Synchrony matters: Chronobiology Research Group at Charité
Interview with Professor Kramer

The Future: A Brave New Cyborg World?
From rehabilitation to self-enhancement

Scholar Minds: in, out and about academia
Into the future and back again

Time can be a wibbly wobbly thing. For me, at least, it has become. Since March, when corona first thumped over Berlin, I’ve found myself immersed in one amorphous and strange chunk of time, that does not pass. Shortage in demarcation, as in small daily plans I used to have, made the time gradually collapse among my routine. More than I’d like to admit I find myself losing track of when am I in space.

But this is only my experience. People experience different things in the realm of time. It can be perceived as distorted, stretched, or shrink. Why? Maybe it is age, cognitive integrity, attention allocation, or only individual characteristics (p. 11). But time can be assessed via personal reports, as mine, or by phenotypical features. Like those that make you tick in the morning. Are you an early bird or a late owl? Chronobiology may explain it. Read our interview with Prof. Kramer to get a grasp of what makes you tick (p. 4), or when.

The objective nature of time is a hot topic in physics. Some say it does not exist. It is more like a coordinate in the unfolding of events - going beyond the spacetime forged by Einstein’s relativity theory. On the other hand, research on hypobaric hypoxia shows that time-dilation is an observable phenomenon. Who better than a climber familiar with the Himalayas may talk about it (p. 8)? Go figure. And because time also translates into a handful of behaviors, I can ask you how mindful are you of your time (p. 24)? - and you understand it.

The objectivity of time may be under construction, yet, as a concept, it may be at a hand. We can track, for example, how people change across their lifespan. Can you remember when you started minding (p. 13)? Have you ever wondered what’s your age in dog years? Well, science has. And then attempted to make translational age in animal research more accurate. For the benefit of many, physicists included. Some may say it is just a number, but when it comes to serious research, age does matter (p. 14).

And what if not only brain networks matter but also their timestamps? Chronnectome researchers are now tracking connectome timescales (p. 10). Is it the future of brain research? Well, Brain-Computer Interfaces (BCI) may be (p. 17). And, so much for the future, CRISPR has finally made it in the present. The long-overdue female-only Nobel Prize has been granted to two Chemists. Meet Dr. Emmanuelle Charpentier, director of the Max Planck Unit for the Science of Pathogens in Berlin. So let me not waste more of your time, as we hope you enjoy this issue as much as we did.

Mit freundlichen Grüßen

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This issue’s winner is Leandro Rawatt, who wrote a great overview piece about CRISPR/Cas9, for which the Nobel Prize was awarded recently (p. 20).

Congratulations, and thanks to everybody for their contributions!
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Professor Achim Kramer is a chronobiologist at the Charité-Universitätsmedizin and one of the leading experts in the field worldwide. He studied biochemistry at Freie Universität, Berlin, then continued his Ph.D. in the same field at Humboldt Universität Berlin. He did his first PostDoc in medical immunology at Charité. However, it was his second postdoc in neurobiology at Harvard Medical School to point out the direction of his career.[3]

What motivated you to do research on the chronobiology field?
I did my Ph.D. and my first postdoc in a different field, peptide chemistry and protein structure. At that time, it was the end of the last century, and it was said that the 21st century will be the century of the brain, which I found exciting. So, I travelled to the East Coast US to see which neurobiology lab would be a good fit for me, and I had several interviews. Before I made my plan for the trip, I saw in a Berlin newspaper, Tagesspiegel, a report about a lab that discovered Bmal1, one of the clock genes. I was unaware back then of the existence of the circadian clock. I thought it was very interesting, so I e-mailed the guy and I did my second postdoc there. Now we are working primarily with cells from peripheral organs, which turned out to have circadian clocks, too, rather than with neurons; however, the molecular mechanism is very similar; e.g., in the brain and the liver[1].

Did you find the transition from the field of biochemistry to neurobiology difficult?
It was in some ways difficult, but in others not. The first difficulty was the language barrier, and it’s a little bit funny. I had my postdoc interview with Charles Weitz, who had a strong Californian accent. I was used to the terms of peptide chemistry like acetylation or acylation. So, I always thought he was talking about acylation – rather than oscillation... At the time, I also didn’t have much experience with molecular biology techniques, but this was quick to learn, and the lab helped a lot. Compared to biochemistry, in biology the data get noisier; when you look at a structure, there’s either a hydrogen bond or not, but when you look at cells, all the cells look different, etc.

How did the Nobel Prize in 2017, awarded to chronobiologists, change the perception of chronobiology by the public, as well as the scientific community?
When the Nobel Prize was awarded to the three colleagues (Jeffrey C. Hall, Michael Rosbash and Michael W. Young), I was sitting in my office. I got a call from a journalist at Die Berliner Zeitung, who wanted a statement explaining to the public what the researchers were doing. The journalist was already in the auditorium downstairs, sitting together with many important people of Charité. There was a habit of having a Nobel Prize breakfast with people betting who will get the Nobel Prize for physiology and medicine. At the time, they all bet for CRISPR, and this year it happened. People, and maybe particularly the non-science people, always thought chronobiology is a cool thing because they find they are all affected by the circadian clock. The Nobel Prize changed the view in which everyone now accepts it’s a fundamental biological program with a clear genetic basis – and not just a theory.

Where is the field heading to now?
There is a change in science, and the trend is going towards circadian medicine and not just circadian biology. We have many people at Charité who are now doing projects on the circadian rhythm. For instance, Claudia Spies has designed new Intensive Care Units (ICUs) with nice light-dark cycles and tests whether people get less delirium after an operation when they have a good circadian rhythm. We are conducting a study together to test what happens to the circadian rhythms of COVID-19 patients in the ICUs. For example, rheumatoid arthritis is a clear circadian disease, for which new medication, tailored to the time of day, is tested, and so on.

The experimental models that are used to test drugs, for example, mice, are nocturnal and humans are not. Could this explain the so-called preclinical to clinical translational failure?
There was a recent paper in Nature in June [2], where this was exactly one of the questions. It was about stroke treatment, and they were addressing why many of the preclinical attempts fail to cure or treat stroke. In preclinical studies with nocturnal animals, animals are treated at the wrong time of the day, during their sleep and not during their active phase. Nocturnal animals have an anti-phasic sleep-wake cycle concerning the light compared to humans. Whether this is the reason why the translational gap occurs needs to be tested. At least the evidence in that paper is encouraging that there is a difference based on the time of the day, as well as a diurnal vs. nocturnal difference.

My hypothesis is that some of the translational gaps may be due to the chronotype differences (the natural tendency concerning the times of the day when someone prefers to sleep or is most active) [4] in the human population compared to isogenic animals. Humans are always...
different on a genetic basis compared to most animal strains in which drugs have been tested. The genetic difference, in combination with the real world light/dark difference, determines the chronotype. We know that which time of the day affects the pharmacokinetics and pharmacodynamics of many drugs. There are thousands of clinical studies, and only a fraction of them take the time of day into account. Therefore, my hypothesis is that many of the translational gaps can be attributed to the difference in chronotype. If you take your drug at 8 am, for a late-type it might be in the middle of the night, and for an early type, it might be well in the morning. Is it really important that you take your blood pressure medication at 8 pm vs. 8 am? What if you take it at 9 pm instead of 8 pm and how much is it different? When we talk about personalization and chronotype adaptation, even one hour could be important. The next years or decades will tell us how important it is exactly. So, we need to do all those carefully designed studies to really find out to what extent this makes a difference.

**What are the major challenges in the experimental design of chronobiology?**

Regarding human research, it is definitely a good stratification of the cohorts. Related to my subject, this refers to a good chronotype. Two parameters are important: the phase and the amplitude. The phase is related to “when”; whether your chronotype is early or late compared to others. The amplitude is about how good your clock is, whether it has a good rhythm.

**In which cases has a disturbed clock been observed?**

When we talk about neuroscience, it has been observed that patients lose their good sleep-wake cycle in many diseases, like Alzheimer’s or Parkinson’s. There are indications that the circadian amplitude is dampened. So, they don’t have a good sleep-wake cycle, which is only an output of the clock. The question is whether the underlined oscillator is also dampening its amplitude. Amplitude is difficult to measure because normally you need many timepoints to check whether at some time it’s high and the other time low. I am really interested in researching this and finding something that gives us a good feeling or handles to measure the amplitude and correlate it with the disease. This is also a little bit of what Claudia Spies is doing in the ICU by applying light-dark cycles. In earlier days in the ICUs, lights were always on, and there was a relatively high light level. With a bright light during the day and good darkness during the night, you can improve patients’ circadian clock. This will have, in turn, an effect on the number of days they have to stay in the ICU, on the severity of delirium, cognition, and so on. This is what she is measuring.

**Do you think that chronotype could be used for the prognosis of such diseases within the next years?**

I don’t think that chronotype could be used for prognosis. There is actually a REM-sleep behavior disorder (RBD) as a prognostic marker for Parkinson’s disease. However, the question is whether RBD patients have disturbed clocks in the first place or whether they have particular clocks. This is not known yet. It’s always the question of hen and egg; what is causing what? If you have a disturbed clock, would this accelerate disease progression? Or on the other hand, if you make the clock better, would it have a positive effect on the progression? How could you improve the clock? With what kinds of treatment, for example, light therapy, melatonin therapy or exercise versus good sleep, etc.? All these are all interesting questions.

**Your current research includes BodyTime, a test you have developed to identify an individual’s chronotype** [4]. **How do you achieve this, and how many phases have already been completed?**

We have completed two phases. In the first phase, we used blood to measure people’s chronotype by using one single blood sample and an AI algorithm that would try to detect the so-called time-telling genes. Now we have transferred the technology to hair root cells, from which we can get enough RNA by plucking out just a couple of hairs. By examining the relative expression of certain time-telling genes, we can determine the phase or the chronotype. The idea is that many genes have a rhythmic activity during the day: you have morning-, day-, evening-, and night-active genes. If you plug out your hair in the morning and night-active genes are still very active, while the morning-active genes are not so active yet; even if it was 8 am, then you are still biologically in the middle of the night, so you are probably a late-type.

We are also doing a validation study that needs to be completed, in which also sleep patients and shift workers participated. What’s been completed are our images are from the BodyTime website.
controls, which always needs to be compared to the gold standard. For chronotype, the gold standard remains the determination of the time when melatonin secretion starts. Melatonin is a hormone of the pineal gland, secreted when it becomes dark and is usually secreted about 2 and a half hours before bedtime. To determine this time point, the participants have to come into the lab in the evening and sit in a dark room. They could also do it at home with home sampling kits, but it would be less accurate. They have to give a little bit of saliva every half an hour for about six hours in a row. Then, you do an ELISA (Enzyme-Linked ImmunoSorbent Assay, a commonly used analytical biochemistry assay), and you determine when the melatonin levels start to rise. So, we compare our hair test against this gold standard. The deviation between this melatonin test and our hair test is between half an hour and one hour, which is approximately the noise or the melatonin test’s accuracy. Thus, we are probably as good as the melatonin test, but much simpler; you just take your hairs out in the morning, put it in the solution, and then send it to the lab.

How could chronobiologists contribute to better circadian clock synchrony for society?

We are lobbying a lot for schools. The beginning of school times should be later, especially for the older kids. It has been shown that chronotype is age-dependent. At the end of adolescence, between sixteen and approximately twenty-one, students have a really late chronotype, so school is starting way too early.

Could this also apply to the job market? Many jobs start in the early morning, which may interfere with a late-type person’s performance. I think most of the employers would not be aware of this circadian rhythm issue and maybe wouldn’t be too interested in it. Could this eventually change in order to adjust the work schedule according to the employee’s chronotype?

Some companies are indeed interested in the health of their employees. For instance, we have collaborated with one hospital in Bavaria, which did the chronotype test for many of their employees and tried to do a chronotype adapted personal work schedule. I believe it will change eventually, but it will not be easy. For schools, you could make it better for all of them by shifting it later. When you have groups and teams at work, though, it can’t be really personalized, but you can have a good average for everyone. In the first phase of the lockdown, we also did chrono-adapted shifts so that we could have some of the work still going on, which fortunately worked very well.

Another area where chronobiologists can try to impact society is the human-centric lighting issue - what is healthy light? We can also lobby for less light during the night, more light in the offices during the day, and having the right color at the right time. So, no blue light in the evening from your computers, a lot of blue light during the day when you work in your office and so on.

Now, especially with home-office, it’s hard to reduce the screen-time. I think everybody noticed during quarantine that it was harder to get to sleep, and our whole clock was disturbed. Exactly. The complex thing to understand is that light, including blue light, is good and bed, depending on the time. There are companies selling blue light shielding goggles, and this is not always good. It’s only good for certain times of the day. In the morning and during the day, blue light is good; it helps you be alert and have a good cognitive performance to keep your clock synchrony. When you have blue light at the wrong time, then it is especially harmful. It’s not so simple as saying blue light is bad, and we don’t need it.

How do you find the plan of abolishing the practice of day-
light saving time? Does it have a positive influence on our circadian rhythm? Do you think there should be a common European policy in choosing either winter- or summertime?

It is already agreed among the EU to abolish the daylight saving time switch twice a year and there is good scientific evidence why it is better. Then, the question is whether it should be „summertime“ or „wintertime“. This is the wrong question being asked in the first place. There was a poll, and people were asked whether they want permanent summertime or wintertime. Of course, people voted for summertime, because they associated it with warm weather, nice evenings and so on. The alternative equally accurate question to ask would be are you voting for our normal Middle European time, or are you voting for Eastern European Time? Then people would vote for the normal Middle European Time. However, summertime is Eastern European time. Studies showed that if your social clock is aligned to the sun clock, your midday is really when the sun is in the zenith, it is healthier. It has been shown that people who live in the Eastern part of a timezone are healthier than those living in the western part. Since Berlin is roughly at the center of our time zone right now, we strongly recommend that keeping the normal Middle European Time (wintertime) is the right time for keeping us healthy. However, we probably have to redefine the time zones in Europe again. There are papers out already from my colleagues, pointing to where the time zone should be. For example, it makes no sense to have Spain in the same time zone as Poland. They are so far apart, and you can never be right for both of them.

The general relativity of time perception (explained)

Take home message

Taking everything into account, whether you are an early bird or a night owl, make sure you adapt your life as much as possible to your chronotype. In this way, you’ll prevent yourself from living out of synchrony with your biological clock, which would eventually lead, among others to fatigue and the so-called social jet lag. Don’t forget to find the light (in this case literally!) - the right light during the day to keep you alert and no blue light in the night. And keep in mind: Synchrony is the best policy!

Zoi Chasapopoulou
M.Sc. Medical Neurosciences


If I could slow down time* Shaira Bibera @wholesomecomics
Time has been paradoxically viewed as concrete in terms of its measurability, and abstract in terms of its concept. We consider the time to tick once every second and believe that one hour is made of sixty minutes, but sometimes elevation to heights could convince us otherwise. Let’s find out how heights modify time.

**Einstein’s hardware and brain’s software**

In Neuroimaging studies on time perception, visual stimuli are presented to assess perception. Looming refers to the large refraction of an object, like a rising sun seen over a duration of time, and cues like e.g. discs having a circle on it, which gets either smaller (recedes), or bigger (looms) as the discs are presented, are called looming stimuli. An fMRI study on such looming stimuli revealed that time is perceived differently by participants presented with visual targets. The time perception is subjectively slower for looming stimuli than for static or receding stimuli [1]. This phenomenon is called subjective time-dilation. If we wanted to apply Einstein’s relativity theory to our perception of time, it’s the hardware of psychophysics streaming in our brains’ software. In other words, our subjective experience, or thoughts about an object or event are squeezed into a point of time when we focus on that object or event, hence, the time appears to pass faster within seconds. Einstein said in 1905 that the perception of a spherical object is deformed according to the position of the observers; that is, if they are at rest, they would perceive the object moving at a different speed. Whereas if the object is traveling closer to the speed of light, they would perceive it as moving slowly [2]. What an intriguing combination of physics and subjective perception is this!

**Time-perception at high altitudes**

Funnily enough, the height of „high” altitudes is a subjective term in itself. However, hypobaric hypoxia (a medical condition when blood oxygen levels are too low, giving rise to distortions in cognitive functioning) typically occurs at altitudes where the partial pressure of oxygen is significantly lower than at sea-level. We cannot yet ascertain if time-perception is distorted in the mountain heights due to the subjective time-dilation, or the cognitive dysfunction. Interestingly, Chronic Mountain Sickness which is usually observed above c.a. 2,500 metres, and is characterised by low level of oxygen in the blood is found to be less frequent/severe in folks living in Tibetan highlands. They have been surviving at an altitude with oxygen pressure less than 80 mmHg for ages, which is drastically lower than at sea level. The factors controlling oxygen sensing are noticeably different in highlanders and lowlanders [3]. A certain influence of the genetic make-up must be playing a role, as highlanders like monks, or Hindu religious ascets, in the Himalayas are even able to hold on to their breaths and thoughts in a stable manner at the high altitudes, somewhere beyond 4,000 metres, where we can merely breathe.

**Sneak-peak into a mountain climber’s experience**

In order to get a first-hand narration, we
asked a mountaineer, Amit Janorikar, from India about his experience at the Himalayas.

Mr Janorikar got trained from the Indian Nehru Institute of Mountaineering (NIM) and went on expeditions on different peaks in the Himalayas, like peak Bhagirathi II which has an elevation of more than 6,000 metres. When asked to recall his experience, in particular about his perception of time, he explained that during the climbing, time appeared to move faster; however, during descend, it moved slower. He reports that it also moved slower when the expedition team was halting in their tents as a storm passed by, or until the snow lifted its huge blanket from the surrounding landscape. He imagines this might happen because one focuses on that ongoing situation or event so much that the time only appears to move slower when there are no other distractions.

Despite knowing from similar impressions of other climbers, Mr Janorikar noticed that this experience is not shared by Sherpas, inhabitants of the most mountainous regions of eastern Tibet, who do not think the time is passing slowly while they climb down. Importantly, he distinguishes this experience from altitude sickness. He shared that when fellow climbers suffered from altitude sickness, their distortions were not just under- or over-estimating time, but much more extreme - in that they did not even know what date, or place, or time it was. He kindly consented to include the photos he clicked during two of his expeditions.

It was amusing and intriguing to listen to his excerpts from his expeditions. However, to get a hand on whether time is relative in great height, we either need a substantial and systematic sample size, or a solid methodology to delve deeper into the concepts of heights in order to generalize, don’t we?

From the past to the future
Although there are plenty of studies reporting distortions in cognitive function [4], hardly any seem to have investigated time-perception at high altitudes. Considering it would be a herculean task to carry a portable EEG on a mountain climber’s head, wouldn’t it be amazing as a future research idea, though?

Unless we gather and analyze some solid data, we may only speculate. It is a mysterious world over there on the top, where the definition of time and how we see it is questioned once again.

**Poorva Kulkarni**
M.A. Berlin School of Mind and Brain
Humboldt-Universität zu Berlin

In 2011, the Human Connectome Project started an ambitious attempt to construct a complete map of structural and functional neural connections in the human brain. Being awarded almost $40 million, the aim of the project consortium was to deepen our understanding of brain function and changes introduced by pathologies. The project also developed new neuroimaging methods and acquired a massive dataset available to all researchers [1,2]. Now in the next step, researchers are using the knowledge gathered in this project to investigate the stability and impact of time on the connectome.

Is connectivity static?
For many years, connectivity was treated as static over time [3]. For example, resting-state functional MRI aims to assess functional connectivity between different brain regions. If this is done for the whole brain, a functional connectome is generated. For this protocol, subjects are scanned for several minutes without performing a task. The resulting signal is then averaged to one connectivity value for each connection over the whole scanning time. However, recent studies [3] have shown variations in functional connectivity over time and even during the rather short scanning time. They thus claimed that averaging activity is insufficient to capture all information contained in the data. Instead, functional connectivity should be considered as dynamic with several distinct connectivity states.

The time-varying connectome
This idea is summarized by the term chronnectome. The term was first introduced by Calhoun and colleagues in 2014 [4] and combines the study of time dynamics (chrono) with the study of brain connections. Thus, the goal of chronnectomic research is to identify time-varying but reoccurring patterns of coupling among two or more brain regions. The investigated timeframe can range from years (slow changes) to milliseconds (fast changes); however, a focus is placed on changes within the range of seconds to minutes. Simply said, Calhoun proposes that functional brain networks change consistently, and these changes can be meaningfully related to behavior and cognition.

Applications of chronnectomic research
The promise of chronnectome analyses is clear: By more accurately capturing all information contained in the data, these analyses might be able to uncover new biomarkers for illness and potentially a finer scale for disease progression. For example, Damaraju and colleagues [5] illustrate this idea in patients with schizophrenia, where analyses using static functional connectivity have been mixed, reporting both hyper- and hypoconnectivity between identical brain regions. In their study, they performed both static and dynamic analyses of functional connectivity. For static connectivity, the signal was averaged over the whole time course, while dynamic connectivity was obtained by dividing the resting-state fMRI data in overlapping 44-second windows and identifying five reoccurring connectivity states in the data. Analysis of static connectivity showed stronger connectivity (hyperconnectivity) between thalamus and sensory states. For example, reduced connectivity between the putamen and sensory networks was only present in a state of high thalamic connectivity. This highlights the advantage of dynamic connectivity analyses to uncover finer differences between different study populations. In general, it has also been suggested that static connectivity follows anatomical connectivity [6], while dynamic connectivity might be crucial to study more subtle changes in processing, coordination, and integration of stimuli [7].

Limitations
The identification of time-varying connectivity states is crucial for chronnectome analyses [4]. Different statistical tools have been used for this purpose, including independent component analysis and graph theory metrics. Yet on a more fundamental level, the question of what qualifies a state needs to be answered. Can there be only one state present at one time or multiple states to varying degrees? Is there a sharp switch between two states or a slow transition? How different do states have to be to qualify as different? Many of these debates are still ongoing, and concerns have been raised, whether different states might solely represent artifacts, for example, due to subject motion [8,9].

Certainly, more research is needed to show the validity of chronnectomic approaches and their usefulness in clinical practice. Already now, it raised important questions on existing analysis practices in connectomic research, thereby advancing the field.

Melina Engelhardt
Ph.D. Student, AG Picht

[8] Langmann et al., Cereb Cortex, 2016
[9] Battaglia et al., Neuroimage, 2020
When do we start “Minding”?

Me and the other
When is the sense of self-present within the infants, and how to conceive it?

This sense is an active issue in developmental psychology and mind theories. ”False believe” tests have long reached some developmental psychologists to suppose that a child does not realize the existence of others’ minds different from their own until about the age of four. Thus, they cannot distinguish their own selves from others until that time. In the ”false belief” tests [1], young children are asked to predict what others will believe and, up to the age of four, they prove they are unable to attribute to the other any belief different than what they themselves know to be true [2].

However, do infants possess an ability to differentiate themselves perceptually as “embodied subjects” from other objects and people? Even if they can’t yet distinguish between “my” and others believe, they might be able to separate unreflectively between [2]:

a. “My”.
b. Others’ actions.
c. “My” embodied being and others.
d. Myself and that thing (any other object).

An innate self
Philosophers such as Dan Zahavi [3] argue that infants have an embodied, perceptual sense of themselves as a distinct self that precedes any recognition; thus, an infant can distinguish their body as an object from other objects. So Zahavi suggests that humans have an innate ability of perceptual sense of self that precedes their conceptual understanding of this self, which will come later through the interactions with their society.

Later, one becomes oneself
Other researchers, such as Maclaren [2], contradict this view and suggest an alternative understanding of selfhood. She indicates that selfhood is not a given entity but rather a result (one becomes oneself). This result comes through perceptual-motor interactions with others. After developing the motor capacities, children can follow others’ directives and determine them and their boundaries; they will not initially make perceptual sense without these capacities. Therefore, the sense of selfhood is more environmentally oriented. Through the interaction with the surroundings, even though the eyes are gaz- ing, children can develop their perceptual-motor capabilities and master it to retrieve a sense of self-possession [2].

Neuroscience research
Deen et al. [4] questioned: “How much of the human brain structure and mind is already defined at birth, and how much results from experience? To answer this question, they scanned awake infants with fMRI while viewing multiple categories of visual stimuli.

The primary purpose was to observe a part of the brain called the extrastriate visual cortex; a profoundly systematic functional organization exists in virtually every average adult, including regions favoring behaviourally significant stimulus categories, such as faces, bodies. Their results indicated that 4-to 6-month-old infants’ visual cortex contains areas that respond preferentially to abstract types (faces and scenes) similarly to adults. However, detailed patterns of activity over various visual categories differ between infants and adults. These results demonstrate that the large-scale structure of category preferences in the visual cortex is adult-like within some months after birth but is consequently improved through development [4].

This study offers a road to understanding the earliest beginnings of the mind, and it seems to provide, to some degree, evidence to Zahavi’s view of the inherited sense of self [3]. However, it still does not answer whether babies are born with this ability or not, or whether this ability is innate. In this regard, Deen et al. [4] indicated that the infant does not have specialized areas for different inputs such as faces or scenes, which need time to develop different faculties in the brain like the motor capacities as Maclaren [2] argued.

Uncertain world
Researchers are currently not quite sure whether we are born with an innate entity of the self or does it evolve later by the experience with the world. They are just starting to understand how babies’ brains are arranged. It will require more hours of collecting data from many babies to fully understand how and when the mind begins.

SHEREEN ABDELNABI  
M.Sc. Berlin School of Mind and Brain  
Humboldt-Universität zu Berlin

[3] Zahavi, D. Advances in consciousness research, 2004  
Humans have a fitful connection with the clock, and indeed the nature of time is rooted in our bodies. Our subjective sense of time is fundamental to our cognition and conceptions of reality. It forms the intellectual structure by which we comprehend the temporal course of events in our lives. Our ability to perceive the world around us and our very sense of self is based upon our looping perception of time, which connects memories of the past, present sensations, and anticipation about the future.

Yet, the way we perceive time is immensely debated! Time perception and experience are different amongst populations of older age group. Ever wondered why people report that “Christmas comes around earlier every year” or “time presents heavy in their hands” as they age, and that days seem to crawl in a way they never used to when they were younger? The burgeoning interest in time perception and how it might be altered in certain clinical populations would undoubtedly bolster our understanding of time-related disorders, providing a perspective on implementing therapeutic and external support to facilitate temporal dimensions of cognition amongst the elderly (see also our Interview with Prof. Kramer, chronobiology researcher at Charité on p 4). While impoverished time perceptual inputs can increase cognitive difficulty while performing tasks, effective cognitive strategies can compensate for impaired time perception. Furthermore, our ability to time intervals in milliseconds to minutes extending over hours to days relies on circadian timing and the integration of different neural systems. As our internal clock slows down with age and seems to wind down over the course of the day, it is imperative to acknowledge that time in the brain does not follow the steady ticking patterns of the world’s most precise clocks. Instead, when the brain is exposed to the exact same interval frequently neurons tend to get overstimulated and fire less, contributing to cognitive fatigue and altered sense of time. In order to explore whether neuronal fatigue causes skewed sense of time, let’s dive in to understand what the “fatigue effect” entails!

The time paradox

Time perception is an essential element of our awareness. One of the most perplexing issues about our subjective experience is that attention influences our perception of time [1]. This implies that less attention attributed to the time dimension leads the internal clock to run slower relative to the passage of physical time [1]. The process is often intuitive, reflected in the saying, “time flies when you’re having fun.”

This leads to the under-estimation and over-production of intervals in context to the physical passage of time. Additionally, studies exploring the connection between time and attention reveal that interval-timing performance is highly sensitive to attentional maneuvers such as divided attention and adherence to distractions [1]. However, the gradual depletion of striatal dopamine due to sustained cognitive engagement during acquisition of skills can lead to the fatigue effect, associated with skewed sense of time [1]. In populations of older age groups, due to the aforementioned phenomenon, a person with a slow internal clock or circadian timing might perceive a three-second stimulus as lasting five seconds and vice versa. In addition, the neural correlates underlying time perception, such as dopaminergic functions and cortico-striatal pathways, suggest age-related decline minimizes the involvement of attention and memory processes [1]. This impacts internal clock and time perception. Therefore, age differences in cognition and associated higher-order processes such as attention, memory, or decision making provide proximal explanations to a slower internal clock. The brain areas which have a role in mediating our sense of time, such as the caudate nucleus, supramarginal gyrus and the frontal lobe, have been associated with atrophy as a consequence of normal aging [1]. The shrinkage of neural networks serves as a mediator of less dopamine-related temporal processing affecting time perception [1]. As we grow older, our internal clock’s speed winds down throughout the course of the day and seems to take longer to recover than when we were younger. The accelerated depletion of dopamine function is what enables us to sense that the external world is moving faster, when, in fact, it may be our internal clock that is going slower! In conclusion, similar to memory, intelligence, and attention, our sense of time is multifaceted, and some timing tasks are more robust to the aging process than others.

Making sense of the world?
The disruption of temporal dynamics of neural activation and slowing down of processes involved in time perception due to age-associated decline in cognitive functions have become the major focus for a wide plethora of studies related to time perception in the elderly [2]. The perturbations of timing ability are observed in clinical populations of individuals with Parkinson’s disorder and associated neurological deficits. While several of these conditions exhibit deficits in sensory processing, as well as developmental and behavioral profiles, it is essential to keep in mind that there is no human condition that can be attributed solely to a disorder of time perception [2]. Therefore, it is interesting to see differences in time perception in pathophysiological conditions. For instance, Parkinson’s disease, which is characterized via depletion of substantia nigra, and reduction in dopamine-releasing neurons, contributes to basal ganglia dysfunction. Recent research analyzing peak interval timing in patients with

"... attention influences our perception of time ..."
the disease found that patients without levodopa medication, showed a slightly longer or relatively lengthening (also known as "slowing") of temporal processing [2]. This suggested that the effects of medication in Parkinson’s disease are secondary to the overall integrity of the basal ganglia canonical to timing in subtheshold and suprathreshold ranges of interval timing. In addition, a similar study performed to analyze the fading sense of time in patients with mild cognitive impairment reported a variety of temporalities: “Just the realization that we’re getting older … I savor the things that are all around us. I enjoy them. I enjoy seeing the sun come up and go down when I go to bed. And, I watch the moon a lot … I wish I could just slow things down” [3]. Although making sense of the external world poses its own challenges and ambiguity amongst the elderly, a considerably reliable body of research suggests that information-processing rates and memory decline can influence time perception to a large extent [3].

**Altered time perception in dementia**

Time distortion is one of the many challenging effects of dementia, including Alzheimer’s disease (AD) and frontotemporal dementia (FTD). The neural paradigm permits a rationale for understanding alterations of temporal awareness associated with neurodegenerative pathologies [4]. Recent research based on assessing the structural and neuroanatomical correlations of altered temporal processing in AD using voxel-based morphometry, suggested that patients with typical amnestic and language-based AD show significant disturbances in temporal interval estimation and event ordering [4]. On the contrary, FTD syndromes exhibit reduced temporal flexibility and clockwatching. Across the patient cohort, behaviors pertaining to time perception, including the tendency to re-live past events, were associated with the relatively preserved gray matter within the left-sided network, including the hippocampus, posterior cingulate gyrus [4]. Besides, patients might also encounter difficulty in staying connected with the present moment [4]. Therefore, activities that involve increased interaction with family and home care can surely make them feel connected even with a distorted sense of time. Additionally, even trivial activities such as looking and talking about old photographs or keeping the organization of the living space static can bolster the feelings of consistency and safety.

**Loss of time perception?**

The experience of how we perceive time is of fundamental importance to make sense of our external surroundings. While our ability to perceive the estimation of duration is largely influenced by cognitive and behavioral profiles, it might also be conjectured that this ability’s integrity is subjected to an individual’s internal timing of life events! In fact, in the elderly, these can be hindered by differentially shaped time functions due to cerebellum pathologies. One such disorder of time perception is Dyschronometria. The disorder is characterized by the inability to accurately monitor the passage of time and can make minutes seem like hours and vice versa. It is a co-morbid disease which occurs as an outcome of cerebellar lesions or cerebellar ataxia [5]. The pathological condition leads to short-term memory impairment and diminished spatial awareness [5]. Therefore, it is imperative to understand that if you step outside even for a short period of time, a person belonging to an older age group’s perception of how long you’ve taken is likely to be quite different from your own!

To sum things up, perturbations in time perception and time experience are presented by a number of neurological deficits. This further mediates changes in attention, memory, internal clock, and decision stages of temporal processing. And as the world’s population steadily grows and reaches older age, it is essential to utilize our temporal knowledge to bridge the gap between learning and conditioning to be able to distinguish between events.

**Sirjan Chhatwal**  
*M.Sc. Medical Neurosciences*

In biomedical research, experiments on animals are used to investigate basic physiological mechanisms, disease biology and drug efficacy. The aim is to model the human condition and infer insights into the human population. How we design those experiments and which animals we choose can have a direct impact on the results as well as the validity of those inferences. One important factor often overlooked is age; more specifically the age of research animals and the way it is reported in publications.

Inconsistent choice in animal age and inaccurate reporting of age information has the potential to impact data quality and increase variability. Inappropriate choice of animal age can decrease the validity and predictive value of preclinical research at the expense of animals, time, and money. It is therefore highly relevant to consider age consciously when planning experiments and report it with precision.

**Age is not just a side note**

Many physiological processes change significantly over the course of life. Throughout different developmental stages, biological systems undergo alterations in hormone homeostasis, metabolism and susceptibility to injury and disease [1-3]. These alterations have the potential to influence experimental outcomes of studies investigating for example basic disease biology. Age-related physiological changes can also contribute to altered pharmacokinetics and pharmacodynamics when assessing drug efficacy [2].

Therefore, age is a relevant factor in experimental design and should be carefully considered when choosing animals for research purposes. Choosing the appropriate animal age, however, is not as straightforward as one might think.

**The devil is in the detail**

The majority of mammals used in preclinical research are rodents, which have a much shorter life span than humans. Around 80% of studies registered in Medline and Embase are performed on mice and rats with an average life span of two to three years under laboratory conditions [4].

Several attempts have been made to translate the age of research animals into human age but the translation of age between species is not trivial [5-7]. The developmental pace between humans and animals differs and the conversion rate is nonlinear throughout life because it varies from developmental stage to developmental stage. An animal life cannot just be perceived as a „short human life“ [4].

Due to the shorter life span, age differences of several weeks may already affect experimental outcomes in rodents. Adequate choice of age regarding the research question at hand is therefore as important as being consistent in age choices. Not acting accordingly can increase data variability and potentially decrease relevance to the human condition studied. Furthermore, the ability of other researchers to evaluate and contextualize experimental results requires transparent and precise reporting of age information.

**It is all about resolution**

Unfortunately, this is rarely done. Age information is currently reported with extremely low resolution. Although a continuous variable, age is often categorized into groups representing broad developmental stages for expediency reasons. The most frequently used groups are 'adult', 'middle aged' and 'aged'.

When reporting and evaluating experimental results, researchers usually describe their animals as being, for example 'adult', often omitting more detailed information about their actual age. A 2014 study assessing age reporting in over 15,000 studies on mice was able to demonstrate that almost 40% of included papers did not report age [8].

Even if more accurate age information is reported, it is usually reported for experimental groups as a range, often in months, which has serious implications. First, given the short lifespan and the associated accelerated physiological changes in rodents, months are a very rough unit of measurement. Second, ranges don’t contain any distributional information. The lack of distributional information, either as mean and standard deviation or as individual animal data, decreases the information value of age data and further limits statistical analysis possibilities.

**Developmental stages – same same but different**

The conceptualization and reporting of age as developmental stages such as 'adult' instead of more detailed information becomes even more controversial when researchers don’t have a unified definition of them. A study by the National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs) revealed how problematic the use and reporting of just developmental stages is.

In a 2017 survey, researchers of various fields in biology were asked which animals they used, how old these animals were, and what reasons justified their choice of age [9]. The NC3Rs investigators were able to show that researchers do not use or define developmental categories unanimously. The most frequently used animals across research domains were 8-12 weeks old. However, the definition of ‘adult’ varied between 6-20 weeks for mice and 8-16 weeks for rats, indicating the lack of a consistent definition for this developmental stage.

Inconsistency in defining developmental stages became even more evident in a recent systematic review on the effect of age on stroke (unpublished data). The animals described as 'aged' differed considerably in age between studies, encompassing a range from 16 to 36 months.

The use of differently aged animals under the umbrella of one developmental stage can cause variability in experimental results. The omission of detailed age infor-
mation, however, prevents the evaluation of research results and may further prevent the replication of research findings due to insufficient information about this basic experimental parameter.

According to the guidelines from the International Committee of Medical Journal Editors, the methods section of a paper “should aim to be sufficiently detailed such that others with access to the data would be able to reproduce the results” [10]. Inaccurate reporting of age information impedes that and thereby hinders scientific discourse and advancement.

**Variability is not the enemy, ignorance is**

In the NC3Rs survey, researchers reported the use of a wide range of animal ages for experimental purposes (2-160 weeks). When multiple researchers investigated the same model paradigm, the use of animal age was compared across laboratories and varied from four to over 40 weeks (Figure 1).

Such differences can increase variability in experimental results. This is not to argue that we should only test model paradigms under highly standardized conditions. Robust experimental results in any given research field require some variability in experimental parameters [11]. However, variability in results can only be accounted for if all relevant parameters, including age, are transparently and accurately reported. Otherwise, evaluation and replication of results are obstructed.

When asked about the reasons behind their choice of animal age, researchers mainly answered with historical data comparability (24%), costs (15%) and availability/supply (18%). Unfortunately, none of the main reasons included relevance to the experimental model or the cellular age and development of the biological system under investigation.

It becomes clear that age and the consequences of age choices don’t get the attention they deserve. Researchers using animal models or evaluating research results based on animal models should start to consider age as an important experimental parameter, even if age is not the primary focus of the research question.

**Standardization of developmental stages is not the full story**

As the NC3Rs survey has shown, understanding and use of developmental stages are not standardized across or within research domains leaving the research community with an apparent need for defining them. One group at the National Institute of Aging (NIA) attempted a biomarker dependent identification of developmental stages in one of the most frequently used mouse strains in preclinical research [12]. Life phases were determined based on homogenous expression patterns of aging-related biomarkers and were matched to the respective life phases in humans. They declared animals of this strain ‘adult’ from 3-6 months, ‘middle aged’ from 10-14 months and ‘aged’ from 18-24 months.

Application of this definition, however, requires consideration regarding several aspects. First, it is unknown how well these definitions can be translated to other mouse strains, let alone other rodent species because they depend on life expectancies, which vary among strains and species. Second, even within the respective mouse strain, they might vary for different biological systems. Not all biological systems undergo age-related changes at the same pace. Third, a standardized definition of developmental stages might be useful to reduce unwanted variability in experimental findings, but it does not substitute the report of accurate age information. Nevertheless, it may be a good starting point for discussions about defining developmental stages.

**Too young, too old: too bad**

This life phase definition has additional implications for the use of animals for research purposes. Scientists at the NIA collaboratively advise against using animals younger than three months as ‘adult’ due to ongoing developmental processes. They considered these young adult animals rather “the biological equivalent of teenagers and college freshmen” [13]. This is particularly relevant because the NC3Rs survey demonstrated that researchers predominantly use animals between 8-12 weeks of age, which are hence too young. Although already sexually mature, rodents

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**Figure 1. Age ranges of rodents reported for specific model paradigms.** Ages used for all models clustered around the 8–12 weeks, regardless of the biology being studied. However, overall ranges varied from four to over 40 weeks between paradigms. Taken from Jackson et al., Lab Anim, 2017.
at that age are not yet fully developed. Mature animals and ongoing developmental processes may impact experimental results and cause unintended data variability. This may be more pronounced for some biological systems than others: for example, while significant brain growth continues until 9 weeks of age [14], maturation of the immune system continues until 26 weeks of age [15].

Researchers at the NIA advise as well against using animals older than 24 months because of the high incidence of confounding age-related diseases. When using aged animals, however, they consider it necessary to not only report age information but to conduct thorough necropsies to determine the presence of concurrent diseases that might affect experimental outcomes. Unfortunately, this is insufficiently done [16].

**Age should be a number (± standard deviation)**

It is important that researchers start communicating about how they understand and define developmental stages. This, however, does not lessen the need for detailed age information. A recent update of the ARRIVE (Animal Research: Reporting of In Vivo Experiments) guidelines reflects the importance of accurate age reporting. They recommend including age information as a summary statistic for each experimental group (e.g. mean and standard deviation) and, ideally, baseline values for individual animals [17].

In the era of online publications and repositories, publishing raw data and individual animal information should be possible for every researcher. This greater transparency would further enable researchers to evaluate the impact of age on experimental outcome using meta-analytical methods. Until now, this is extremely limited due to the imprecision in age reporting and because age is reported only on a group level, although it is an individual animal characteristic and should be analyzed as such [18].

Depending on the life phase and life expectancy of research animals, researchers should also consider the unit of age measurement. Experiments investigating early developmental processes should report age in hours or days, later stages may justify reporting in weeks. Months, however, are too wide a category for rodents with an average life span of two to three years.

**Age is not just a number but also a relevant construct**

With current demographic developments, the proportion of elderly is increasing in the human population worldwide [2]. Thus, modeling age-related diseases as well as using aged populations when assessing disease susceptibility and drug efficacy becomes more relevant than ever. Choosing inappropriately aged animals for experiments can decrease the construct validity (how well a model represents the human condition) as well as external validity (how generalizable experimental results are) of preclinical research. It is therefore important to use aged animals when designing experiments that are relevant to the elderly. Disregarding this, however, mainly young animals are used to model age-related diseases.

One of the main arguments for using younger animals in research is their reduced cost. Aged animals are more cost intensive than young ones and, unfortunately, the increase in cost is disproportionate to the age itself due to the need to adjust for attrition and disease [13]. Still, their physiology is closer to the elderly human physiology modeled.

Prospectively, the increased validity and thus higher predictive value of the model will decrease the number of animals required, the time to proceed in the translational pipeline and associated costs. Therefore, researchers as well as funding agencies need to consider the benefits of performing experiments on aged animals in grant applications.

**How should it be?**

Even if age is not central to the research question, it is a relevant parameter that should be considered carefully and reported accurately. Age information needs to be reported transparently with high resolution in respect to an animals’ life expectancy and the developmental stage of interest.

It should further be reported with distributional information, either as mean and standard deviation, but ideally as individual animal data. Reporting of life phase or developmental phase alone does not suffice, although it is necessary to consider them. It is recommended that researchers communicate with animal facility staff and veterinarians to make informed decisions about their age choices.

Using animals at an age that doesn’t model the human population of interest limits both the validity and predictive value of research findings. This needs to be considered by researchers and funding agencies when justifying and evaluating grant applications involving animals. Representation of the elderly in animal experiments is relevant due to the increasing proportion of elderly people in the human population. This does not only affect the investigation of age-related diseases but also the consideration of aged populations when assessing drug efficacy in general.

Without accurate reporting of animal age, the research community is hindered in contextualizing, evaluating and replicating research findings, which are core processes when striving for scientific progress. Without appropriate use of aged animals, research findings may lack construct and external validity, which are core competencies when striving for scientific progress.

Ultimately, replicable experiments with higher construct validity and thus higher predictive value for clinical research will cost fewer animals on both preclinical and clinical side, less time, and less money. Isn’t that what we want?
The Future: A Brave New Cyborg World?

Elon Musk is envisioning all mankind equipped with Neuralink, a brain-machine interface (BMI) not only meant to make paralyzed people walk again but also to enable you and me to store our memories in a cloud or to communicate via telepathy [1]. Miguel A. L. Nicolelis believes that the human species will influence its own evolution with technology [2]. Hugh Herr expects humans to soon be able to enhance their bodies with mechanical wings [3]. How close is a future in which everyone (who wants) can enhance their bodies and brains by technology?

Controlling the creation of art with your mind

One of the great visions advertised during the latest Neuralink live demonstration [1] was translating ideas into art. Usually, you are restricted to your manual artistic capabilities for visualizing the fantastic creativity you might have in your mind. With a BMI like Neuralink, you could directly transfer your imagination into a computer, which would then visualize your ideas. Already in 2013, the large-scale public experiment “My Virtual Dream” gave a glimpse of how exciting this could be: During one single night, around 500 participants would draw a picture on a dome-like canvas with their brain activity while connected via electroencephalography (EEG) to the brain simulation core of “The Virtual Brain” (TVB) [4,5]. Among other various locations, the event was also repeated in Berlin during the 'Long Night of Science’ in 2016, 2017, 2018, and 2019 [6], combining entertainment, science communication, and large-scale data acquisition.

The "Walk Again Project"

“We probably are becoming the first species that is capable of influencing its own evolution by what it produces: Our technology. Because we are creating completely new constraints on how humans socialize, communicate, mate… So, we are actually creating a new pathway, without even knowing.” (Miguel A.L. Nicolelis, MD, Ph.D. [2])

Katharina Heine
M.Sc. Berlin School of Mind and Brain
Humboldt-Universität zu Berlin

From rehabilitation to self-enhancement

[12] Flurkey et al., The Mouse in Biomedical Research, 2007
[16] Snyder et al., Vet Pathol, 2016

Photo: David Pisarski

© 2015 Kovacevic et al., „My Virtual Dream”: Based on the collective neurofeedback of 20 participants at the same time, artistic video animations were projected on the "immersive art environment," a 360° surface of a semi-transparent dome [5].
Miguel A.L. Nicolelis, MD, Ph.D., director of the Duke University Center for Neuroengineering, is the principal investigator of the "Walk Again Project" (WAP). In 2014, this non-profit international research consortium enabled a paraplegic Brazilian man to perform the 2014 World Cup opening kickoff with the help of an exoskeleton controlled by a brain-machine interface [7].

In 2016, Nicolelis and his colleagues published a clinical study in which they evaluated the impact of the continued brain-machine interface interactive training on eight paraplegics. They found that patients regained the ability to feel touch, to localize pain, and even to voluntarily move muscles in their paralyzed legs despite the former diagnosis of a complete spinal cord injury. Even body functions not directly linked to limb mobility were regained [8]. These findings provide hope for people suffering from spinal cord injury who are otherwise facing a life bound to a wheelchair.

Are we soon all becoming cyborgs?

In his TED talk, Hugh Herr describes the relationship with his artificial legs like this: “Today, I can’t feel my legs. And because of that, my legs are separate tools from my mind and my body. They are not part of me.” He goes on with, “I believe that if I were a cyborg if I could feel my legs, they would become part of me, part of self.” [3]

Hugh Herr is an associate professor of Media Arts and Sciences at MIT and leads the Biomechatronics group [9]. Here, he and his colleagues are developing NeuroEmbodied Design [10], which in a sense might be a foundation for the rise of human augmentation. Not only is he working in the field of bionics, but he also knows by experience what he is talking about: Due to a climbing accident in 1982, he lost both of his legs and describes himself as a bionic man but not (yet) a cyborg [3]. His prostheses function like real legs – but they lack sensational feedback [3].

To enable future amputees to sense and feel their artificial legs’ movement and position, he and his colleagues invented AMI, the agonist-antagonist myoneural interface surgical procedure [10]. With their approach, agonist and antagonist residual muscle tissues are connected, facilitating neuronal feedback, in contrast to the widely used civil-war way of amputating limbs [3]. What is especially striking: Due to the proprioceptive feedback signals sent to his nervous system, a first patient seemingly easily knew how to control his prosthetic foot in a natural way and soon developed a neurological embodiment (the sentiment that the artificial device has become part of his body) [3,10].

Ever dreamed of flying?

But Hugh Herr’s vision doesn’t stop here. He predicts the (near) future, humans to be able to extend their bodies with exoskeletal features that can be mind-controlled and turn us into real-life superheroes. However, even though nowadays’ exoskeletons already provide promising assistance in clinical rehabilitation and can improve movement economy [11], flying Iron Man-like humans are most likely still rather science fiction than reality (for now).

Do I really want to transfer my thoughts directly into the worldwide-web?

Elon Musk has the vision to enhance human cognition and brain communication with a brain-machine-interface called Neuralink [1]. He wants to "solve important brain and spine problems with a seamlessly implanted device" [1]. An aim not so divergent from the research described earlier if it would stop here. But the vision goes way beyond: In the future, the device is set out to be able to connect to the internet and social media, store thoughts and memories in a cloud and transfer them into another (non/semi-human) body, preparing humankind to keep up with advances in artificial intelligence [1,12].

But, what is the current status of Neuralink’s technology?

In a study in 2018 by researchers from Stanford, Brown, and Harvard University, three tetraplegic patients were able to control a tablet computer through a brain-computer interface [13]. Micro-electrode arrays were placed in the cortical area of the dominant hand representation [13]. The recorded neuronal signals were processed and decoded on a separate computer and then ‘translated’ via Bluetooth into the tablet to control a virtual mouse [13]. Neuralink is meant to radically improve such currently available techniques [1]. Over the past year, the developers simplified the link’s architecture, from containing multiple parts to being a coin-sized (23 mm x 8 mm) one-part device [1]. One single LINK V0.9 contains 1024 read and write channels, a 6-axis IMU, a megabit wireless data rate, and an all-day lasting battery that can be inductively charged [1]. The high-precision surgery needed for human application can only be achieved by an advanced robot (which still needs to be developed) and will prevent bleeding or neuronal damage. When the obstacle of a fully automated surgery is solved, the whole procedure will take less than an hour, and you could leave the hospital with your LINK V0.9 on the same day [1].

Three little pigs

A task that the prototype robot is already capable of performing today is inserting the micro-scale threads of the link into a brain [1,14]. Three pigs were presented live during the progress update on August...
Comment from a Berlin expert

Prof. Dr. Petra Ritter, director of the Brain Simulation Section at Charité Universitätsmedizin Berlin [16], co-founder of “The Virtual Brain” platform and organiser of Berlin’s version of “My Virtual Dream”, talked to me and gave her perspectives on how “The Virtual Brain” can add to recent BMI developments as well as which hurdles are still to be overcome:

“The Virtual Brain platform aims to provide personalised brain simulation, reconstructed from brain imaging data. Since the brain is a very complex system, these models are rather abstract and whole-brain regions are summarized. The platform can perform mathematic modelling of interactions between cortical and subcortical regions and answer questions about person-specific structural connectivity.

A practical application is to reconstruct and simulate the propagation pathways of disease-related activity as well as this activity’s origin. With the help of large-scale simulations, surgical interventions for patients suffering from drug-resistant epilepsy might be planned more precisely resulting in better outcomes. This is presently tested in a French study with 400 patients.

Brain-computer interfaces in the form of an implanted chip with a high number of channels can collect information in a higher resolution. These chips might become powerful tools for amputees to improve the control over their prosthetics or for circumventing the neuronal damage of paralyzed patients.

Still, several essential questions remain open which are of ethical, biological and technological nature: How will the brain react to these implants in the long term? What technologies can provide the computational resources required for complex computations of high bandwidth data in real-time? How are the read-out data being protected? How does society address the need for novel rules, regulations and moral conventions arising from these developments?

Towards human clinical studies

Neuralink received FDA (US Food and Drug Administration) Breakthrough Device designation in July, and while waiting for approval, the team is preparing for the first human trials with patients suffering from severe spinal cord injuries [13]. The aims are comparable to those of the 2018 tablet computer study [13], but with a seamlessly implanted and more powerful device that will hopefully improve many patients’ lives.

When I first heard of Elon Musk’s Neuralink vision, I thought that, at least from a neuroscience perspective, we’re far away from that. But exemplary research projects like the “NeuroEmbodied Design,” the “Walk Again Project,” “My Virtual Dream,” and collaborative, open-source efforts like “The Virtual Brain” platform show that many of the Neuralink ideas are not so far-fetched. Although not all science fiction is about to become true right now, Hugh Herr might be right when envisioning our near future as “a world in which what is biological and what is not, what is human and what is not, what is nature and what is not, will be forever blurred.” [10].

LARISSA BREUER
PH.D. STUDENT, AG DEAN

The 2020 Nobel Prize in Chemistry was awarded to Emmanuelle Charpentier, director of the Max Planck Unit for the Science of Pathogens in Berlin, and Jennifer Doudna, professor at University of California (UC), Berkeley. This marks the first all-female Nobel Prize winning team in history and recognizes “one of gene technology’s sharpest tools,” CRISPR-Cas9 [1]. In addition to being pioneers and role models for female scientists everywhere, Charpentier and Doudna are responsible for the optimization of CRISPR-Cas9 as a gene-editing tool. The discovery of these “genetic scissors” have since revolutionized scientific approaches in basic science, crop science and medical treatments by giving scientists unprecedented and precise access to the genome. However, this tool also has applications in dangerous and controversial human genome editing.

**What is the CRISPR-Cas9 system?**

The CRISPR-Cas9 system is a mechanism found in bacteria that acts as a kind of adaptive immune response by creating genetic “scissors” that recognize viral DNA from past infections and destroy it. The name ‘CRISPR’ comes from the clustered regularly interspaced short palindromic repeats, which refers to the once-mysterious repetitive sequence found in bacterial and archaeal DNA. When the bacteria are exposed to a new virus, a piece of viral DNA is inserted between these repeats for reference in future infections. The second part of the name refers to a CRISPR-associated protein: Cas9, which actually cleaves the DNA. The final part of these molecular scissors is an RNA duplex of CRISPR RNA and trans-activating CRISPR RNA, or tracrRNA, that attracts Cas9 to the guide RNA, which the complex uses to recognize invading viruses [2].

**Journey to the Nobel Prize**

While many scientists contributed to the discovery of the function and utility of the CRISPR-Cas9 system, it was Charpentier and Doudna that ultimately optimized the system as a tool for precise genome editing. Scientists already hypothesized that CRISPR may be a form of adaptive immunity in the early 2000s but they were unable to demonstrate DNA cleavage in vitro. It wasn’t until 2011 that Charpentier discovered the final missing piece, tracrRNA [3].

Charpentier’s speciality is pathogenic bacteria like Streptococcus pyogenes, in which she discovered the tracrRNA. In order to investigate the biochemical and molecular machinery of the CRISPR system, she needed partner with expertise in biochemistry. By this time, Jennifer Doudna had already been studying CRISPR-associated, or Cas proteins for several years. By chance, Doudna attended a conference in Puerto Rico, in which Charpentier was presenting her findings. Charpentier describes their resulting collaboration as “short and intense,” but also “precise and deep” [4]. Together, Emmanuelle Charpentier and Jennifer Doudna bioengineered an elegant, simplified version of the genetic scissors. They had shown for the first time that the tracrRNA and crRNA could bind together to direct Cas9 to viral genetic sequences. Furthermore, they suc-
cessfully engineered a single RNA chimera that would guide Cas9 to a sequence-specific location in dsDNA. In order words, Charpentier and Doudna were one of the first researchers to use the CRISPR-Cas9 system to cleave dsDNA in highly specific locations of their choice [5]. The 2012 publication in Science marked the beginning gene targeting and genome editing with unprecedented precision.

**The revolutionary applications of CRISPR-Cas9, for better or worse**

Charpentier and Doudna’s discovery gave scientists unrivalled control over genomes, which they would use to create drought-resistant, pest-resistant fruits and vegetables, modify cell or mouse strains for lab research, and maybe one day to treat genetic disorders and diseases in humans [2]. However, this tool also confers the potential for germ-line editing: the possibility to make permanent changes in humans that would be passed to their offspring. Germline editing raises a host of questions: to what degree of confidence can scientists know or predict the effects of their germline edits? Which changes can scientists make ethically? What makes a given edit medically necessary? In the face of these looming questions, Doudna and colleagues called an “effective moratorium on human germline editing” in 2015 until more discussion and research could be undertaken [6].

In the fall of 2018, the world was suddenly plunged into a sci-fi novel when Chinese scientist He Jiankui announced the birth of the world’s first genetically modified human babies [7]. Twins Lulu and Nana were born to an HIV-discordant couple (in which the father is HIV-positive and the woman is HIV-negative). Using the CRISPR-Cas9 system in both embryos, He attempted to disable the gene CCR5, which codes for a protein on the surface of immune cells. This protein is used by the HIV virus to gain entry to and infect human cells. Without expressing the CCR5 gene, He hypothesized that the babies would be immune to HIV infection [7].

The current consensus in the field is that germline editing should be used only in serious, medically necessary circumstances, which does not seem to apply to this circumstance. Any danger to the newborns or the mother (who was not protected by a CCR5 mutation in this circumstance) can be mitigated by any number of strategies recommended by the CDC for HIV-discordant couples [8]. Beyond being medically unnecessary, it is possible that He’s work may have harmed the twin girls. In 2019, a study by Rasmus Nielsen at UC Berkeley analyzed over 400,000 human genomes and corresponding death registers and concluded that the mutation of the CCR5 gene may actually increase susceptibility to other viruses such as West Nile and influenza viruses [9,10].

In an editorial in Science, Doudna observed that “although human embryo editing is relatively easy to achieve, it is difficult to do well and with responsibility for lifelong health outcomes [...] The ‘CRISPR babies’ saga should motivate active discussion and debate about human germline editing” [11].

**The 2020 Nobel Prize in Chemistry: Revolutionary for more reasons than one**
While CRISPR becomes a household—or lab bench—name, its notoriety is not the only reason this year’s Nobel Prize in Chemistry is to be celebrated. Between 1901 and 2020, there have been 337 Nobel Prizes awarded to 624 Nobel laureates in Physics, Chemistry, and Physiology or Medicine (hereafter referred to as the STEM fields). Only 22 of these laureates, or 3.5% of all laureates, were women. Nearly half of female laureates were recognized within the last two decades, which still represents only 7.5% of laureates since 2000.

While Emmanuelle Charpentier and Jennifer Doudna are not the first women to be awarded a Nobel Prize in chemistry, they are, however, two of only four women to win the Nobel Prize in Chemistry since 2000; and the first all-female team to be awarded a Nobel Prize. Of 76 Nobel Prizes awarded from 2000 to 2020 in the STEM fields, only 21, or 13%, were awarded to a team including a female laureate. Of those 21 prizes, only one was awarded to a team without a male collaborator—to Emmanuelle Charpentier and Jennifer Doudna.

**Why don’t more women win the Nobel Prize?**

Although more women are entering STEM than ever before, the gender discrepancy even within the last 20 years is shocking. Even in the last two years (2019 and 2020), only 3 of 17 Nobel Laureates in the STEM disciplines were women. Why is this gap persisting so strongly?

BBC journalist Mary K Feeney cites studies that demonstrate how “early exposure to STEM, educational policy, cultural context, stereotypes, and a lack of exposure to role models” cause women to avoid entering STEM fields [12]. But that’s not all. Women face a variety of invisible barriers that hinder their progress in these fields, making it difficult to reach the notoriety necessary to be nominated for a Nobel prize. The disproportionate burden of childcare and other family-related obligations weigh more heavily on women, reducing the amount of time they can devote to bench science and hindering their progress on the track to tenure [12]. Female applicants for positions in academia are more likely to be judged on physical appearance and other personal information, and their letters of recommendation are more likely to raise doubts and less likely to use strong words of praise. Women cite themselves less than men do and as a result, they are less likely to build visibility in the field. Even after becoming experts in their fields, women are less likely to be invited as keynote speakers.

Even Doudna and Charpentier seem to have complicated relationships with their identities as scientists and as women. Charpentier puts her identity as a scientist first in her Nobel interview: “First, I’m a scientist,” she says, and “independent of the gender, [...] I think it’s most likely a very positive message for the girls and the young women who wish to start in science, continue in science, and to really provide a clear message that it is possible to achieve ultimate recognition, even if you are female” [4]. Doudna acknowledges a similar reluctance to discussing her gender first. “Earlier in my career, I was very, very keenly interested in not being seen as a ‘female scientist’” Doudna stated in an interview with National Geographic [13]. Over the course of her career, however, she has come to recognize the struggles that female scientists face and brings this advice: “Walk into a room like you own the place. A man would do that without compunction” [13].

**Lessons to be learned**

The 2020 Nobel Prize in Chemistry presents much to be considered. It asks us to consider the intersection between our identity as scientists and our gender, racial, and cultural identities. It reminds us that the gender disparity at the forefront of academia and research remains significant and asks us to consider what kinds of gaps still persist. It begs the question: how do ethics play into science, and how could the results of our work be used in the future? Who is responsible for how discoveries are used? These are questions that we must be aware of at all levels of scientific advancement and present challenges that we must constantly be discussing, starting with you.
Academia is becoming increasingly aware of the fact that only a minority of doctoral candidates will succeed in pursuing an academic career. The rest of us therefore need to face the question of what else to do with our lives and how to make a living out of it. This series aims to direct your attention to all the useful skills you have, seemingly trivial, that were acquired as prerequisites to perform your research, but which are incredibly precious outside the lab!

Probably not a freshly started Ph.D. student, but most who are some time into their Ph.D. at some point wonder what they are doing. Have you ever asked yourself why you started your Ph.D., how it’s going and why you pursue it despite the stress, hurdles, poor payment and insecure perspectives? You might recall your enthusiasm to dive deep into a particular question or remember the want to do your part in understanding and fighting a disease. Maybe it’s the idea that holding a Ph.D. helps to secure better jobs and wages. Maybe you’ve reached a point where you simply want to finish it in order to move on to something else. Quite some different points of view, right? All of these reasons (and the many more that there are) are legitimate. The crucial point is that you do have a motivation that drives your actions. In that, motivation is slightly different from interest. Something can interest (or stimulate) you enough for you to enjoy it, but it takes more than that to actually make you DO something. Admittedly, you might have trouble thinking of peers who have no internal motivation for anything, but that’s grad school! This is where people gather, who are highly motivated (in whichever way) and have the stamina to keep following their path! And it’s a really good thing!

But, - you might wonder - sometimes you simply don’t wanna. Haven’t you ever felt super lazy and not doing a single thing despite your knowledge of what needs to be done to get you where you want? The good news might be: this (slight) feeling of guilt might mean that you are, in fact, motivated to do those things and are currently just lacking some energy to do so. We are in no way advocating to burn yourself! Get some rest and recharge your willpower, whenever you need to, because the motivation that you have is precious! And your ability to identify and foster your motivation is what enables you to do your best. Something any employer worthy of that motivation will cherish!

It might be a bit of a stretch to view it in that way and we are happy to hear your thoughts at cns-newsletter@charite.de!
You cannot stop yourself from spending your whole day gaming or binge-watching the latest season of your favorite show? Your procrastination has turned into a problem for you? Then the following tips and tricks might help you to pimp up your productivity!

Who hasn’t been there?
There is a proposal you have to write, a presentation you need to put together, or this talk, that you really, really should be preparing for. But... right now? No. You don’t really feel like it. And for this very important task, you want to commit 120% of your attention. You need the right amount of time, the right state of mind – essentially, it must be the perfect day. But today? No. Today is not this perfect day. Today, you feel this urge to vacuum the whole apartment, re-sort the socks in your drawer by color, or go outside to take a walk in the park. Or to write this article.

“Gamify your productivity”...
... was the title of Pascal Heymann’s online workshop during this year’s Bernstein Conference Ph.D. Symposium. Pascal Heymann is a speaker, author, presentation trainer, and the creator of “Berlin Speaking” [1]. He coaches people in how to improve their pitching, storytelling, confidence and keynotes [1]. But before turning his passion for public speaking into a job, he worked in computer game development and testing while studying physics at the University of Aberdeen. In his workshop, he shared his insights about self-motivation through gamification with the Bernstein Ph.D. community. And who would need a toolset for self-motivation more than Ph.D. students? That was probably what the symposium organisers had in mind when deciding on this topic (by the way, nice choice!).

The four-step plan to increase your productivity
• Observe yourself and your own behaviour
• Identify your motivators (“gamification factors”), what gets you going the most?
• Find tools to apply these motivators into your work-life
• Do!
If it doesn’t work: Repeat!
And I did it again.
Good! You have caught yourself wasting your time. Now ask yourself: “Why have I spent the last hour on Instagram or Twitter?” Write it down! A second question: “What is it that I am not doing right now and why am I not doing it?” Think about other activities that you let eat up your time. Observe yourself and your behaviour objectively, and be honest with yourself. What is most important, and also the take-home message of the workshop: Identify your traps, find out your motivators, and discover which tools are your tools.

It takes strength to resist the dark side
During his workshop, Pascal introduced the Octalysis Framework of Gamification, developed by Yu-kai Chu [2], and added examples on how to translate the core drives in gaming into real-life situations. He explained that there are eight forces motivating us to stay engaged, three “dark forces” and five positive forces.
ones. One of the dark forces, avoidance, is the main motivator for procrastination itself, while scarcity and unpredictability are, amongst others, known for driving gambling addiction [2]. Though as researchers, we depend on our curiosity, these negative motivators might not be the best foundation to boost our productivity. But to be aware of them, might help identify the traps that can lead you down the line of procrastination again. So, ask yourself: Why do you want to avoid a certain task? Is it because you are afraid of failing or making a mistake. Is the size of the project overwhelming? Or maybe it is because you simply don’t like the task and subconsciously think that it isn’t worth your time or effort.

Now, what are our positive motivators?

(1) Social influence: Did they see me (not) working?
Get yourself a mentor or an accountability buddy, so you are not the only person to whom justify your work progress (or the lack of it). Or try out co-working! Not wanting to be the only person sleeping or gaming in the public library can be a good motivator. And maybe already seeing other people busy at work can give you just the push that you needed.

(2) ‘To Do’ lists: Create accomplishments!
Check, another task done! With ‘to do’ lists you can visualize what lies in front of you and also what you have already put behind you. You can even push it to the next level by applying a point system to each task and thereby visualising the impact of your work and make an actual game out of it.

(3) That feeling of creation: Ownership
The wish to avoid what is ahead can be huge, be it out of fear of failure or that you simply don’t like the task and think it is not really worth it. However, the feeling of having accomplished or created something in the process can be a rewarding perspective nonetheless.

(4) Don’t lose track of the meaning of it all: Your long-term goal
That is the light at the end of the tunnel: A successful career, publishing in a big journal, or finishing up your Ph.D. This is what keeps you going in the long run.

(5) Empowerment or unlocking new abilities
Some points of your ‘to do’ list might not directly bring you closer to your long-term goal. But they can be a necessary requirement to advance, like learning a programming language, getting deeper into statistics or learning a new experimental technique. Instead of seeing these tasks as yet another hurdle in your way, a change in perspective might turn them into an opportunity to grow your expertise.

It’s your choice how you perceive and use your time
I asked Pascal how his perception of time changed before and after applying gamification to his life. He said, “I am more conscious of my time now. I used to see time only as hours of the day. You have a deadline, it is millions of moments away and suddenly there is no time left. Now, I mindfully look at how I use my time. If I have a day where I do nothing, I actively decide to do nothing. For example, before opening Facebook, I ask myself ‘What is my goal here?’ If the answer is ‘I am looking for distraction because I want to avoid doing something else’ I don’t open Facebook. If the answer is ‘My mind needs a break’, I do it.”

So now it is up to you to find your way of motivating yourself to use your time effectively. And sometimes the decision to spend your time in an ‘unproductive’ way can be the right thing to do.

LARISSA BREUER
Ph.D. student, AG Dean

“Gamification is the craft of deriving all the fun and engaging elements found in games and applying them to real-world or productive activities.” Yu-kai Chu

[1] https://berlinspeaking.com/

Helpful tools to stay productive, submitted by the participants of the Bernstein Ph.D. Symposium 2020.
Word cloud form adapted from https://bit.ly/freeSVG
CAREER

These mixed results kind of begs the question: how is it possible for graduate students to be at the same time broadly satisfied and yet increasingly... unwell [6]?

A couple of years later... (Oh well...)

A survey of over 6,000 Ph.D. candidates published by Harvard University in 2017 [1] sounded the first alarm on a situation now widely discussed in academia. Doctoral candidates are six times more prone to undergo a mental illness-related episode than the general population [2,3]. Burnout syndrome, depression, anxiety, and stress-related symptoms are the most common. In the UK, a survey of 140 universities with more than 21,000 Ph.D. candidates has shown a similar result: one in five students has a current mental health diagnosis [4]. Albeit Ph.D. students from different parts of the globe report being quite satisfied with their decision and research programs, it is also shown they are at a higher risk of developing mental illnesses [2-4]. In Germany, it is not different. A survey conducted by the Max Plank Institute revealed that 53% of the participants reported at least one of the following: depression, burnout, eating disorder, chronic fatigue, sleeplessness, and migraines [4,5].

Yet, the number of Ph.D. candidates opting for an academic career increases by the year, as new programs are being created. And, by all means, if you are a first-year, do celebrate! But then, brace yourself for the tough challenges ahead. These mixed results kind of begs the question: how is it possible for graduate students to be at the same time broadly satisfied and yet increasingly... unwell [6]?

In the long run

A group of Ph.D.’s from the neuroscience community at Charité-Universitätsmedizin Berlin and Humboldt Universität zu Berlin asked themselves the same question. Then they joint efforts and put their minds together to bring to life Scholar Minds. It is an initiative created to think about (and around) academia - with all of its perks and painful endowments. And, more importantly, this project aims at learning how to navigate them. “A Ph.D. is a marathon, not a sprint”, says one of the members. Is it possible, after all, to find a good-enough life-work balance within it? Well, looking at the numbers on mental illness in academia [7], it is a task much easier said than done, one for which help seems to be much appreciated. So far, as they are reaching out to other Ph.D. and master fellows, the debates and workshops have been directed to the neuroscientific community - but not necessarily.

Scholar Minds approaches and techniques: the Toolkit 101

Scholar Minds has developed a Ph.D. toolkit aiming to promote connection and in-depth debate, which focuses on destigmatization and mental health: Do not dismiss your stress. Different people face unique challenges on their paths to specialization. However, people do not need to stand alone against their struggles. The toolkit comes to life in the form of a workshop comprising four online-sessions, lasting approximately 90 minutes, with pauses and breakout rooms (via zoom). The sessions are divided into four weekly meetings. Every session focuses on unpacking techniques and strategies around one of four different topics and a guest speaker. For the first workshop round, the psychiatrist and neuroscientist Dr. Simon Guedelmann, who is a specialist in emotion regulation, presented his current research on mindfulness.

What the weekly meetings are all about:

1 - Strength: Identify your resources and support network - know your strengths and build upon them.

2 - Mind: Get to know mindfulness techniques and gather your focus. Learn how to be mindful of your emotions and manage intrusive thoughts and feelings.

3 - Habits: No one was born knowing how to have good working habits. Rather, it is a process to be learned. The output is being more mindful about time and productivity.

4 - Positivity: a positive mindset can be nourished. Learn strategies that may orient your mindset towards growth by identifying your stressors.

In time: The Toolkit has been adapted and extended to master students: “Scholar toolkit 101”. Upcoming meetings in December 2020 and January 2021.

Mind the gap, and don’t fall for the trap

Efforts such as Scholar Minds come into play to give academics an option. Sometimes things turn difficult, but who to talk to? Or, more importantly, why get to the point of burnout or developing a major crisis if it can be prevented? Academia does have its ways, and it does change and improve. But it takes time. Meanwhile, we all have to cope.

Gap (a) – an ode to failure

Increasingly, career success in academia is defined by a complex spectrum of measurements that include publications, citations, funding, contributions to conferences. And, more recently, the positive impact it brings on people, the economy,
Your success will be measured by how many acceptance letters you receive. Right? If so, be aware. Failure is coming for you. Everyone gets the “We regret to inform you...” email, no exceptions. The paper was rejected, that grant was reviewed (again) or the stipend not renewed. It is not as trivial as it sounds to confront the painstakingly hidden way to success. It has been called the “Shadow CV” [10] and let’s be honest: it sucks. The truth is that receiving the feared “no” also remains somewhat of a taboo [10]. Because having your paper rejected or massively reviewed feels very personal. However, as much as we only see the successful side of the published paper or the grant approval, remember, the rejected one is also only one version of your work. That can - and sometimes may need - to improve in one way or another.

**Gap (a) – unmute your mental health**

Mental health issues are not uncommon. Many successful scientists who now are professors and P.I.’s have reported episodes of depression, anxiety, and stress-related syndrome during their careers. However, there isn’t, until today, an established culture that encourages or even welcomes this conversation within academia. But it may be changing as more awareness has been brought towards the so-called „Mental Health Crisis“ [13] among graduate students. More academics have been opening up about it in what seems to be a refreshing change, towards a better life-work balance. (If you are interested, you may check the collection that Nature Magazine keeps on the debate [13]). On the other hand, we can all understand that people may not want to volunteer this type of personal information. However, much can be done. A better question may be: how can you find help among your structure? For more helpful information about mental health, check https://bit.ly/ScholarMinds

**Gap (b) – the stigma of time**

So pace yourself: Early-career jobs tend to be precarious, generally speaking. But in academia, it feels this stage lasts longer than it should. To progress, a researcher needs to reach a certain threshold in the measures listed above [8-10]. On top of that, the continuous learning process to get that grant, the position, the publication. Meanwhile, you may feel you are still in „school“ while that younger cousin is already checking the boxes for buying a house and expecting the second baby. Breathe and remember, a Ph.D. is a journey and it comes with some perks too. Even if one does not stay in academia and fight for that tenure position, a mean salary of a Ph.D. graduate is above the average of non-graduates in the industry [11]. Nonetheless, it does open doors, according to Isaya Hankey in his column in Nature Magazine in 2019 [12]. In the long run, it may prove to be beneficial.

**Food for thought**

All in all, academia isn’t perfect. It enables people to pursue their interests, meet interesting and brilliant people who are working on cutting-edge topics. In contrast, is permeated by a somewhat outdated attitude that highlights the brilliance and glosses over the struggles that come with a win. But the good news is that for those willing to join this conversation, initiatives such as Scholar Minds arise. They don’t have all the answers - or any, as a matter of fact. But they are a start by which people may shape a better environment - also in academia.

**How to find them**

- Email: scholar-minds@charite.de
- Twitter: BerlinMinds
- Facebook: Scholar Minds Berlin
- Website: https://bit.ly/ScholarMinds

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**Lorena Sganzerla**

**M.A. Berlin School of Mind and Brain**

**Humboldt-Universität zu Berlin**

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[6] https://go.nature.com/39ydizi
[7] Sverdlik et al Int., J. Dr. Stu., 2018
[12] https://go.nature.com/33w6SN1
[13] https://go.nature.com/2VBjKCg
Join us on May 27 and 28, 2021 for the 7th Women’s Careers and Networks (WoCaNet) symposium in Göttingen (Germany) or online!

Women’s Careers and Networks 2021

Transformation: Blaze Your Own Trail

May 27-28, 2021
Find us on: 
http://www.wocanet.uni-goettingen.de/

#WoCaNet2021
WoCaNet 2021 aims to bring together students, researchers, and renowned scientific professionals for a stimulating two-day event, organized by Ph.D. students of the GGNB (Göttingen Graduate Centre for Neurosciences, Biophysics, and Molecular Biosciences) and postdoctoral researchers of Georg-August University and the Max Planck Institutes.

Excellent networking opportunities
Inspiring talks, an interactive panel discussion, fun workshops and a career fair will give you the opportunity to explore different trajectories and establish important contacts to promote your career path. We have put together an amazing set of speakers from a variety of research fields: From social demography (Dr. Alessandra Minello) to clinical and affective neuroscience (Dr. Sarah Garfinkle), from “warm technology” (Karen Dolva, CEO) to science policy and advocacy (Dr. Catherine Young). Learn from neuroscientist and Max-Planck director Dr. Erin Schuman, as well as from Dr. Eva Pellicer, physicist and Associate Professor at Universitat Autònoma de Barcelona, about their experiences and stories of “transformation” during our keynote sessions.

Discover your personal and scientific potential!
The focus of this year’s symposium will be the importance of “Transformation” in our lives, from both a professional and personal growth point of view. Throughout the event, we will explore the circumstances and unexpected challenges that contribute to a scientist’s path, as well as the impact that science has on society and vice versa.

Blaze your own trail!
About 10 years ago, the organizers of the first symposium created an event where early-career female scientists can interact with successful women from diverse professional backgrounds (academia, industry, science journalism and politics) to profit from their experiences and to discuss different career options. Since the overall aim of our symposium is to promote diversity, everyone is welcome to join and learn about how gender can impact your career (choices) and how you can blaze your own professional trail.

Don’t forget to register on our website!
Registration will be open between February 1 and March 31, 2021. For more information, check out http://www.wocanet.uni-goettingen.de/ and don’t forget to follow us on Twitter (@WoCaNet), Facebook (@WoCaNet21) and LinkedIn!

See you in 2021!
Whether we meet online or in person, and whatever 2021 brings, we are prepared!

Larissa Breuer
Ph.D. student
AG Dean on behalf of the WoCaNet 2021 Organizing Team
Soapbox Science Berlin 2020

Have you ever tried to explain your Ph.D. project to your grandparents or a distant relative? Have you ever presented your research without PowerPoint slides or notes to hold on to? Did you ever walk up on a stage and talk in front of an audience? If you can answer any of these questions with a yes, chances are you stepped a little outside the standard academic conference presentations. Tick all of these questions and we have Soapbox Science.

My experience
On the day of the event, I was terribly nervous. I had practiced what I wanted to say in German and English multiple times, built some props for illustration and I was, objectively, ready to go. However, when the time to step on my soapbox came, I got extremely nervous. I was in the first round of speakers, so no audience had formed yet. Should I just step on the box and start talking? What if nobody stopped to listen?

It turned out, all of these worries were unnecessary. About 10 seconds after I stepped on my box, people came to hear what was happening. Most of them listened for the entire 10 minutes I had prepared, many asked questions and wanted to know more.

Time flew by and before I even noticed I had done four rounds of my talk and my hour on the box was over. Even after I left the soapbox, several people approached me and asked questions about my research. It was, like so many previous speakers had said, a rush and one of the best, most exciting things I have ever done.

Ways to participate
If you are curious about Soapbox Science now, make sure to check their website and the Berlin Soapbox Science pages [2,3]. There are many ways to engage in the initiative – for example, by joining the organizing team, being a volunteer during the event, or becoming a speaker yourself.

Melina Engelhardt
Ph.D. Student, AG Picht

[3] Twitter: @berlin_soapbox

“Registrations for next year are already open! http://soapboxscience.org”

Credit: Melina Engelhardt

“It was one of the best, most exciting things I have ever done.”

MELINA ENGELHARDT
PH.D. STUDENT, AG PICH
A Warm Welcome to New Students

Nineteen new first-year students — one of them as part of Neurasmus as well as nine integrated MSc/PhD students of the Einstein Center for Neurosciences Berlin — and six second-year Neurasmus students from all around the world joined our MedNeuro family this year, all highly motivated. Unfortunately, the obligatory campus walks as well as the tour at the Berlin Museum of Medical History at the Charité had to be canceled. As usual, the office gave an introduction to the program and helped the students with administrative issues as part of the onboarding process.

Due to unforeseen complications, one of our students is still in his home country because of visa issues. With lectures mostly taking place online, he was able attend most of them, nonetheless.

A little gem for enthusiasts of statistics: 23 out of the 25 new students in total are female — exactly 92%!

PhD course: Improving [Your] Science

This year, we decided to postpone this course to help PhDs make the most of their science. Developed with the QUEST Center Berlin, the yearly course prepares all incoming students for their upcoming research projects by covering topics such as experimental planning, smart analysis strategies, open science and how to establish one’s profile on the international neuroscientific stage.

Planned date: Spring 2021! We will keep you posted.

A Big “Thank You” to The Students!

The office would like to express a great deal of appreciation to all students, Master’s in particular but PhD students as well as, for the patience that classes had to be switched back to online learning as of November 2nd! We were happy that we could start the first semester with in-person classes in October. Luckily, we were already prepared — with all the experiences gathered from the summer semester — so that the transition went smoothly on our side.

We all are well aware, that being a stranger in a foreign country is very challenging, especially with very limited possibilities to meet in person with each other! This makes us even more thankful. Thank you for being so open to these changes!

Master’s Thesis Defenses

The first couple of defenses of our Master’s students have taken place — virtually, of course — including the Neurasmus students. We are happy that this also went very well and that the quality of the presentations was amazing!

Evaluation of our Master’s Program

On December 2nd, our MSc program has been officially evaluated by external reviewers with several discussions rounds: management (office and scientific personnel), heads of the modules together with the office, current and former students and lecturers.

So far, we only got a verbal feedback, and the overall impression of our program was considered very good, administratively and scientifically — in particular combined with the Neuroscience environment in Berlin. A final written report is expected in January 2021.

Evaluations, consisting of reading our report based on previous feedback and suggestions, commenting on it and the interview sessions, take place every three years to ensure and enhance the quality of our program. Our program would like to extend our warm thanks and appreciation to all reviewers and the Quality Assurance team of Charité to take the time to evaluate our program!

Ralf Ansorg
MedNeuro Office
January

07 - 08. International Conference on Cognitive Science and Artificial Intelligence
Tokyo (virtual)
11 - 23. SfN Global Connectome: a Virtual Event
18 - 19. International Conference on Cognitive Flexibility and Executive Functions
Rome (virtual)

February

18 - 19. International Conference on Enactive Cognition and Phenomenology
Rome (virtual)
22 - 23. 31st International Conference on Neurology and Cognitive Neuroscience (webinar)
22 - 23. 11th Global Summit on Neuroscience and Neuroimmunology
Vienna (virtual)

March

10. 65th Annual Meeting of the German Society for Clinical Neurophysiology and Functional Imaging (virtual)
10. 9th Annual Neuroscience Virtual Conference LabRoots
12. European Life After Stroke Forum
Barcelona (virtual)
13-16. Cognitive Neuroscience Society 2021 Virtual Meeting

April

12 - 15. BNA 2021: Festival of neuroscience Virtual Event
14 - 16. EuroNeuro 2021 Virtual Event
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