**Contents**

**Focus**

3a Big Data is Everywhere  
3b WhatsApp, Doc?  
4 Your Virtual Shrink  
5 Digital Love - Can We Fall in Love with a Computer System?  
6 Your Lab Notebook Goes Digital  
7b Soapbox Science  
8 The Societal Impact of Digitalization of Healthcare Services  
9 Medical Robotics: Science Fiction Brought to Life.  
10 From Clay Tablets to eReaders: How Digitalization Changed Scientific Publishing  
11 Piracy Ahoy: Hackers Get (Neuro)scientific  
12 Will Transparency Make Us Healthier?  
13a Facebook and Mental Health  
13b Neuralink: Implantable intelligence?  
14 Machine Learning in Diagnostic Imaging: Needs, Opportunities and Promises  
15 Neurofeedback – The Underestimation of Our Brains  
16 Are We All Becoming “Digitally Demented”?  
17 How Wearing a Fitness Tracker Can Change You  
18 Can You Be an Internet Addict?  
19a Digital Healthcare in the Movies  
19b Book Review - Weapons of Math Destruction  
20 Documentary Review: Hopes and Hypes Around Digital Health  
21 Postcards from Alicante

**Career Development**

22 Interview: 2 MedNeuros in Digital Health  
24 Talk Datagy to Me: Coding for Careers in Neuroscience  
25 “Dr. Robot”? A lean Business Perspective on the Future of Digital Health

**Brain in Press**

26 Pressespiegel

**News in Brief**

27a News in Brief

**Whazz Up?**

27b Whazzup

**Imprint**

27b Imprint  
28 TK Advertisement

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**Editorial**

Big data (and big changes!) on the horizon! Welcome to our June edition of the newsletter, celebrating and critiquing the digitalization of (neuro)science. And it’s everywhere—both on (page 15 and 17), in (page 13), and around you (page 3). For some, digitalization may be a saving grace for medicine (pages 9 and 13), while to others, the physical and societal cons (pages 8 and 16, respectively) outweigh the pros. We also get to the burning questions on everyone’s mind: Can I fall in love with a robot (page 5)? Will machine learning steal my job (page 14)? And how much time is TOO much time online (page 18)?

One thing you have likely notice is our new look, made possible by the good people at Charité’s internal design service. We are excited to work with them, and help the newsletter reach a whole new audience.

Finally, the CNS newsletter is spreading outside of Berlin! This issue, please welcome new contributor Alena Deuerlein, an MSc student from Goethe University Frankfurt, as well as Apoorva Madipakkam, now based at the University of Lübeck. A big thanks as well to the newest member of our editorial team, Silvina Romero Suárez. All of this brought to you by the wonderful world of digital communication and networking.

Happy reading!

Helge Hasselmann & Constance Holman  
Co-editors-in-chief

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**Contest - Who won?**

Like what you see? Interested in contributing? We are always looking for new authors and submission on anything related to the topic of neuroscience. Send us an article, some beautiful shots from your microscope, poems, short stories, critiques, reviews – anything! The best contribution will be rewarded with the book Welcome to Your Brain by Sandra Aamot and and Sam Wang.

Come on and write like there’s no tomorrow! Send your contribution to cns-newsletter@charite.de to win. Deadline for submission for the next issue is July 20th, 2017.

This issue’s winner is Silvina Romero Suárez, who wrote a fascinating piece about digital technologies and mental health. Congratulations, and thank you very much for your article!
Opinion - Big Data is Everywhere

Does Size Matter?
Big data used to be a big issue a couple of years back. Nowadays, big data is everywhere around the globe and especially in medical fields and healthcare. Even seemingly “small” data applications rely on big data: take a look at healthcare applications (see pages 3 and 17 for examples). What about your credentials to have a loan? Have you even considered all the variables that come together to determine your credit worthiness? This all is a huge amount of data to process.

How Did Processing of Big Data Start
Processing huge (and steadily increasing) amounts of data is basically the main objective of big data. Applying statistical models [1], advanced statistical learning theory algorithms [2], such as support vector machines (SVMs) and others, projecting high-dimensional data to “processable units” (e.g. hyperplanes) has been one of the main goals [1-3]. The general idea is, put simply, to analyze a large amount of data most efficiently. This started with high-performance multi-processor units to process your data is quite an easy feat. So, what is the “big” deal about big data then?

Is Big Data Still That Big?
Big data is not a “buzz word” anymore, nor has it been for the last couple of years. It has simply become reality as literally everything is integrated in big data now [4]. A lot of these data are almost instantly processed: social media show it every second of your life with matching algorithms to find the best fits (e.g. Facebook, Twitter et al., online gaming to find appropriate opponents, etc.).. Behind the scenes, big data has been developed, explored and used for years to make this possible [1-3].

Big data is not that “big” anymore these days, neither in computing power nor in capacity. Moreover, it has become quite common. This also applies to science: how do you determine asap if a patient has a stroke and needs immediate care [5-7]? How do you process MRI data quickly in order to analyze it correctly and effectively? How much computing power and storage is actually necessary to get MRI images in almost “real-time”? Theoretically speaking, there are almost no limits in big data anymore.

Healthcare Apps

Effectiveness of Healthcare Apps
You wake up with a strange rash on your hand, and realize you need to see the dermatologist. When dealing with life and death, it is better to be safe than sorry! When dealing with life and death, it is better to be safe than sorry!

In a world that is being rapidly digitalized, it should come as no surprise that there is a staggering 165,000 healthcare apps available on the internet today for almost every possible ailment! [1] Why is this number so high? The problem is that the market of healthcare apps is largely unregulated. One does not need to be a medical professional to develop a health app. According to Dr. Franko from the University of California, San Diego, “The approval process generally requires that the app meets each company’s guidelines and pertains to content matter, but the process does not validate the data contained within the program for medical accuracy or functionality before making the app available for public use” [2].

Medical Misdiagnoses
If it were only a matter of discounting calories and steps, leading to ineffective weight loss apps, the situation might not be so bad. However, in the case of other apps for example, those that claim to monitor blood pressure, diabetes or even detect skin cancer, inaccuracy could mean the difference between life and death. A recent study that was published in JAMA Dermatology found that even the most accurate apps for diagnosing melanoma falsely classified 30% of melanomas as low-risk cancer! [3] Similar evaluations of other therapeutic apps like those for bulimia, posttraumatic stress disorder, suicide prevention and insulin dosing have led to disturbing conclusions of a blatant disregard for safety and poor scientific basis of these apps [4].

The take-home message? If you are using a healthcare app to challenge yourself to be more active in a healthy way, then go for it. But if you are using it for something more, especially for therapeutic reasons, then tread with caution. When dealing with life and death, it is better to be safe than sorry!

Apoorva Rajiv Madipakkam  
PhD Student, AG Sterzer

www.medical-neurosciences.de
Your Virtual Shrink

How Technology Contributes to the Treatment of Mood Disorders

ELIZA, a computer program that can hold a conversation with a human, was created in the 60s by Joseph Weizenbaum [1], one of the fathers of artificial intelligence (AI). In his famous script DOCTOR, ELIZA emulated a psychotherapy technique similar to the one developed by the psychologist Carl Rogers. Similar to Rogerian therapy, ELIZA used reflection (the therapist summarizes what the client told them to show understanding) and non-directed questions, which build a conversation exclusively based on what the client discloses. Although the intention of Weizenbaum was not to create a virtual therapist, the program was surprisingly successful in eliciting emotional responses from the users, who even attributed human-like feelings to ELIZA [2]. While this reaction motivated the creation of other computer programs for psychotherapy, it was never really put into practice due to the obvious limitations of a computer’s empathy.

More Trust in Machines?

But this is starting to change, as AI research now focuses on equipping computers with empathy. For example, at the Institute for Creative Technologies (ICT) in LA, researchers have created computer avatars with social intelligence, so-called virtual humans (VH). VH are able to speak, show emotion and react with appropriate gestures to verbal and non-verbal stimuli [3]. The VH therapist they developed is called Ellie. Ellie is able to ask tricky questions like “when was the last time you felt really happy?” and can recognize signals of depression and other mood disorders by measuring reactions to those questions as well as facial expression, posture and tone of voice [4]. Interestingly, it seems that people are less ashamed to show their feelings to a computer than to a human being. For example, one study found that participants were more willing to open up emotionally when they believed that Ellie was controlled by a computer rather than a human [5]. Children with autism spectrum disorders (ASD) also find the company of robots very pleasant. Many social robots have been developed to help children with ASD practice their social and emotional interactions. The results seem promising, the children usually engage happily with the robot and show enhanced attention, eye-contact, spontaneous language and imitation behaviors [6].

I’ll Consult my App

If you look for the term depression or anxiety in your app store, you will find many applications. Some of them claim to provide a test to know if you suffer from depression or other mood disorders. Some are tools to monitor your emotional states, while others show you skills to cope with panic attacks or suggest feel good activities as well as exercises in breathing, meditation or mindfulness. Some apps are evaluated in clinical studies like the Moodpath developed by the Free University [7] or Deprexis, which has already shown benefits for depressed patients with multiple sclerosis [8]. Most apps use techniques based on Cognitive Behavioral Therapy (CBT), which focuses on identifying and addressing negative thoughts, feelings and cognitive distortions. The effectiveness of internet-based CBT has been established for depression, panic disorders and social anxiety [9-11]. Therefore, these interventions seem like a promising alternative when taking into account that only half of the people suffering from a depressive disorder receive adequate treatment for their condition [9]. So go ahead and try one if you need one! For reference, the Anxiety and Depression Association of America published a list of the best apps reviewed by professionals in mental healthcare on their website [12].

Let’s Play with your Fears

Afraid of spiders, heights or talking in public? Just put on your virtual reality goggles. Exposure therapy (ET) is one most effective treatment for phobias and post-traumatic stress disorder (PTSD). In this therapy, the patient is confronted with their fears or trauma memories in a safe environment. After repeated systematic and controlled exposures to fear-evoking stimuli, the patients learn to overcome their fear and distress responses. Exposure can also take place virtually, and virtual reality (VR) has been shown to be a great tool for this. The advantage of VR is that realistic immersive environments can be tailored to patients’ needs. For example, the ICT has created a VR system called Bravemind that represent Iraqi and Afghan cities and combat scenarios, and has been successfully used to treat war veterans with PTSD [13]. In Germany, there is active research on the topic at the Max-Planck-Institut for Biological Cybernetics in Tübingen and by the Play2Change project from Regensburg University. Machines will probably never be able to substitute the warm sensation of a sympathetic human ear but these technological advances seem like a promising alternative that will hopefully make mental health treatment available for everyone who needs it.
Digital Love - Can We Fall In Love With A Computer System?

Our relationship to technology is becoming ever so intimate. Our smartphones and computers know when we usually go to bed, what we eat, where we went to school, our favorite movies and sexual orientation. The information software can gather about us far extends what our closest friends will ever know. Our relationship to technological devices may just be the closest relationship in modern society. Put all of that information and intimacy into a program, wrap it into a lovable object and you've got yourself the perfect companion.

Digital Love Equals ‘Real’ Love?
While some might frown at the idea of being able to love anything other than a human being, think about people who have very loving relationships with their pets. They’re not human and yet they are commonly seen as a member of the family. The National Institute of Advanced Industrial Science and Technology in Japan has developed a robotic baby seal named Paro that is already used in a therapeutic capacity in retirement homes and in hospitals across the United States [1].

In a different study, researchers examined the social behavior of adults and children toward the AIBO dog. They found that although the subjects of the study treated the dogs like a technological tool, they also attributed human characteristics such as mental states to it [3].

Overall, robotic pets appear to trigger similar responses as ‘real’ pets in humans [3]. Does this conclusion only hold for pet robots? After all, we wouldn’t be falling in love with pet-like but with human-like robots. A recent neurophysiological study was able to show similar findings with respect to humanoid robots. The participants observed photos of either a human or a robot hand in painful situations, such as a finger being cut by a knife [4]. The study showed that people did feel empathy toward humanoid robots, which means we really seem able to relate to robots.

How Realistic is it?
So it is possible to feel love for a robot, at least to some extent. But just because it's possible doesn't mean it will soon become a natural state. Is it really realistic that in the future people will fall in love with artificial intelligence? Another look at one of the world’s technologically leading countries, Japan [5], is instructive. In a survey, more than 70 percent of the nation’s 20-year-olds reported being single, compared with only 50 percent in 1996 [6]. Another survey stated that about 40 percent of singles in their 20s and 30s reported that they were not looking for a relationship [6]. In addition, a surprisingly big number of youths are not interested in intimate relationships at all: 22 percent of males in their late 20s reported having no interest or despising sex in a study conducted in 2014, compared to only 8 percent in 2008 [6].

Digital Love Equals ‘Real’ Love?
What's the Evidence?
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Curiously, experts say young Japanese adults often turn to digital relationship substitutes [6]. The reasons why they are becoming uninterested in relationships are diverse and complex, however a survey revealed that many of them think that being in a relationship is “bothersome” [7]. Therefore, artificial intelligence seems like a safe and less complicated alternative to find love.

So What’s the Conclusion?
Going back to our initial question of whether it is possible to love a computer system, the answer seems to be: yes, to a certain extent. However, answering this question leads to a multitude of new ones. How will artificial intelligence redefine love? Will digital love replace human love? What consequences for procreation will there be?

The fact of the matter is, from the beginnings of humankind to our modern world, love has never been a clearly defined concept. The rules of love within society have been under constant change. Owing to the open-minded people of the world, society has evolved to a point where love is accepted regardless of physical appearance, disability, race or gender. So who knows? Maybe in a few decades, people will fight for their right to love artificial intelligence.

Alena Deuerlein
Master Student in Psychology/Interdisciplinary Neurosciences
Goethe University Frankfurt

Your Lab Folder Goes Digital

Even though labs today have high-profile technical equipment and produce data mainly digitally, most of the documentation is still done on paper. Labfolder provides an electronic, web-based note book that allows you to store, organize, and analyze your scientific data in a digital format, accessible anytime and anywhere. We met with one of the founders, Florian Hauer.

What is the idea behind Labfolder?
Labfolder is a digital platform where scientists can capture, validate, collect, and also connect all the data and data sources in the laboratory. In most laboratories, scientists still use paper-based lab books. Labfolder transforms these labs into the laboratories of the future, where everything is digital and connected. The idea is that science will be better, more transparent, more reproducible, and more successful if the lab goes digital.

When did you start working on Labfolder?
I started working on Labfolder together with my co-founder Simon Bungers in 2011. It all started with writing a grant for the EXIST fellowship from the German government which awarded us 100,000 EUR to start. We started building the first prototype in 2012 and founded the company in autumn 2013.

You came directly from working in a lab and created Labfolder. What is your background?
My background is molecular biology and biosciences. I had done electron microscopy before I started with Labfolder; it is a discipline which is very data-heavy.

How did you get into this field? Why did you decide not to follow research?
It was curiosity. And then followed by possibility. My co-founder and I were curious to see what it would look like to have our own company. When we got the possibility to do it, we grabbed it immediately. We were often asked if this was not very risky, but our statement is that staying in academic research is equally risky. There is actually no difference whether you want to pursue the academic path, go to the industry or build a startup.

Did you have any training which prepared you for your adventure?
We had to learn everything right in the moment: how to do tax declarations, set up contracts, register a company, and so forth. Luckily, we were embedded in a network from the FU Berlin, which came with our funding. They gave us support in many ways. But I can tell you this: If you have done scientific lab work, then doing the bureaucratic efforts of founding a company is really not rocket science. For a scientist, I would say, it is not a big problem to figure out how to do all these things that are necessary to start and run a company.

What were the milestones in the development and growth of Labfolder?
Our first important milestone was the release of the alpha version in 2012. After only 3 months of development, we released the first very basic prototype of Labfolder, which was already good enough to ignite the interest of some users here at the Charité. More milestones were the steps of publishing new features and available languages. Among the milestones are also the partnerships that we made both with other startups like Mendeley and investors, but also our agreement with the Max Planck society, and very recently with the BHH to roll out Labfolder here at the Charité and the MDC.

Who is using Labfolder already and how many customers do you have?
Around 14,000 scientists are using Labfolder. Most are from Germany, but also from the rest of Europe, the US, and Asia. Our customers are 60% academic research laboratories, the others are companies. However, the number of customers does not necessarily reflect the number of users, as for example the Max Planck society is one customer with many users. We also have customers that are using Labfolder in analysis labs with routine testing.

How is Labfolder going to evolve in the coming years?
Very soon we will release a few features that will allow scientists to manage their data even better. One feature will allow you to control the experimental parameters in a more structured way, and run queries on your experimental data. Another feature will allow you to link all the material you are using by introducing a material database.

In the long run, we are interested in implementing all the features that allow scientists to get a better grip on their data and make more out of it. The promise of digitalization is not only to have everything digital, but to also do something with the data: To make connections that were there but were not visible before. In the age of big data, it is important to make it possible for scientists to easily store and access it.

What do you like the most about your job?
I like that I have to do something new every day. It never gets boring. There are no normal work days!

What are some of the challenges of your job?
Well, the challenges are also that there is something new every day. But I think it is the challenges that make us grow stronger. I would say that it is probably not the easiest of all jobs, but in our team we are all equally hungry for challenges and for the success that comes with mastering them.

Do you sometimes wish you would be doing experiments in a lab?
I actually still do lab work as a guest scientist! It is very important to me to stay connected to the laboratory and science. Of course, I do much less. I usually take 2 weeks holiday per year.
Soapbox Science

Are you excited about the science you’re doing? Well, why not tell the world about it? This June 4th marks the first ever German edition of Soapbox Science [1], an event aiming to promote women in science and the work that they’re doing. Twelve talented scientists, ranging in discipline from hydrology to neuroscience will gather on Tempelhofer Feld, standing up on a box and telling the world about their work.

Soapbox Science was founded in the UK by research biologists Seirian Summer and Nathalie Pettorelli, and has roots in a long tradition of public discourse [1]. The name comes from Hyde Park’s Speakers’ Corner in London, a traditional site where members of the public are allowed to speak their mind about any topic. The founders thought it would be the perfect format to get the public interested in science, and challenge their perceptions about what a scientist "should" look like (in short, old, white, and male). What’s more, they thought it would be a great way to present young girls interested in STEM professions (see our last issue for thorough coverage of the “leaky pipeline”, and women’s traditional underrepresentation in these careers [2]).

So come check out this great event, and cheer on the MedNeuros taking part! We will give you an update in an upcoming issue to celebrate the inaugural event.

Quick facts:
When: June 4th, 2017, 14:00-17:00
Where: Tempelhofer Feld, near the Columbiadamm entrance
Who: Organizational committee, volunteers, and 12 talented scientists from the Berlin research community
Why: Indulge your curiosity, and learn about exciting work being done by female scientists
How: Generous support from the Leibniz Institute of Freshwater Ecology and Inland Fisheries

Want to find out more? http://bit.ly/2q6c1bw

Constance Holman
PhD Student, AG Schmitz

Ah! big data. You must have come across the catchy term and the accompanying mixed sentiments of awe, excitement, confusion and begrudging admiration it usually evokes in the reader. If you are the skeptical type, then you probably must be sighing internally with exasperation and thinking, “Not again”. However, for the ones unaware of this buzzword and the claims of big data taking over our lives; the term itself refers to the gigantic amounts of data available today for analysis. This data can come from people and organizations due to increased reliance on uploading, storing and sharing information digitally [1]. The digitalization of healthcare data may take place through mobile health technologies which includes mobile operators, device vendors, content developers and healthcare providers. The size and scale of the global mobile health market is expected to increase by 2018 (from $2.4 billion in 2013 to $21.5 billion by 2018) with Europe leaving the US behind in this regard [2,3].

Big data— even bigger baggage

Remember Uncle Ben from Spider Man and his wisdom, “With great power comes great responsibility”? Such is the case with big data. The huge trove of data available under the umbrella term of big data comes with its own set of legal, social, ethical and political baggage. Realizing this, the European Commission initiated a project called BYTE (Big data roadmap for cross-disciplinary community for addressing societal externalities) to address the impact of big data in Europe [1].

Six case studies were conducted in areas involving crisis informatics (using social media to help in humanitarian relief during crisis situation), culture, energy, environment, healthcare and smart cities in 2016. The approach employed during case studies was semi-structured interviews and focus groups [1]. In health sector, the important economic impact of big data is cost saving via timely and accurate diagnoses of rare genetic (such as ALS) and more widespread disorders (such as cancers).

From a societal and ethical standpoint, identifying rare genetic disorders through utilizing big data provides better understanding of these disorders as well as offering new services like genetic counseling for family members. Development of personalized medicine may also boost research involving genetic disorders. However, not everything is sunshine and unicorns. Use of big data in healthcare may cause over-medicalization of a population otherwise deemed healthy. In other words, making the general public conscious about their health to the point of paranoia. Other negative impacts may include individual discrimination based on genotype stratification and denying healthcare policies to individuals at a genetically predisposed risk.

The Societal Impact of Digitalization of Healthcare Services

The battle for anonymity and data protection

Legal risks arise due to regulating frameworks and newer big data practices not being on the same page with newer advances rendering existing frameworks obsolete. Large data from the public does provide more information but also poses privacy issues. Data security preservation measures also hamper further research on the same data and gene patenting and licensing of new drug therapies may threaten the intellectual property rights. The BYTE project suggested making updates in four legal frameworks that included copyright and database protection (limiting copyright extent, collective licensing and adding exceptions to data mining in copyright), protection of trade secrets (by developing standardized solutions and adopting legal protection of them), privacy and data protection (by broadening privacy-by-design approach for legal and organizational protection) and anti-discrimination (by popularizing anti-discrimination-by-design methods and developing transparent and accountable frameworks) [1].

Unexpected benefits

Bigger data sets emerging from increased digitalization of healthcare also offer opportunities which could be exploited for the greater good (if used correctly). Aside from early diagnoses and better treatment outcome, the hype around big data analytics also helps propel new innovations and updating outdated business models in healthcare. Not to mention greater public involvement by participating in data collection and the subsequent improvement of the standards of data analytics because of an informed public demanding transparency and accountability. Privacy may not always be an impediment to innovation, as there would not be such a fuss about privacy and data protection, had the public not been educated and interested in it [1].

In the end, we must realize that any societal impact of big data, be it positive or negative, is not an inherent property of the data; but, rather, is a manifestation of the resulting decisions and activities carried out by industry, researchers and policy makers who use it [1]. Keeping in mind the risks and opportunities, existing business and legal frameworks in healthcare sector need to be smartly adapted for digital healthcare.

Zara Khan
MSc Med Neuro

Image source: https://www.flickr.com/photos/116926349@N04/140696456
When there is talk of robots, science fiction might be one of the very first things that come to your mind – a world of machines that are controlled by a computer to fulfill tasks of a human, sometimes also made to look like one of us. While most science fiction scenarios represent a distant futuristic world, the implementation of robots is already present, including in healthcare and medicine.

Robots in Surgery is Modern Reality
Modern surgery is characterized by minimally invasive procedures wherever possible. To make the surgeon’s movements more precise or to operate tiny instruments within a human body, a technology called da Vinci has been developed [1]. The da Vinci system translates the surgeon’s actions into more precise movements using a camera with a high definition 3D view, and wristed instruments that are more mobile than the surgeon’s hand. The development of the first prototype was funded in the late 1980s to be used in battlefield surgery but soon Intuitive Surgical Inc. realized the commercial potential and entered the healthcare market with FDA approval in 2000. Today, Intuitive Surgical is the global technology leader in minimally invasive robotic-assisted surgery with da Vinci used in cardiac, gynecologic and head surgery.

Another technology already implemented in clinical routine is the disinfectant robot Xenex [2]. Using ultraviolet light, Xenex is able to disinfect any area in hospitals, and therefore helps to reduce the ubiquitous burden on patients and healthcare systems caused by, e.g., multi-drug resistant Staphylococcus aureus infections.

Humanoid robots interacting with patients
Besides these more practical examples, there are already social robots developed to serve as companions for lonely patients, or those with mental health issues. Pepper, a humanoid robot, is advertised as being “kind, endearing and surprising” [3]. The idea is that Pepper can recognize your emotional status and react in an appropriate way. Through constant interactions, this humanoid slightly evolves with you, learning and memorizing all of your preferences, tastes, and habits. Two Belgian hospitals hired Pepper to take over the role of a receptionist, greeting visitors and patients and helping them to find their destinations within the hospital.

If all this already sounds exciting to you, then recent and ongoing projects in medical robotics will amaze you! The company Virtual Incision developed the first miniaturized robotically assisted surgical device (RASD) that is able to do colon resection inside the human body without the need to open the patient’s abdomen [4]. Just last year Virtual incision completed its first in-human trial successfully. So far, this mini surgical robot is not commercially available, but as soon as the technology enters hospitals it might enable surgeons to operate in completely new dimensions – making the impossible possible.

Transforming medicine
Mini robots assisting surgeons are astonishing enough, but imagine if we could shrink even further, to the micro or nano scale! These tiny devices could deliver drugs to specific sites in our bodies or to specific cells like tumor cells, revolutionizing therapeutic interventions. Although micro-or nanorobot technology is still in its infancy, there are numerous fascinating ideas being pursued by researchers.

One of these is to use the principle of origami to fold structures into tiny packages that unfold themselves and release their content once they reach their site of action. The group of Ido Bachelet successfully used DNA structured in a way that forms a computer circuit that can be programmed for very specific tasks [5]. Using this DNA, origami robots in the future would enable us to specifically release drugs, move cells or reprogram cells. The range of possible applications seems unlimited!

The advances in medical robotics described above are only very few examples of all the ongoing astonishing developments out there. As long as people’s curiosity and fascination for robots and artificial intelligence are not overshadowed by anxiety, we will soon be facing great developments in medicine and healthcare.

Eileen Schormann
PhD Student, AG Krüger

From Clay Tablets to eReaders: How Digitalization Changed Scientific Publishing

Creating knowledge is a researcher’s primary goal, with publications being the vehicle for dissemination. However, manuscripts are no invention of modern times. The earliest evidence of written records comes from clay tablets in Mesopotamia, and didn’t change much until Johannes Gutenberg’s revolutionary printing press in 1450. This new technique brought us a huge step closer to mass-produced scientific publishing as we know it today. In 1665, the first scientific journal was founded: Philosophical Transactions of the Royal Society. Big titles of today, i.e. Nature and Science, only started in the 19th century [1].

In the very beginning, scholarly publishing was rather an expensive investment than a source of money, however, more recently publishers’ business models were based on subscriptions and fees to finance processing, printing and shipping of their paper-based products [2,3].

The current process of scientific publishing works by selling access to journals that feature articles that have been submitted by authors for free and have been reviewed by peers for free as well. In contrast, open access journals and platforms, such as PLoS (Public Library of Science), levy a publication fee from authors, but make their articles available to everyone.

The Rise of Open Access
Despite an increasing variety of open access online journals classical publisher-controlled academic journals are not in decline. The (hotly debated) impact factor of a published paper still determines a good part of the reputation of scientists, tempting many to still prefer established classical journals over new open-access channels argues Michael Eisen, geneticist at Berkeley and one of the PLoS’ founders [3]. However, nowadays several open-access titles are already high ranked, like Translational Psychiatry or PLoS One Medicine, rendering these concerns increasingly obsolete.

Only since 2008, when the NIH implemented open access rules in its funding policy [4], has the general attitude of the scientific community towards alternative journals changed. Consequently, the online journal PLoS One avoided producing classical print publications altogether and therefore rejection or delay in publication of articles due to space limitation of their (print) issue. The online only open access journal selects manuscripts only for their scientific quality, possibly ending the cherry-picking by the journal and subsequent delay of otherwise accepted work. Such a simple, but fundamental change in publishing policy has dramatically shortened the time until novel research enters public knowledge [3,5].

This is very important as only free access to research conclusions allows objectively informed and thus truly democratic processes. The control of knowledge via pay walls by very few publishing companies has inevitably led to formation of resistance: see an article on page 11 detailing the rise of data piracy in academic publishing.

Digitalization permits free access to knowledge
Digitalization also changed the medium of publication from printed journal “papers”, over to PDF files to alternative formats like ReadCube. Also, not only do publication databases enable fast searches for relevant literature, but newly established scientific social networks (like ResearchGate, Academia.edu or Mendeley by Elsevier) allow easy access to individual researchers and their work. Nowadays, this often includes “non-traditional” formats such as blogs or podcasts [7,3].

New technologies and digital tools have also influenced the kind of published data itself: Original studies can now easily include raw experimental data as supplemental files or freely available databases for other researchers to inspect. Web-based journals also allow easy embedding of various multimedia files as realized in the Journal of Visualized Experiments, a methodology-oriented online journal which publishes video files with accompanying manuscripts. Digital tools have generally sped up the generation of data and graphics, but made the publishing process prone to manipulation of images and data, thus contributing to the “irreproducibility crisis” [8].

In summary, digitalization made our primary goal of creation and distribution of knowledge faster, more flexible and versatile.

Bettina Schmerl
PhD Student, AG Shoichet

Even Hotter Than Off The Presses
Another new approach to disseminate research independently from the publisher companies is provided by platforms like arXiv.org. They allow researchers to publish their work as preprints and have it critically reviewed by colleagues long before being submitted to classical scientific journals, a route of publishing common for mathematicians and physicists [6]. A similar approach was taken by the Registered Reports of the Journal of European Psychology Students, which allows publishing the work before any data was collected. Based on the scientific quality of the proposal, but independently of the results to be achieved, the submissions might be accepted to peer-review and publication afterwards [1].

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Piracy Ahoy: Hackers Get (Neuro)scientific

Working at a large, wealthy institution like the Charité, we are mostly insulated from the frustrations of academic paywalls. Multi-million euro academic subscription fees assure that works published in most large biomedical databases are easily within reach, and not being able to access a publication is the exception. However, in other places, a publisher paywall can literally make or break an academic career. A single paper typically costs around 20-30 euros to purchase, while some websites cheekily offer “rentals”. Imagine yourself considering what you can afford to read. In science, information is power, and corralling this information behind paywalls means a steep imbalance in who gets to set the tone of the cutting-edge research.

Introducing Sci-Hub

If the digitization of scientific knowledge is feeding an ever-growing problem, could it also provide some solutions? Some self-proclaimed scientific data pirates are using big data to beat online scientific publishing at its own game. Enter Sci-Hub [1], the “Pirate Bay of Scientific Publishing”. On this site, not unlike PubMed, anyone can search and download texts pertaining to their scientific field. It’s free, simple, and incomparably popular worldwide. Understandably, the publishers hate it.

A few quick facts and figures [2]: Sci-Hub handles about 200,000 paper requests per day, coming from all over the world and most academic disciplines. The heaviest use of the site is in Iran, but other nations aren’t far behind. The publisher arguably being hit hardest by these illegal downloads is Elsevier, though analysis found that Sci-Hub was only diverting about 5% of its legal traffic. Thus far, more than 6 million papers have been accessed through the site, and these numbers continue to grow. The number one downloaded paper so far was a piece on wind turbine testing [3], followed by a paper on glioma [4].

Sci-Hub was the brainchild of 22-year old Kazakh computer science and neuroscience student Alexandra Elbakyan. Frustrated by the lack of availability of scientific resources in her home country and with a knack for hacking, she created the site in the hopes of leveling the playing field for academics worldwide [5]. She’s widely been celebrated as a game-changer in the field of digital media, but her whereabouts are currently unknown... Due to ongoing legal proceedings, being found could mean imprisonment.

The Publishers Strike Back

In 2015, the publication group Elsevier sued the website for unlawful use of copyrighted material [1]. Despite Elbakyan invoking the Universal Declaration of Human Rights, which calls on signatory parties to “to share in scientific advancement and its benefits”, Sci-Hub lost, and the website was promptly taken down. However, thanks to a sophisticated team of hackers and administrators involved in the project, it was up again in no time, and has since appeared under several different domain names. In the age of Big Data, Sci-Hub is not disappearing anytime soon.

Recently, Science magazine undertook an official study on the use of Sci-Hub, and the results were surprising. Whereas the study authors expected that use of the site would be most popular in less developed countries, it seems that the site was also being heavily used in Europe and North America [2]. Site critics seized on this point, claiming that for most, data piracy was an issue of convenience, rather than necessity. In some sense, they’re right: Science’s analysis of the site found that a large number of open-access articles (which theoretically anyone, anywhere can access) were being pulled from the site.

Leverage and Loopholes

There are other reasons why some are skeptical of Sci-Hub. One argument is that official publishers often keep track of downloads and usage statistics for individual works — something that Sci-Hub doesn’t do. These statistics are increasingly being used as career metrics for researchers. Without facts and figures about journal readership/downloads, institutions or smaller publishers may cut ties with periodicals that are not generous with their materials, and the loopholes researchers have to jump through may tempt them to sue instead. [2].

Piracy or Cooperative Change?

However, one point remains a fact: publishing companies are not immune to change. Ten years ago, open access publishing for scientific articles was still in its infancy, and today represents a major step forward in the democratization of scientific knowledge. This happened through public pressure together with cooperation of the companies. But will publishing companies ever be able to deal with scientific data piracy in a productive manner? Peter Suber from the Office of Scholarly Communications at Harvard put it succinctly when interviewed in Science: “Lawful open access forces publishers to adapt [...] unlawful open access invites them to sue instead.” [2].

A final argument from the publishing industry is that many large companies already have lots of ways to get free access to articles in their collections. For example, after users register with the journal Science, they can access all articles that were published more than a year ago for free [6]. However, not all journals are as generous with their materials, and the loopholes researchers have to jump through make the process cumbersome, and still occasionally expensive. The heavy use of Sci-Hub in less wealthy countries suggests that (a) most researchers don’t know about these special channels to access manuscripts behind paywalls, or (b) they don’t work as advertised [2,6]. Whether a matter of education or logistics, it’s clear that there is still significant work to be done on the part of the journals.

DeepMind – Will Transparency Make us Healthier

You might have heard of DeepMind last year, when they invented a program that could beat human players in the game Go. The British artificial intelligence company, now owned by Google, has been pushing the boundaries of algorithmic learning research for some time now. I was interested to learn that currently their main field of application is healthcare. An entire division of the company is working on a range of challenges with medical data, from interpreting medical images to integrating patient data, all under the banner of DeepMind Health [1].

This work has been taking place in collaboration with a number of UK NHS foundation trusts. For example, a project aimed at detecting and predicting ocular degeneration from digital eye scans is the outcome of a collaboration with Moorfields Eye Hospital London, who have granted access to their database of anonymized digital images of the eye. Similarly, patient CT and MRI scans from University College London Hospital are being used in a machine learning approach to improve treatment planning for head and neck cancers.

How Big Data Helps Medical Professionals

Their largest project has been a collaboration with the Royal Free London NHS foundation trust and Imperial College Healthcare NHS trust in developing a mobile app to provide real-time patient information to nurses and clinicians. Called Streams, this app intends to speed up communication and decision making in hospital environments by replacing a number of older solutions relying on papers, fax, or pagers. The intention is to consolidate a patient’s medical results within a single interface where data-driven alerts can be sent out as soon as there is any indication of a problem, and actions can be decided upon by relevant health workers. The current focus is on a specific disorder, acute kidney injury, where such an approach is presumed to be particularly promising, but obviously the vision extends far more broadly.

From this technology, it is not difficult to imagine a future where data from multiple continuous bio-monitoring sources could be integrated so that patients, or any individuals, could be diagnosed and monitored in real-time. Glimpses of this path can already be seen with existing technology like continuous glucose monitoring devices, which provide continuous real-time blood-glucose measurements to diabetics, the data from which can then be accessed (and sometimes shared) via mobile apps [2]. Perhaps even more seemingly mundane biological data could be insightful from a medical perspective — think what information a Fitbit might reveal if state-of-the-art machine learning were applied to its data. Integrating all of these varied sources of information together to generate a comprehensive and detailed medical picture of an individual is surely something DeepMind Health have thought about as well.

This whole idea rests upon the ability for a private company to access potentially sensitive patient medical data, and DeepMind were doing just this, often without patient consent. Predictably, this drew some criticism. DeepMind responded earlier this year in an interesting way. Rather than attempting to seek patient consent, they instead took an approach of transparency by announcing their development of a data-logging process - the verifiable data audit.

Transparency vs. Data Privacy

The idea is that a record of all interactions with patient data will be generated and saved, with a log of who was accessing an element of data, when, and for what reason. This record will be automatically updated and stored in a semi-decentralized manner that has been likened to blockchain, with records in a distributed network of healthcare institutions such as hospitals. The data is structured so that any time it is accessed or changed this will be immediately recorded. As such, guidelines can be put in place to ensure that the data isn’t used in unauthorized ways. It also means that all access of data will be traceable forever in a way that should be tamper-proof.

At the epicenter of all this technological innovation is data - as the 21st century is starting to teach us, data is powerful and data is valuable. So where there is a question of data, there is always a question of privacy trailing close behind. If we can imagine these technologies, we must also be able to imagine a future where our most intimate biological details are shared widely and accessible to many. The price of a detailed understanding of our own body is perhaps our privacy in that matter.

In this discussion, DeepMind are not strictly advocating privacy - rather, they are advocating transparency. Yes, your data will be accessed by many people, but with a strict record of who and for what purpose, which will ideally necessitate adherence to data sharing guidelines. Before patients themselves have access to their own records, this will likely still sit uncomfortably for many people. Until then, the success or failure of initiatives like DeepMind Health will determine how willing we are as a society to invest our data in our health, and to whom.

James Kerr
PhD Student, AG Sterzer

Can Facebook’s Appetite for Data help prevent Suicide?

Facebook is not known to be squeamish when it comes to user data privacy. However, as the social network increasingly becomes a digital reflection of our mental states, could its data mining be put to good use?

Even if this might be news to you, posts involving self-harm or suicidal ideation are alarmingly common on Facebook. More often than not, they are fortunately not a sign of imminent danger - in some cases, however, they are. Worryingly, scientists say there could be a link between suicide risk and related posts on social media [1]. Since the vast majority of teenagers uses social media (and suicide is the third most common cause of death in this age group, [2]), why not put this information to good use?

Following competitors like Twitter, Facebook has recently revealed its own plans to use data mining to help prevent suicides. In case its algorithms spot signs of someone at risk, they alert its community officers. If deemed necessary, these post additional resources on the user’s feed and establish links with crisis intervention services. In addition, Facebook is rolling out a function that allows concerned friends to flag posts and get staff involved.

Interestingly, Facebook says its algorithms won’t be merely looking at content, but will also consider changes in language, time of log-in and other non-verbal signs. Ultimately, Facebook’s algorithms may be able to pick up much more subtle clues - like nuanced visual and verbal expression of emotions in pictures and videos. By having access to information from a vast number of users, Facebook’s machine learning algorithms might, in fact, advance knowledge in a notoriously difficult field. Indeed, even experts with decades of clinical experience struggle to identify patients at imminent risk of harmful behavior.

A life without social media is unimaginable for many of us and we seem more than happy to share intimate information about our innermost lives online. This means that there is no real reason to get upset about Facebook’s latest bid to monitor its users. Ultimately, however, the company needs to show that its algorithms do what they are supposed to do - help people in distress.

Helge Hasselmann
PhD Student, AG Otte/Paul

Neuralink: Implantable intelligence?

The fact that globalization has led society to become more technology-driven will probably not come as a surprise - machines facilitate production in manufacturing companies, self-driving cars will soon make human drivers obsolete, and human workmanship is increasingly replaced by Artificial Intelligence (AI). This replacement highlights a growing need for humans to evolve in order to keep up with advancements in AI or risk irrelevance [1].

A brain-computer interface could help bridge the gap between human intelligence and artificial intelligence, according to CEO of SpaceX and Tesla Elon Musk [2]. His new company Neuralink was registered as a medical research company in California in July 2016 [2]. The company’s main goal is to develop so-called “neural lace” technology - devices that can be implanted in the human brain with the aim to boost computing abilities [3]. People could communicate in milliseconds and up- or download their thoughts onto computers [4].

Overall, this new technology could enhance cognitive function in humans and help us keep up with accelerating advancements in AI [4]. It could also resolve the anxiety many people have about the uncontrollability of AI. With the implementation of neural lace, people would remain in charge completely.

So are we on our way to becoming cyborgs? The idea of a neural lace may seem far-fetched and, indeed, we probably still have a long way to go. However, new advancements in medicine have already shown the potential of brain implants. Deep brain stimulation, which uses implanted electrode arrays to send electrical impulses to target brain areas, is used for otherwise treatment-resistant disorders, such as Parkinson’s disease. This may only be the start of a new type of implantable intelligence.

Alena Deuerlein
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Goethe University Frankfurt

Thumbs up for suicide prevention!
Machine Learning in Diagnostic Imaging: Needs, Opportunities and Promises

Whenever there is discussion about the use of big data or machine learning for patient management at scientific conferences, people’s eyes uncomfortably shift towards the radiologists. Hunched up in dark rooms, the flickering light from their fancy computer monitors ceaselessly reflecting off their glasses, they have always been, to some extent, outliers in medicine. For as long as anyone can seem to remember, neurologists, surgeons, pediatricians and the like have all thought they can do a radiologist’s job just as well. Apparently, so do computers.

Radiology Needs More Automation

There is no doubt about it: radiology could use some help. Imaging data is more complex than ever – a decade ago, looking at a plain head CT scan would have been enough to decide how to treat a stroke patient. Today, for a similar patient, four different scans would be run in specialized centers to make better-informed decisions. Each needs to be interpreted and integrated with other imaging and clinical information, which is no easy task. And as more equipment becomes available, the total number of scans being done is expanding at an outrageous rate [1].

To make matters worse, there are also too few radiologists being trained in many countries [2], especially developing ones [3]. Many hospitals have resorted to “nighthawk” teleradiology to cover this gap, with radiologists in Australia covering shifts in Europe for example. Thankfully, most imaging data are now stored digitally – the days of awkwardly holding up photographic film against a window in lieu of a lightbox are long gone – meaning algorithms have easy access to a vast and growing amount of data.

A Match Made in Heaven?

A radiologist from Iowa, Gwilym S. Lodwick, suggested over half a century ago that computers could be used for diagnosing lung nodules and bone tumors on x-rays [4]. Before medical imaging went digital, this was done by filling out a checklist of features by hand (e.g. “how sharp are the borders of the lesion?”), then using the results to make predictions. This seems remarkable, but it set radiology on the road to automation, and Lodwick was nominated for the Nobel Prize in Medicine in 1975.

There is an irony to all this. Two central principles of medicine are particularly revered in radiology and might be the reason the speciality has a huge target on its back. Firstly, diagnostic decisions increasingly rely on subtle imaging features rather than crude diagnoses.

What else is systematic and good at identifying patterns? You see, radiology never stood a chance (or so it seems).

Falling Short of a Radiologist’s Duties

Nowadays, machine learning is being used in radiology for either classifying different types of tissue, known as computer-aided detection (“does this part of the image show grey matter?”) or to diagnose or stage diseases, known as computer-aided diagnosis (“is this a lymphoma?”). Of course, that is far from everything a radiologist does. If you look at a radiology report (a good one, I mean), you will see that it’s a rich, detailed description. The diagnosis only comes briefly at the end, almost an afterthought. Why? Because clinical decisions increasingly rely on subtle imaging features rather than crude diagnoses.

In medicine, neatly categorizing everything, which is what most algorithms currently do, is convenient (and necessary), but oversimplified. In practice, diagnostic radiology is probabilistic, involves carefully unraveling relevant from incidental findings, and putting things in broader context – things are rarely (pardon the pun) black and white. Some companies, like the mysterious DeepRadiology, are working on algorithms that are more flexible and dynamic - generating radiology reports that don’t just classify, but describe what the algorithms “see” in the images [5].

So far, exuberant promises have been made, but it’s not clear yet whether these new approaches will deliver (or what will happen to radiologists if they do). Medical imaging doesn’t exactly have a great reputation for living up to hype.


Ahmed Khalil
PhD Student, AG Fiebach

Look out for Ahmed’s follow-up to this article, discussing whether radiologists are in actual danger of being completely replaced by computers (even if new approaches deliver on their promises) – coming soon on the CNS blog!
Opinion: Neurofeedback – The Underestimation of Our Brains

The brain is plastic. Neuroplasticity is one of the first facts that we learn in the course of our neuroscientific career. Controversially, many people, including some clinicians and psychologists, believe that a “dysregulated” brain that develops depression, anxiety or addiction more easily can never be “rewired”. Thus, medication can only soothe the symptoms, but not the dysregulated brain per se (although this has not gone without criticism). Unfortunately, sometimes doctors prescribe medications instead of thinking about ways to tackle the cause.

However, the extent to which our brain function is purely due to genes is specific and limited. The rest is shaped by the environment, and especially by our behavior. We are the ones who can affect our thoughts and actions, if we know how to. Easy ways to influence the brain indirectly are, for instance, diet, hydration level, exercise and psychotherapy. However, neurofeedback, the direct control of changes in brain processes, is also a powerful, yet less well-known technique.

A Simple Technique

Neurofeedback is a specialized form of biofeedback [1], which monitors general brain and bodily functions, such as blood pressure, heart rate and brain waves, to promote control over usually involuntary physiological processes. Neurofeedback is a technology-based learning method that provides real-time information in order to positively reinforce the desired alteration of brain activity. This can be measured using different methods, including electroencephalography (EEG), near-infrared spectroscopy (NIRS) or magnetic resonance imaging (MRI). What’s more, neurofeedback can be used for various conditions, like panic disorders, stress, sleep problems, but also autism, attention deficit hyperactivity disorder (ADHD) or Parkinson’s disease [2,3].

As you learn to improve and regulate the modulation of your brain, medication can theoretically be reduced. As a case in point, children with ADHD often have huge behavioral problems: they are impulsive, get bored quickly and are easily distracted. This has been linked with aberrant brain activity, as studies have shown reduced activity in the prefrontal cortex, which is involved in controlling situation-specific activities and regulating emotional processes [4]. The fact that these symptoms already surface at early ages may lead to the (erroneous) conclusion that they are genetically determined. The call for redeeming methylphenidate (more commonly known under its brand name Ritalin) from parents often becomes louder when the child reaches school age. Worryingly, it’s not known how the daily intake of Ritalin, a chemical cousin of amphetamine, calms kids down and increases their ability to concentrate. Even more worryingly, it has also remained unclear what causes the severe side effects that include headache, nervousness and depressive mood [5].

Why are doctors rarely informing their patients about this potential treatment? My guess is that it is not profitable. For sure, it is profitable for patients, but not for big pharma. They have the financial resources, but they might not be too keen on promoting this alternative approach by research and marketing. A therapy in which patients with usually chronic symptoms (such as ADHD) learn to treat themselves in a relatively short period is not good business for them.

Neurofeedback offers an option to exert self-control, which is often claimed to be impaired in ADHD. Thereby, patients could be taught to control their frontal cortex activity and thus enhance attention and concentration. Via EEG, the brain waves in this area are measured and a computer disassembles their frequency components and visualizes them on a monitor for the child to see [1,6]. Transferring these abstract brain curves into something playful, like a ball that approaches a goal when the child produces desired brain activity changes, turns this therapy into a simple, but interesting computer game. In the second step, the monitor is black and the children are asked to ‘think’ the same as they did when the ball went into the goal. If they manage this ‘blinded’ as well, they can be offered a treat. Importantly, children learn very fast and only a small amount of training is sufficient for them to transfer their ‘concentration mode’ to daily life.

Classic Versus Alternative

This is just one example of how a “dysregulated” brain can be taught to control itself non-invasively and without side effects. Sure, it is not a panacea – disorders have different origins, and people are different. Nevertheless, it is a powerful method that is well worth a try.

Image source: Anahita Poshtiban

Anahita Poshtiban
PhD Student, AG Plested

[4] Cubillo et al., Cortex 2012
[5] Lee et al., BMC Psychiatry 2011
Are we all becoming “digitally demented”?

There is no denying it – we as a society have become reliant on technology in our daily lives. Can you imagine writing a paper without using Word’s spell checker? Or writing a text message without relying on autocorrect to avoid an awkward typo? But does overindulging in the technical conveniences of our digitalized lives mean that we are depriving ourselves of our skills?

Worries about losing our cognitive acuity thanks to technology are not completely new. Especially in South Korea, one of the most thoroughly digitalized countries in the world, physicians are concerned by what they call “digital dementia”. The concept behind this is known to all of us. Imagine our cognitive functions working like our muscles. If you don’t train them, they’ll slowly atrophy and lose strength. Take the author of this article as an example: According to many, map reading and spatial navigation have never figured among his strengths. The advent of satellite navigation and Google Maps, however, have made him lazy and, as a consequence, he is often seen wandering the corridors of his lab, completely disoriented.

It is easy to see why digital dementia advocates are especially worried about kids. Constant exposure to television, the internet and computer games, they claim, deprives them of “real-world experiences”. This supposedly harms their healthy development and turns them into socially disinterested loners. German weekly Der Spiegel quotes Manfred Spitzer, a psychiatrist and one of the most avid proponents of digital dementia, vowing that “(...) as shown here many times over, they [the digital media] truly do make us fat, dumb, aggressive, lonely, sick and unhappy.” [1] But is this really anything more than fearmongering?

Dumb, aggressive, and lonely because of digital media?

Besides the obviously lurid term dementia, let’s get one thing straight first: Digital media cannot be bad per se – it depends on how you use them. If your online experience is restricted to cat videos or DIY makeup tutorials, it is easy to see why your cognitive abilities won’t benefit much. On the other hand, that is not what most people do. They use the internet to look up information, connect with friends and extend their knowledge. Among kids [2]. A similar case could be argued for video games, which have even been linked with improved cognitive skills [3], but depending on content, may also lead to less pro-social behavior and empathy and more aggression [4].

What is more, research on this topic is methodologically tricky. This is because many variables of interest are correlated, a problem that often is not controlled for and may introduce bias. For example, it is easy to imagine that people who watch a lot of TV, on average, have lower academic achievement. Equally plausible, however, is that teens from disadvantaged backgrounds score lower grades – and watch more TV. Often, if you correct for these confounding associations statistically, the negative impact of digital media evaporates [5]. Also, many studies often assess screen time per se, lumping together exposure to any kind of electronic device. This implies that watching an hour of WWE Smackdown on TV is comparable to an hour playing online chess – and that can’t be right.

Similarly, whether digital media have a positive or negative effect on kids depends on many factors, including content. Take TV shows: An easily relatable study found that watching “Dora the Explorer” was associated with better verbal skills, while Teletubbies was associated with worse verbal skills, and one of the most avid proponents of digital dementia, vowing that “(...) as shown here many times over, they [the digital media] truly do make us fat, dumb, aggressive, lonely, sick and unhappy.” [1] But is this really anything more than fearmongering?

Dumb, aggressive, and lonely because of digital media?

There is no good or bad – and definitely no “dementia”

So, is the story about digital dementia really grounded in facts or are these scare tactics propagated by technology-averse Luddites? Again, there is something to both sides of the coin. While undoubtedly over-relying on apps for every small juggle of mental arithmetic’s can’t be conducive to cognitive brilliance, there is no imagina-able life without pocket calculators, GPS or spelling checking. More important, however, the way we use digital media determines whether they are beneficial for our grey matter or not.

There is no question that technological progress and digitalization have a huge impact on the way we grow up – also in terms of cognitive abilities. Likewise, it is obvious that something as complex and multi-sided as technology can’t be uniformly good or bad. Maybe, though, it is a good idea to give those kittens on YouTube a break and turn to something more “intellectual” – such as the many marvelous articles in this issue of the CNS Newsletter.

Helge Hasselmann
PhD Student, AG Otte/Paul


Image source: Zentrale Medien dienstleistungen, Charité (C.N.)
How Wearing a Fitness Tracker Can Change You

Lately, a big market for fitness trackers has emerged. Different wearables and apps can measure a number of fitness-related parameters, including heart rate, GPS tracking, steps, distance covered, pace, calories burned or even sleep quality. In many cases, you can also log your caloric intake to get an even better profile of your performance. But the psychological aspect of fitness trackers is just as important as the technology behind them because they do more than inform: they reinforce, motivate and reward.

The Advertised Effects
Fitness trackers and apps are advertised as beneficial for your health and lifestyle. They provide an objective measure of your activity so you can’t lie to yourself. Wearable trackers should get you to be more active, motivate you during exercise and provide information about your daily routine or workout without requiring manual calculations or notes. Furthermore, they should help you to reach your fitness goals.

These devices and apps are becoming increasingly popular in personal healthcare and promise easy lifestyle changes. These promising words fall on fertile soil. Most adults are aware of (or at least suspect) not meeting their recommendations of physical activity levels.

Do They Work?
Fitness trackers are great for those who really have no idea how many calories they burn during an activity and can help those in need of a motivational tool to keep them going. However, one study found that using a pedometer did not significantly increase step count among overweight and obese adults [1]. Another study with overweight people showed that after 18 months, those who had used a device that tracked steps and calorie expenditure lost on average five pounds less than people without self-tracking [2]. Thus, devices that monitor and provide feedback on physical activity may not offer an advantage over standard behavioral weight-loss approaches after all.

From personal observations and a (non-representative) survey among colleagues, it became apparent that a fitness tracker motivated us to be more active initially. For nearly all it was fun to log and track our own health data and progress with colorful charts and badges for achievements. However, the excitement – as with all new toys – had died away at some point and most of us were back to our previous activity levels after a while. Until now, not a single long-term study has analyzed the effect of constantly wearing a fitness tracker on the average consumer.

What Else Do They Do?
However, many users also observed that they developed a guilty conscience if they had not moved enough. In some cases this led to abandoning the device altogether. Thus, wearing the device alone is not enough to lead a healthier life. Many devices and apps offer an online platform where users can compare themselves with others or even a challenge a friend. This additionally increases the motivation, but also the pressure to perform and reach your goals as the wearer is held accountable by the device, app and group members. The motivation to be at the top of a ranking can also be amplified by the ability to broadcast your exercise statistics via social media.

This can, for obvious reasons, also have negative consequences for some people. One study examined the relationship between use of calorie counting and fitness tracking devices with eating disorder-related behaviour in college students [3]. Participants using calorie and fitness trackers manifested higher levels of eating concern and dietary restraint. Interestingly, fitness tracking, but not calorie counting, emerged as a unique indicator of eating disorder symptomatology. These findings suggest that for some individuals, these devices do more harm than good.

Should I Track?
It is nice to know your daily step count, heart rate, caloric intake, and the like, but wouldn’t you also have an approximate idea about these parameters if you simply reflected on your daily routine? Depending on how important it is for you to know the exact parameters, it makes sense to wear such a device... or not. Many devices have a built-in alarm that goes off if you have not move for a certain time. This might come in handy, but can also be annoying if you are at work and just can’t go for a walk right now. In the end, it always depends on the individual who wears the device.

If you are not prone to being overly critical about your weight, tracking your workouts and food intake can be motivating. But tracking everything might become obsessive for some, as the numerical focus of the trackers is akin to the obsessive fixation characteristic for eating disorders and exercise addiction.

It’s true that these devices make you be more aware of your health. However, this can also be achieved without fitness trackers but instead with good education about lifestyle and health.

Personal Records

<table>
<thead>
<tr>
<th>Activity</th>
<th>Most Steps in a Day</th>
<th>Most Steps in a Week</th>
<th>Most Steps in a Month</th>
<th>Longest Goal Streak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps</td>
<td>56,636</td>
<td>128,429</td>
<td>349,864</td>
<td>3 days</td>
</tr>
<tr>
<td>Cycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pool Swimming</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Badges

Achievements

Can You Be an Internet Addict?

Have you missed important social or work activities and preferred to stay at home and surf the web? Have you found yourself daydreaming about using the internet? Have you ever stayed online more than you were planning to? These are not questions from a “5 Signs you have...” online test. These were some of the criteria proposed by Dr. Ivan K. Goldberg to describe a new disorder back in 1995, intended as a parody of the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders (DSM) [1]. What he wasn’t expecting, though, was receiving countless letters from people claiming to suffer from just this condition. Some years later, Goldberg’s mock proposal was cited in virtually every article discussing a new phenomenon, called “Internet Addiction Disorder” (IAD).

The Problem with Internet Addiction Disorder

Now, more than 20 years later, numerous questionnaires are available to assess problematic internet use. However, the debate about the very existence of IAD still continues. For instance, the DSM’s latest edition does not figure IAD in the newly created category of behavioral addictions. Only one type of internet usage, Internet Gaming Disorder, was proposed as a “condition that requires further research before its consideration as a formal disorder”. This did not include the use of social media, gambling or general use of the internet, despite the fact that they also have been proposed as potential sources of problematic behavior.

Another important medical taxonomy, The International Classification of Diseases of the World Health Organization, also does not list it [2]. The reason for this is that many questions remain. Some argue that IAD should be classified as a substance use disorder because of shared characteristics such as excessive use, withdrawal, tolerance, and repercussions in daily life [3]. Others see it as an impulse control disorder, while some think it is similar to obsessive-compulsive disorder. For many, it is not even clear if IAD is truly a separate clinical entity or if it’s merely a specific manifestation of an underlying disorder.

As with many psychiatric disorders, the line defining what is “normal” is blurry. The internet is an essential part of everyday life and many activities wouldn’t work without it. On the other hand, the increasing use of social media makes it seem like we are creating an alternative personality or life. Internet behavior has reached such an importance that new disciplines such as neuromarketing and online marketing have emerged and aim to analyze, exploit and sell it as a product. All of this makes internet use unlikely to decrease in the future.

It is important not to pathologize normal behavior, however. A key determinant of whether a behavior is “abnormal” is if it causes functional impairment. What would be interesting to see is how the line around normal internet use is pushed further or how its contours change with time. Certainly, few things are perceived so differently across generations as the concept of the “healthy use of technology”.

Research on IAD is Just Beginning

The lack of proper definitions and diagnostic criteria makes clinical research difficult, and IAD is no exception here. The absence of universally accepted diagnostic criteria for IAD means it’s tricky to generate epidemiological data. According to a review by Weinstein and Lejoux [4], the prevalence reported in surveys in Europe and the United States ranges between 1.5% and 8%. Also, depending on the country, there was a high comorbidity with psychiatric disorders such as depression, anxiety disorders and even cannabis and alcohol abuse.

Most of the studies have considered IAD in the framework of substance use disorders or internet gaming. What is more, they were mainly conducted in Asian countries like South Korea, which have seen excessive use of the internet in the past (see page 16). For instance, cases of cardiopulmonary-related deaths in Cybercafés have been reported [5]. In neuroimaging research, executive functions, decision-making and attention have been investigated and together suggest prefrontal dysfunction and reduced cognitive control in at-risk users [6].

As awareness of problematic internet use grows, experts have already suggested several medical interventions [7] - in particular antidepressants [8,9] because of comorbidities (e.g., depression and anxiety). Cognitive behavioral therapy may also be useful [10]. The general consensus is that balanced internet use should be promoted, not complete abstinence. What this balance should exactly look like is yet another open question.

Studying IAD has important implications for the development of public health policies. It is difficult for psychologists and medical practitioners to recognize pathological behaviors if these are not regularly screened with the proper diagnostic tools. It is clear that a lot of research is still needed, which obviously is only possible if we ever agree that there is a disorder in the first place.
Digital Healthcare in the Movies

As science and technology pave the way to automated processes in healthcare that affect us all as a society, related topics have started to hit the big screen as well. Two rather overlooked movies recently dealt with the issue of healthcare robots and are definitely worth watching: the animated film Big Hero 6 (2014; German title Baymax) and the indie comedy-drama Robot & Frank (2012).

Baymax is an inflatable healthcare robot created by lead character Hiro Hamada’s older brother Tadashi. Both are extremely talented in engineering and programming and while Hiro wastes his talent on robot destruction fights, his brother motivates him to apply to college. He succeeds and at college develops a friendly inflatable healthcare robot. Unexpectedly, however, Hiro’s brother then dies in an accident at a science fair. After weeks of depression, Hiro randomly reactivates Baymax and slowly begins to recover. Together with his friends, Hiro discovers inconsistencies related to his brother’s death. To avenge Tadashi’s death, they transform into superheroes and armor the ex-healthcare robot Baymax to fight for justice.

An entirely different story is covered in Robot & Frank: Former jewel thief Frank struggles with dementia and is becoming increasingly disoriented. His children, tired of taking care of him, arrange a therapeutic care robot to look after their father. At first, Frank is very reluctant to accept his new companion but later has a change of heart when he teaches his robot the skills of lock-picking and burglary.

Both stories deal with situations where people are desperately seeking help and find great relief in the assistance of robots. However, both movies also feature an abuse of the intended function of these healthcare bots. Baymax becomes a fighting machine (though, deep down, he’s a good guy) and Robot assists in Frank’s burglaries. Therefore, both movies ask the question of who takes moral responsibility for a robot’s actions. And so should we!

Obviously, all technology can be equally used for good and bad purposes. But science and engineering have to ensure that abuse is impossible, especially when technology is used by people who are vulnerable because of disease or disability. Yet another question is how well, if at all, technology will be able to mimic human empathy when it comes to compassionate care of others.

There is much more to healthcare than feeding, washing and dispensing pills. It is also about a smile, a chat, a gentle touch, and time. I wonder whether machines will one day be able to provide this and, if so, where will humanity be by that time?

Bettina Schmerl
PhD Student, AG Shoichet

Thinking Twice About Big Data: A Review of Weapons of Math Destruction by Cathy O’Neil

I used to stare in wide-eyed, uncritical awe when hearing about the wonders of machine learning. You’d be forgiven for feeling the same reading this issue of the newsletter. Nothing is perfect, but big data can be imperfect to the point of irony.

In her book Weapons of Math Destruction, mathematician-turned-data scientist (and mathbabe. org author) Cathy O’Neil illustrates how flawed big data can be.

She argues that algorithms are problematic in ways that contradict a core belief: that they’re fair. Humans are inherently biased and make subjective decisions based on their experiences and prejudices. Computers are presumably objective and bias-free. If we’re looking to promote fairness and equality, it makes sense to use them to make decisions.

In the real world, that’s simply not the case. Our biases are projected onto the algorithms, which then magnify them, apply them indiscriminately, and allow them to reach far more people in less time than any human could. What’s worse is it’s often not clear exactly what these algorithms are doing; there’s little regulation or oversight. No one goes back to check for mistakes or their consequences. So it continues, leaving (even well-meaning) people happily hiding behind the illusion of fairness.

All this has tangible, often disturbing, consequences. It’s bad enough having a racist algorithm judging beauty pageants [1], but big data is used to decide who gets into what school, who gets a job, who gets a loan, and how people get punished for crimes. At some point, critical parts of our lives will be decided by an algorithm, there’s no avoiding it. As a consequence, responsibility is shifting. Traditionally, doctors, lawyers, and the like were considered to hold great power over our lives and well-being. But the damage they can do (intentional or otherwise) is limited. Data scientists who design algorithms for making such decisions, on the other hand, hold exceptional power over people.

It’s about time we realize this and take measures to prevent things going awry. Reading this book is a good start.

Ahmed Khalil
PhD Student, AG Fiebach


www.medical-neurosciences.de
Documentary Review: Hopes and Hypes Around Digital Health

7 billion people, 3 million doctors. Doesn’t take a genius to figure out that there is a dire shortage of medics! With this in mind, the short documentary “Hopes and hypes around digital health” produced by a Slovenian company “Danes Medicina”, gives us a quick overview of current opinions and (you guessed it) hypes prevalent in the digital health sector. This is a regular news-type documentary with a narrator in the background and clips of short interviews, on-screen texts and graphics pieced together.

The documentary features short interview clips from angel investors (a catchy term for an investor who lends funding on more favourable terms and helps startups get on their feet), startup founders, doctors (or more specifically “doctrepreneurs”) and savvy app-developers. The premise is simple: Investment in digital health has skyrocketed in 2014 and 2015 due to its potential role in dealing with global ailments. However, legislation and data privacy issues continue to be a thorn in its side.

Where Do Healthcare Apps Go After Inception?
With specialized healthcare investors jumping on the band wagon, the government is no longer the only funding source for startups. But the competition is tough in the startup market and the stakes are higher than ever. The documentary claims that some 100,000 health apps are available in app stores nowadays. One might wonder how many of them survive the sands of time. Certainly not that many. Those with know-how about the nitty-gritty of startup culture blame it on the failure to understand and keep up with the quickly transitioning landscape of the digital health industry. Perhaps one of the most challenging aspects for an app to survive in the digital health market is to ensure that it can act as a reliable long-term intermediary between doctor and patient.

Latest Developments in Digital Health – A Doctor in Your Pocket
Artificial Intelligence (AI) in healthcare has led to the introduction of interesting technologies like an artificial pancreas that relies on personalized data from the patient and learns from the patient’s use of sugar. Doctors at NYC are working with IBM Watson computers (a supercomputer that combines AI and analytics to act as a question-answering system) to devise personalized treatment plans. The fun doesn’t stop there. Babylon, a healthcare app founded in 2014 by Ali Parsa, aims to digitalize the process of triage. As a digital healthcare service provider running on subscription, Babylon users can book virtual consultations with doctors via text and video messaging. If the patient still feels dissatisfied or wants further consultation, they can then go on to book a physical appointment. Aside from offering convenience, the app also has the potential to save both the consultant and the patient’s time over something that could be resolved by answering a few questions. Thus, an intervention by a smart third party between the doctor and the patient may help to streamline the healthcare system.

The Verdict
With a run-time of slightly less than 30 mins, Hopes and hypes around digital health is a quick watch that gives you a good overview of the ever-so-popular topic of the hypes in the digital health market and features a good mix of doctors, investors and app-developers. However, be warned; this is no keep-you-on-your-toes documentary that will make you stay up all night. For those who are a bit more attuned to all things big data and digital health, this will sound a tad repetitive (After all, how can you claim to be a big data aficionado if you are unaware of Google’s Deep Mind? See our article on page 12). Moreover, the lack of background music and a mechanical narrator’s voice may limit the viewership of this documentary. Go for this one if you just want a quick rundown of the latest in digital health. You can watch the documentary on YouTube (http://bit.ly/2pOWo6D).

Zara Khan
MSc MedNeuro

ENCODS, or the European Neuroscience Conference for Doctoral Students, took place this year in Alicante, Spain. This event is an opportunity for young scientists to get up to date on the latest developments in their field, but also to network and learn about soft skills that are important for the neuroscience job market.

Out of a delegation of seven students from Berlin, 3 lucky MedNeuros (Ahmed Khalil, Eileen Schormann, and Mariana Cerdeira) were in attendance.

Activities included lectures, roundtables, workshops, and of course some time to enjoy the beautiful sun and scenery!
MedNeuros in Digital Health

Lee Stopak

Interview

With the startup and digital health scenes boosting in Berlin, it is natural that our program colleagues are part of the trend. We talked to two MedNeuro Master graduates (both from the class of 2014-2016) who are currently working in digital health companies in Berlin, straight out of the Master’s: Lee Stopak, in Ada Health and Christiane Meyer, in Flying Health.

What product does Ada Health offer?
Ada is an app for symptom assessment. So if you’re feeling unwell, you can follow the questions in the app, answering what you have been feeling and it will give you a list of the most probable diagnoses. But it also instructs that it’s meant for guidance of the patient, and it should not replace a visit to the doctor.

What are your functions and responsibilities?
Most people in the company are either developers with a computer science background, or doctors working on the content. I am probably the only one with a biology/research background. I am part of the research team, and am developing a prototype to try to integrate data from a genetic profile database to the app, so it can further aid with the symptom assessment. I do a lot of literature research and programming, with which I had some previous experience, but for this job I’ve had to learn more about CSS, HTML and Javascript.

Which language is spoken in your work environment?
I talk to my colleagues in English. Naturally, the Germans talk in German amongst themselves, but everyone speaks English.

How did you get interested in this field and find this job position?
A friend of mine was working for the company, I sent him my CV and he forwarded it to the managers. At first, they said they didn’t have a position for me because they need medical doctors, but later they started this new genetics project, so I got an interview. I was hired at first with a 2-month student part-time contract (20h/week) while finishing my Master thesis and now I have a permanent open-end contract.

What are the things you like the most about your job?
One of the things I was afraid of when leaving academia was losing my autonomy – but in this job I still have it. I got very lucky with the position, because I really like genetics. Working in a startup is in a way very familiar, but also new. I’m also very excited about learning more about programming, which is something I wanted to do, and to be working with a product that is useful in society.

What are the things you don’t like?
It is an office job, so I guess one thing I don’t like is to be sitting all day and not moving much.

What are your future plans? Do you plan to do a PhD afterwards?
Maybe in the future, but right now I like working in this company and want to see how it goes.

“I was afraid of losing autonomy, but I haven’t”
What are your functions and responsibilities at Flying Health?
I am part of the research team and the head of the startup scanner. I search for and evaluate startups within the field of digital health, and look for new trends and innovative ideas.

Can you describe a typical day?
There is no day like the other, which is great. I am a person who easily gets bored, so it is great to have the variety. Weeks are usually filled with meetings, searching for the newest trends, evaluating or scanning startups, writing articles for our trend report, writing reports assessing startups for our partners, going to meet-ups or attending one of our own events such as “Kaminabend” and pitch days.

Which language is spoken in your work environment?
Both German and English.

How did you get interested in this field and find this job position?
After completing my Master’s, I was certain I did not want to do a PhD. What I didn’t know was what to do instead, because I felt like a PhD was the only thing I was trained for. I was, however, intrigued by the Berlin startup scene and its fast-paced and stimulating environment. But to be fair, I just got really lucky. My boss was giving the keynote lecture at my graduation and his life and work fascinated me. I wrote him an email two days later, asking for advice on how to get into the startup scene and 17 days and 2 interviews later I had a job.

What are your future plans? Do you plan to do a PhD afterwards?
I am still constantly learning and undergoing new experiences. My work environment enables me to grow and discover new things on a daily basis. As long as this is the case, I am happy right where I am. At some point I might do a PhD, because I am still passionate about science, but not right now.

What are the things you like the most about your job?
I love being right at the forefront, knowing or getting to know the newest trends and startups or the most innovative ideas and solutions. Having one’s finger on the pulse of the time, knowing what is out there - and even more, what is going to be out there in a year or two - is amazing. But the absolute best part are my bosses and colleagues. They make work more than enjoyable and rewarding.

What are the things you don’t like?
The job is very fast-paced and new enquiries often interfere with other tasks. Sometimes, just sometimes, it would be nice to have a boring day and to be able to stick to a plan.

How is work-life balance in your job?
I work around 40 to 50 hours a week. Monday to Friday is mostly dedicated to work but the weekends are all mine. No laptop, no (work-related) emails. So work-life balance is good.

Thank you for the interviews!
We wish you two all the best in your careers!

Mariana Cerdeira
PhD Student, AG Harms
**Talk Data-y to Me: Coding for Careers in Neuroscience**

Big data and digital health are more than just buzzwords – they represent one of the most fundamental ways in which neuroscience will change in the coming decades. Knowing this, it’s important that we equip ourselves with the right tools to compete in an increasingly digital job market. One of these skills is the ability to program. While not critical for every lab application, it can make one’s research easier in many respects, as well as standing out on a CV.

Being a relative newcomer to the world of programming, I am no expert. However, I do know how overwhelming learning to code can be. My experience thus far has been heavily based on trial and error (or, as a German colleague once called it, “Attempt and Fail”), but I have managed to achieve some small personal successes. In the interests of this issue, I humbly present a few thoughts for those considering, or just beginning to learn to code.

1. **Choosing the right language matters**
   You may be in a research group (or company) that already has a go-to programming language. If so, congratulations, the choice is made for you! Don’t reinvent the wheel and benefit from the expertise and analysis routines of those around you. However, if you are starting from scratch, or need to tackle a new problem, it’s worth doing your research. Python, Matlab, and R are all fairly safe, flexible choices, but it really depends on your application. All three have special toolboxes for neuroscience applications, and sometimes you may need more than one to get a desired result.

2. **Learning one language makes the next one easier**
   So you’ve started coding with reasonable success, and suddenly you need another language to use a new toolbox or program. Do not despair! You can use a lot of your pre-existing knowledge to speed up the process. Just as with spoken languages, written languages often share fundamental properties and rules. Though the syntax may differ slightly, core principles remain, and being able to think about your data logically already puts you in a great position to learn the finer points. It’s like English and German: even though the words are different, both languages still have the same building blocks of nouns, verbs, adjectives, etc.

3. **You will learn to think differently**
   This one is a lot more intangible, but will slowly seep into the way you handle your data. It can be as simple as storing your data in an organized manner so that a program can easily flip through your files – something I still struggle with. Other examples include chunking problems into a series of small, workable sequences, designing smart conditionals (if -> then statements), and thinking about ways to handle exceptions, or anomalies that could make your program crash. Am I better at playing chess? Absolutely not, but the way I write code and deal with data has become neater and tighter with every day that I code. It’s still nowhere near the elegant solutions of more experienced coders, but I feel like I’m making progress.

4. **You just need to get started**
   This is everything. Programming can seem like a huge, impossible discipline made unnecessarily complicated by a bunch of know-it-all geeks. But anyone can do it – I’m not a huge math/logic person, but with good resources and the right motivation (“Doing this will make your life exponentially easier” or “Pre-existing tools are not sufficient to analyze this”), even I can blunder through a few programs that deliver their promised results. I got started when my bachelor’s thesis supervisor threw me some data and told me to make graphs with it. The resulting figures were aesthetically a disaster… but it was enough to give me a taste of what it was like to work with data via a programming language.

   The good news here is that most programmers are practically evangelical, and there are a lot of fantastic resources online to get your feet wet. Personally, I have used Codecademy [1], DataCamp [2], and Coursera [3] to learn more about Python and R. Both the Bernstein Center for Computational Neuroscience and the Berlin School of Mind and Brain offer programming courses which MedNeuro students can take [4,5]. It’s crucial that you start taking what you’ve learned and applying it to your own data as soon as possible.

5. **You need to practice**
   Just like learning a language, confidence and fluency only come with practice. Again, this can be challenging in a lab setting, when blocks of analysis are interspersed with experiments. Occasionally I will sit down in front of a program I wrote several months (or weeks!) beforehand, and have absolutely no idea what I was thinking or how I should proceed. As mentioned above, some sites like Codewars [6] are designed to make sure you don’t get rusty with programming fundamentals. Try and always keep your coding semi-active, and it will be much easier to pick it up again when you need it most.

6. **It will be difficult and frustrating**
   Yes, you will want to throw your computer out of the window. But it will be temporary. And on the flip side, you will be rejoicing over the tiniest of victories. Coding is great for treasuring the small things in life.

7. **There’s a lot of help out there**
   The good news is that many coding languages have vibrant online communities, where everyday users can post questions or get feedback on their current programs. The odds are that you’re not the first to encounter a problem, and websites like Mathworks [7] or Stack Overflow [8] are great places to search around for advice. With the increasing drive for open science, many labs are publishing code repositories of analysis sequences, or at least describing their programs in more helpful detail. Finally, talk to other coders in your own discipline and find out what you might have in common. Just getting a fresh perspective can help you see a problem in a new light.

   **Constance Holman**
   PhD Student, AG Schmitz

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“Dr. Robot”? A lean Business Perspective on the Future of Digital Health

Digital health is expanding rapidly, and startups have their foot on the accelerator. Dr. Markus Müschenich is a managing partner at the Berlin-based Flying Health Incubator [1], which coaches digital health startups to successfully enter the market. To understand digital health, Müschenich says that, “You have to think about where health happens today ... Health does not happen in the hospital, in the [medical] practice, or in the gym, but it happens when you’re at home or you’re at work ... And if you look at the healthcare system, this part is not represented, neither by law nor by specialty.” Startups are filling this gap, and they are doing more than just counting calories or steps: Startups are taking on ‘serious health’. Müschenich explains, “If you have 20% failure counting steps it’s no problem. If you fail 20% of the time with the insulin dosage of a diabetes patient they might die or go into a coma. If a serious health product fails, it becomes dangerous for the patient ... in other words, serious health is what we know from the healthcare system.”

The Smartphone and Beyond- Killer Apps for Health
Startups have the opportunity to revolutionize healthcare now because of a new tool: the smartphone. Müschenich says the smartphone is a “killer app” for digital health, meaning it can facilitate the delivery of digital health services and technologies to patients in a significant way. In the near future Müschenich sees two new killer apps that build upon the smartphone. The first is deep learning, which will make digital health products smarter. The second is chatbot, which will understand natural human speech and respond like a doctor, nurse, or friend. He foresees that with the combination of these technologies, “digital health” can be a competitor of the doctor-based healthcare system.

Competing with Traditional Healthcare
Müschenich’s training as a pediatrician informs how he envisions chatbots competing with the doctor-based healthcare system. “You don’t push the doctor out for severe diseases, severe questions. You push the doctor out for questions like ‘I have fever of 36°C’” (a fever is actually above ~38°C). “So the first step is that the smartphones [with chatbot] will help the doctors to get rid of those patients and to have more time for the patients who need a real doctor.” In fact, an app (Ada) that supports this type of functionality was released fully in the United Kingdom on April 19th this year, and it will even connect users to a doctor if the issue is serious enough [2].

Müschenich says deep learning will go even farther to compete with the doctor-based healthcare system. “The second step will be that doctors will be replaced who just do diagnosis with their eyes: radiologists and dermatologists.” He’s not the only one. Geoffrey Hinton, a computer scientist at the University of Toronto and engineering fellow at Google, has published several research papers pitting deep learning algorithms vs. doctors in diagnostic radiology. Hinton speaks bluntly about this ‘second step’: “I think that if you work as a radiologist you are like Wile E. Coyote in the cartoon ... It’s just completely obvious that in five years deep learning is going to do better than radiologists” [3]. A radiologist might not be very pleased with this assessment, but as Müschenich puts it, “The smart doctor will love a smart device.”

Advantages and Safety
Maybe doctors will love a smart device, but will patients love one as well? Müschenich believes that a lot of people will trust digital health products because of the excessive wait time or cost (for uninsured patients) of an appointment. In other words convenience will drive patients to try digital alternatives. Beyond convenience, Müschenich insists that research like Hinton’s which demonstrates the superiority of a digital health product compared to the doctor-based analog will be important in creating trust. He also stresses the importance of regulations and quality checks. Agencies like the BfArM in Germany and the FDA in the United States require the licensing of serious digital health products as well as certifications for data privacy.

What about the Data?
Data privacy is an important part of the healthcare system and patient trust, so it may surprise you at first that digital health companies are collecting user data. Fret not however, because regulations ensure that apps de-identify your data and importantly data collection is integral to the benefit the app can provide you. Müschenich urges that we should think about health apps more like we think about Google: it isn’t just an internet search tool, but rather an entry point into a huge, intelligent system. Digital health products like mySugr [4], a diabetes management platform, work in just this way. mySugr has about one billion data points and uses them to make predictions about what patient will present a problem at what time. With more users, the product gets better and better. When the data is big enough, Müschenich likens the result to a “digital gut feeling”, replicating what only the most experienced physicians can offer. So next time you have a cold or a strange rash, you really may want to consider ‘Dr. Robot’.

Daniel Cortez Stevenson
MedNeuro MSc Student

Digital apps will compete with doctors

Brain in Press

Your Very Own Ninja Turtle
Researchers from the Korea Advanced Institute of Science and Technology developed a technology to remotely control an animal’s movement with human thought. In their study, a signal originating from a human brain could guide where a turtle moves by controlling its instinctive escape behavior.

The researchers chose the turtle for its cognitive function and ability to recognize a white light source as an open space and move toward it, and move away from obstacles in a predictable manner. The human-turtle setup consists of a head-mounted display combined with a brain-computer interface (BCI) to immerse the user in the turtle’s environment. The turtle wears a system mounted on its shell consisting of a camera, a Wi-Fi transmitter, a computer control module and the stimulation device: a black semi-cylinder with one opening to let light in that can be rotated around the turtle’s head via the BCI. The human operator receives images from the mounted camera, allowing him to steer where the turtle should move. The BCI system records the thoughts left, right and idle as electroencephalography signals. The commands activate the turtle’s stimulation device via Wi-Fi, turning it so that it obstructs the turtle’s view. This invokes its natural instinct to move toward light and change its direction. Finally, the experimenter acquires real-time visual feedback from the camera mounted on the shell and in this way continues to steer the turtle’s trajectory remotely.

Kim, et al., J Bionic Eng 2016

Scientific Evidence of a Higher State of Consciousness
In a study led by the University of Sussex, neuroscientists observed a sustained increase in neural signal diversity in people under the influence of psychedelic drugs. This is the first study to show brain signal diversity that is higher than during awake state. The diversity of brain signals provides a mathematical index of the level of consciousness.

Healthy volunteers were given psilocybin, ketamine or LSD, all known to induce a psychedelic state. Recording spontaneous magnetoencephalographic signals, the researchers found that the level of consciousness was higher after drug ingestion and that electrical brain activity was less predictable and less ‘integrated’.

Anil Seth, co-author of the study, said in an interview with ScienceDaily: “We found correlations between the intensity of the psychedelic experience, as reported by volunteers, and changes in signal diversity. This suggests that our measure has close links not only to global brain changes induced by the drugs, but to those aspects of brain dynamics that underlie specific aspects of conscious experience.” The findings could help inform discussions about the medical use of such drugs, for example in treating severe depression.

Schartner et al., Sci Rep 2017, via ScienceDaily

Umbilical Cord Plasma Revitalizes Brain Function
A protein found abundantly in human umbilical cord blood, but decreasingly in the blood of older people, can rejuvenate learning and memory in older mice, according to a study by researchers at Stanford University School of Medicine. The findings could lead to new treatments for age-associated decline in cognitive function.

In an earlier study, Wyss-Coray’s lab showed that direct infusion of young mice’s blood improved memory and learning performance in old mice. To distinguish the effects of old and young human blood on hippocampal function, the researchers used immune-deficient mice that could be given repeated injections of human plasma without experiencing immune reactions. When the older mice received human umbilical cord blood plasma, measures of hippocampal function improved notably. Plasma from older people, on the other hand, didn’t help.

To find out which plasma ingredient was making old brains act younger, the researchers compared plasma protein levels in humans and mice from different age groups. One protein in particular caught their attention: TIMP2 (tissue inhibitor of metalloproteases 2). Injecting TIMP2 into old mice duplicated the beneficial effects of umbilical cord plasma. Mice that were given TIMP2-depleted human cord plasma derived no learning and memory benefits. And young mice who received TIMP2-neutralizing antibodies performed worse than before.

Toahest, a biotechnology company which Wyss-Coray co-founded, has licensed the rights to this intellectual property.

Castellano et al., Nature 2017 via Standford Medicine News Center

Growing Microglia From Skin Cells
At the University of California, Irvine (UCI), scientists have created a method to generate microglia using human skin cells. This marks an important step in the use of induced pluripotent stem (IPS) cells for targeted approaches to better understand and potentially treat neurological conditions such as Alzheimer’s disease (AD).

Skin cells were donated from patients at the UCI Alzheimer’s Disease Research Center and reprogrammed into a pluripotent state. The researchers then guided these pluripotent cells to a new state by exposing the cells to a series of differentiation factors which mimicked the developmental origin of microglia. The resulting cells acted very much like human microglial cells.

“Microglia play an important role in Alzheimer’s and other diseases of the central nervous system. Recent research has revealed that newly discovered Alzheimer’s risk genes influence microglia behavior. Using these cells, we can understand the biology of these genes and test potential new therapies,” said senior author Blurton-Jones in an interview with ScienceDaily. They are now using these cells in three-dimensional brain models to understand how microglia interact with other brain cells and influence AD and the development of other neurological diseases.

Abud et al., Neuron 2017, via ScienceDaily

Claudia Willmes, PhD Student AG Eichkolt/Schmitz
News in Brief

New Master’s Students: 18 To Be Confirmed
There are 18 candidates who confirmed the participation of our program. 11 out of 18 of them are female, 7 from the EU and 5 from the US. This does not even include our dear students of Neurasmus Program. According to Charité regulations, students have to pay EUR 2,500 per semester. We will warmly welcome them in October.

New Annual Meeting: Neurasmus Students to Meet in Göttingen
From July 3-6, Göttingen will be the host city of this year’s Neurasmus annual meeting. We coordinate activities and schedules with the Göttingen office. Neurasmus alumni from the Neurasmus Alumni and Students Association (Neurasa) are preparing a workshop. Like last year, the meeting will also include the graduation ceremony of the fifth cohort of students. Congratulations and best wishes from Berlin!

The 2016 Neurasmus students will leave Berlin for Amsterdam or Bordeaux. We wish them all the best for their second year.

Upcoming Events 2017

**July**

8.-11. XIII European Meeting on Glial Cells in Health and Disease
http://bit.ly/2pvMOVk


16.-20. Alzheimers Association International Conference
http://bit.ly/1sBNiJeE

22. Christopher Street Day
http://bit.ly/2q0zF9y

**August**

4.-6. International Berlin Beer Festival
http://bit.ly/2q2W7x5

19. Long Night of Museums

20.-24. International Society for Neurochemistry
http://bit.ly/2q0yBTh

**September**

6.-9. EFIC 2017 - 10th Congress of the European Pain Federation
http://bit.ly/2q37BAy

8.-11. European Brain Behaviour Society Meeting
http://bit.ly/2qOCqYs

12.-16. 17th World Congress on Pain
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Katerina Mihova, TK-versichert seit 2009