sent a reporter to cover the event, A Brain-stimulating evening, for radio broadcaster NPO Science.
[http://www.npowetenschap.nl/programmes/de-kennis-van-nu/Radio-5/2015/Juni/17-06-2015-Als-volwaardig-afscheid-nemen-niet-kan.html].

Euronews
Euronews, the most-watched news channel in Europe, travelled to Amsterdam to report on the hackathon for television. Their report is available in September 2015.

Colophon

hackthebrain.nl

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