

Off the BENCH

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The Eppendorf – LifeScienceStyle Magazine

A QUESTION OF DEFINITION

A glossary of scientific terms
eliminates ambiguity – and promotes
mutual understanding

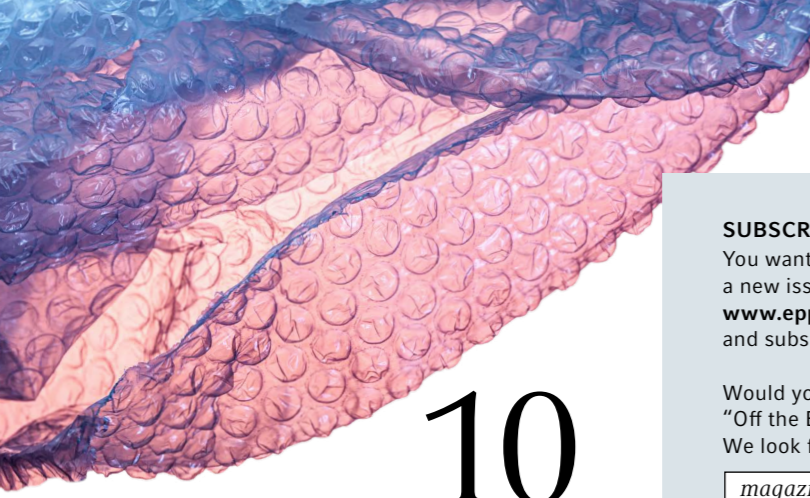
BEHIND THE LENS

Martin Oeggerli sets the stage
for the tiniest of animals and
objects. His photographs
illuminate nature



Dossier Novel Solutions through Creativity

presented by
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i Dear Reader,

Artificial intelligence has many a surprise in store. It is subject to so much research that news of progress has become commonplace. It hasn't been all that long since the California-based company OpenAI introduced a new version of its chatbot ChatGPT. Now, this program has become even better at answering our questions. That being said – the system continues to make mistakes. Thus, despite all the euphoria, a critical appraisal of its security and reliability is warranted.



AI can also paint pictures. But does this automatically equal creativity? Can it break new, abstract ground independently, or is it limited to generating results from vast amounts of data? This is the big question that concerns many scientists – and the one we are addressing in this issue of "Off the Bench".

In our dossier, you will read about what enables the human brain to think truly creatively. While it is plausible that some people are more creative than others, it is possible to promote daily creative thinking with the help of a variety of techniques. On this note, I would especially like to recommend to you the interview with creativity researcher Sebastian Kernbach, starting on page 20, as he touches on the specific needs of researchers who themselves must come up with ever more approaches to solutions.

Most certainly, artificial intelligence will not be able to conceive the same impressive images of microorganisms that Martin Oeggerli creates with his scanning electron microscope. His art turns mites into monsters. We spoke with the researcher and photographer about his passion which earned him the prestigious Lennart Nilsson Award.

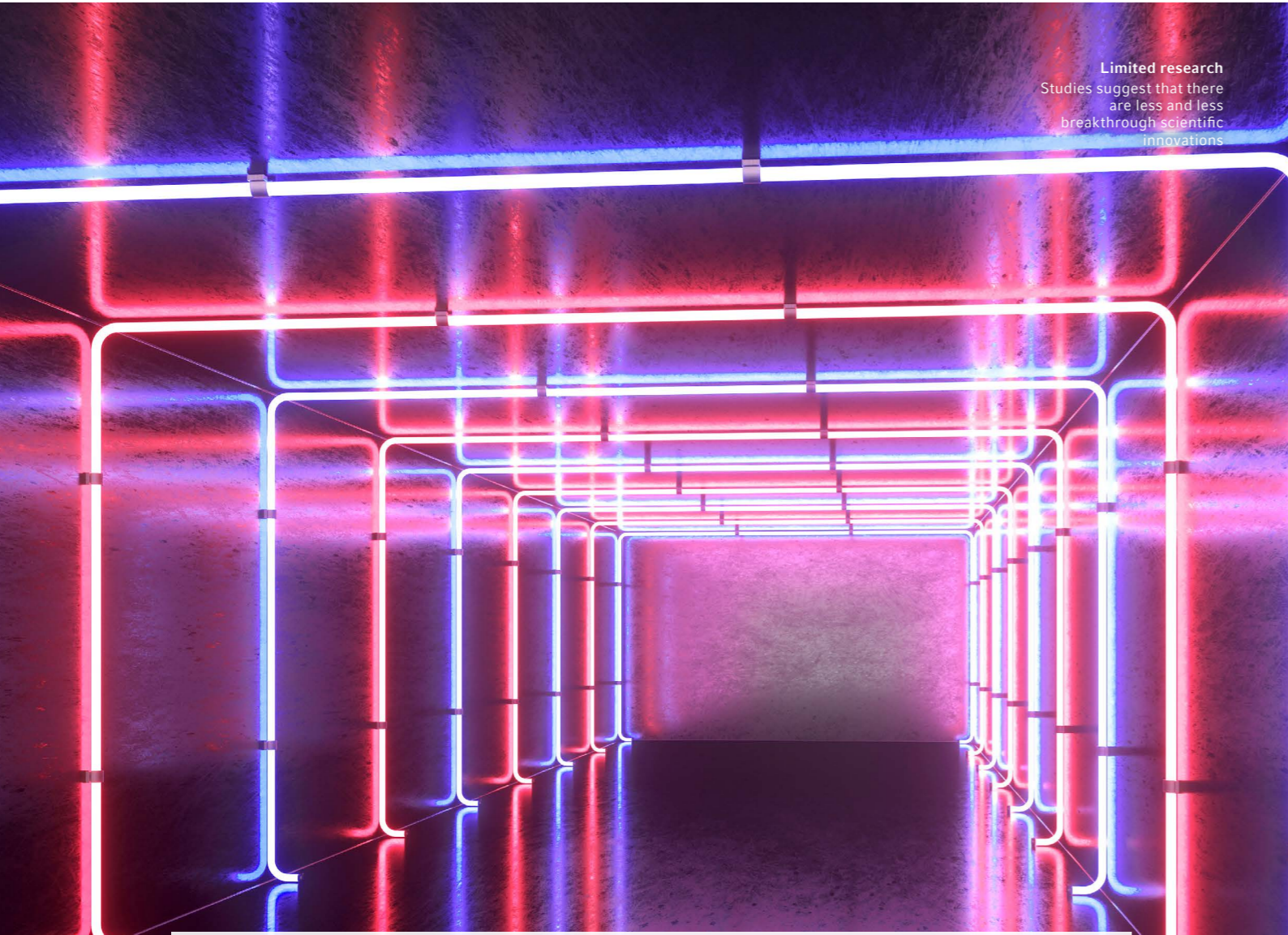
Ultimately, we all like to let our thoughts wander – for work or leisure – into the unknown. This is what makes us human. Today, and – hopefully far into the future.

I wish you an inspiring read,

Eva van Pelt
Co-CEO

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Snippets of Knowledge



Limited research
Studies suggest that there
are less and less
breakthrough scientific
innovations

Science at an Impasse?

The discovery of penicillin, the development of the Theory of Relativity or the invention of the polymerase chain reaction – considered to be the key technology of genetic research: disruptive discoveries such as these pave the way for groundbreaking innovation. According to a study published in the journal “Nature” earlier this year, however, scientific breakthroughs are becoming increasingly rare.

A team of researchers led by Michael Park at the University of Minnesota studied 45 million scientific journal articles from a period spanning approximately 70 years as well as four million patents from a period spanning 40 years, and they have found: while the total number

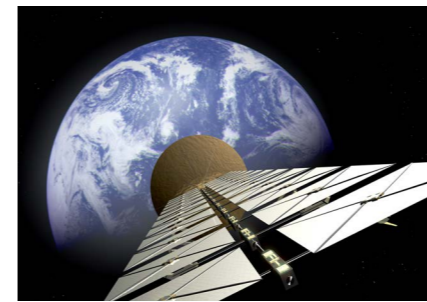
of scientific articles is increasing, the number of contributions with a disruptive impact is not growing. Even the titles of many journal articles will now contain terms such as “improve”, pointing towards the fact that the work is merely based on the improvement of existing knowledge.

A lack of time, less room for creativity or the wrong financial incentive by research funding are being discussed as possible reasons for the dearth of innovation. The authors of the study, however, put the onus on the researchers themselves: “Relying on small slices of existing knowledge may benefit individual careers, but it will not benefit scientific progress overall.”



It’s the Mix That Counts!

The more balanced the gender distribution in a research team, the better the results and the more often are they cited in other publications – this is what the research team led by Brian Uzzi at Northwestern University in Evanston, Illinois, discovered. The team studied 6.6 million articles which had been published in roughly 15,000 scientific journals over the past 20 years. Their work analyzed the composition of teams conducting medical research. The reasons why mixed-gender groups do better than purely male or purely female groups remain the subject of further study. It is possible that better exchange of information as well as different perspectives when it comes to research questions could make a difference.



Space Power

The increasing scarcity of energy on Earth calls for swift action – leading to more and more innovative ideas. As such, with its project “Solaris”, the European Space Agency ESA intends to generate solar power from space and send it back to Earth in the form of microwaves. What may sound daring is actually taking shape: ESA is initially investing 65 million US dollars in a feasibility study. “Solaris is a futuristic project. If it works, it will be a milestone for climate protection as well as energy independence”, said Josef Aschbacher, Director General of ESA on the occasion of the World Economic Forum in Davos this past January.



For 85 Years

Researchers at Harvard University followed up on the question: “What does it really take to lead a happy life?” To this end, they accompanied a group of 724 men from Boston and more than 1,300 of their descendants across three generations. One major factor turned out to be positive connections with other people. The study found that good friends are crucial to achieving the best health, both mental and physical, at the age of 80.

Preventing Crime

Anticipating criminal offences before they happen. Stopping people before they commit a crime. This is the goal of predictive policing. The AI-based approach is not new, but it is becoming increasingly effective. A team of social scientists led by Ishanu Chattopadhyay at the University of Chicago report in the journal “Nature Human Behaviour” that their AI-algorithm would be able to predict future crimes with high probability up to one week in advance. Chicago served as a test subject: the city was divided into areas, and based on their respective histories of violent crimes and other offences, they were analyzed on a time scale. Based on these data, AI generated predictions of future crimes. With great success: it achieved an accuracy of around 90 percent.



Awe-Inspiring Astronomy

The James Webb Space Telescope has been delivering high-resolution images from space since 2022. These provide researchers with unforeseen findings about distant galaxies, displaying our cosmos in all its beauty. We present four spectacular images.

! The Death of a Star

This image is among the first that the James Webb telescope – the largest space telescope built to date – sent to Earth in 2022. It shows the planetary nebula NGC 3132 (“Southern Ring Nebula”), approximately 2,500 light years from Earth, at a resolution that had hitherto been unattainable. The glowing cloud of burning gas and dust is what remains of a sun-like star at the end of its life. The originator of this cloud is not the large radiant star in the

center, but the small one, visible to the left of the center, at the border between the bluish and the brownish areas. It is the telescope’s near-infrared camera (NIRCam) that allows us to see detailed images such as these. Since the sensors record wavelengths which are imperceptible to us, these were subsequently converted into visible colors. Thus, each one of these impressive images from space is also a work of art.

! Revival of a Classic

The image of the “Pillars of Creation”, roughly 7,000 light years from us, already achieved fame in the 1990s. In 2014, the Hubble space telescope, with its much-improved technology, delivered more precise images. Since that time, the Eagle Nebula has been an iconic formation. Now, the James Webb telescope goes a step further by allowing the formation which also known as the “Hand of God” to shine in a new light once again. It shows novel details – for example, the glimmering red areas that are visible at the tips of some of the pillars. These are ejections from stars which, at a few hundred thousand years old, are still relatively young. According to the European Space Agency, new data such as these will allow better study of the conditions under which stars form within the Eagle Nebula, which stretches across roughly four light years.

! Interstellar Vacuum

This colorful image – generated on September 8, 2022 – shows a very early phase in the development of a star. Its origin is an expansive cloud of gas and dust, at a distance of approximately 460 light years, inside which matter slowly contracts under the influence of gravity, compressing it to form the protostar L1527. This embryo of a star itself is located at the “waist” of the cosmic hourglass and will thus act as the center of attraction for additional matter. This will accumulate in an “accretion disc”, the narrow side of which is visible in this image as a fine dark line by the polar star. In this way, the baby star feeds itself, until it is so dense and hot that the fusion fire will ignite inside it – which marks the beginning of its life as a glowing star. In all probability, this is how our own sun may have come to life once upon a time.

! Zooming into Space

Due to their gravity, galaxy clusters distort the light and can thus become what is known as gravitational lenses. These multiply and enlarge the images of galaxies in the background. This sparkling image shows the galaxy cluster SMACS J0723.3-7327. Before the James Webb telescope focused in on it, using its NIRCam to take high-resolution images, only 19 multiple images of six background sources

had been known. Thanks to the JWST, 27 additional multiple images of ten further objects can now be identified. On the occasion of the publication of these images in the summer of 2022, astrophysicist Sherry Suyu of the Technical University of Munich said: “These spectacular images show a large variety of greatly enlarged galaxies which, thanks to our exact model, can now be studied in detail.”

Goosebumps in the Brain

A crackling campfire, rustling leaves or a hairbrush gliding through hair – sounds such as these have a relaxing effect, and they are summarized under the acronym ASMR. Read on to find out more about the latest relaxation hype.

When Craig Richard wants to relax after a stressful day, he sometimes watches one of the painting courses by the late TV host and landscape painter Bob Ross. He then listens to him as he strokes the canvas with his brush. The professor of biopharmaceutical sciences at Shenandoah University in Virginia equally loves the sound of scissors as they cut hair, even though he himself sports a bald head. “For the longest time, I had no idea why I found these things relaxing, and neither did I know that they could be connected”, he remembers. “I guess I simply thought I was a little strange.”

A gentle wave of relaxation

Quite the opposite is true – Craig Richard is not alone with his preference for relaxing sounds. Countless people all over the world love auditory sensations that trigger a pleasant tingling on the head. In some people, this sensation will continue to expand as a wave of relaxation to the neck, flowing down the spine. A pleasant shiver, comparable to a gentle electrical discharge. This phenomenon is known through its acronym, ASMR, which stands for “Autonomous Sensory Meridian Response”. Autonomous because the effect starts without the participation of the person who hears the sound and sensory because on occasion, the phenomenon affects all the senses. In the view of Traditional Chinese Medicine, meridians comprise lines through the body which conduct the life energy – and the pleasant shiver of ASMR. Response signifies the response of the body to the sensory input.

In 2013, Craig Richard came across ASMR by chance while listening to a podcast in his kitchen. “At the time, very little information on this topic was available, but I was immediately fascinated”, he recalls. “After all, I had always experienced it as relaxing.” As a result, he

contacted computer scientist Jennifer Allen, the woman who had coined the term ASMR. They started collaborating on a research project the very same year.

Pleasant tingling reaches an audience of millions

Allen had also experienced the pleasant tingling on her scalp while listening to certain sounds. She founded a Facebook group which over time attracted many fans who shared similar experiences. Currently, there is no greater relaxation hype than whispered or rustling sounds, or even sounds produced by chewing. In 2021, ASMR was the third most searched term on YouTube, where the most popular ASMR video was downloaded 33 million times. Celebrities like Paris Hilton and the American rapper Cardi B are practicing the friendly whisper in front of the microphone while unknown ASMR artists and their clips go viral. For example, Jane from South Korea – her channel now has more than 17 million followers.

But how do these ASMR-associated sensations arise? This is what Craig Richard and Jennifer Allen wanted to find out. One result: “Our brain scans show that certain areas of the brain are active when someone is experiencing ASMR and the tingling”, explains Richard, and he adds: “The areas that are predominantly involved include the medial prefrontal cortex and the insular cortex, and also the nucleus accumbens, which is a part of the reward system in the brain.” The fact that ASMR touches these areas of the brain may lead to the conclusion that neurotransmitters such as the

endorphins serotonin, GABA and oxytocin are involved, and it appears that oxytocin, which is released during cuddling and which has lust-intensifying properties, may be the most important. Particularly the sounds of breathing and whispering allow us to sense the presence of another human being – even virtually”, elaborates Craig Richard. “Thus, ASMR sounds are capable of fulfilling the desire for closeness – one possible reason why ASMR became so popular during the pandemic.”

Oxytocin may also be the reason why some people are receptive to ASMR sounds whereas others are not – and may even be repulsed by the sounds of eating. “The amount of oxytocin released is determined by genetics, and the manifestations may vary considerably”, says Craig Richard. Accordingly, a biological component is most likely involved when it comes to a preference for ASMR. At the same time, says Richard, one’s own life experiences may contribute to increased openness towards these sounds, as well as the individual mindset or cultural imprint.

Pleasant – and good for you

It has been proven that those who enjoy it will relax with ASMR. “Heart rate and blood pressure go down – both are prerequisites for the body to enter a resting state”, says Richard who compiles his findings on the website asmruniversity.com. Even people with anxiety or depression should give it a try and see if an ASMR video or podcast works for them. The gentle sounds are capable of soothing anxiety or lifting a downcast spirit. The research is still in its infancy; there are many open questions that Craig Richard intends to answer: “For example, I would like to find out about the effects of ASMR on stress-related hormones such as cortisol or adrenalin.” ■

<https://asmruniversity.com> <

Sounds good
The rustling of bubble wrap triggers in some people a pleasant feeling of well-being

The Mushroom Miracle

They can be poisonous or delicious. Only a small part is visible above the ground; their expansive network of “roots” which permeates the soil makes up the vast majority of these organisms. Fungi can contain healing substances, and they form the basis of many sustainable technologies.

Fungi are neither plants nor animals; in fact, they comprise their own kingdom. They do not require sunlight; instead, they permeate the ground, wood and other organic matter in their search for nutrients originating from living as well as dead organisms.

Roughly 120,000 species of fungi are currently scientifically cataloged, whereas a vast majority are still unknown: researchers estimate a possible five billion species. Some species baffle the observer with superlatives – for example, the honey mushroom in the Malheur National Forest

in Oregon is the largest living organism on Earth.

The network of this fungus inhabits approximately nine square kilometers – the equivalent of 1,200 soccer fields. Biologists estimate this giant mushroom to be up to 8,500 years old and weigh 400,000 kilograms. The largest fruiting body of any mushroom visible above ground was found 12 years ago in China. The *Phellinus* fungus was almost eleven meters long and weighed 400 kilograms.

Fungi are extremely well networked. There are up to six tons of fungal hyphae in one

hectare of forest soil which can add up to an incredible 100 billion kilometers. In comparison, the Moon orbits Earth at a distance of only 380,000 kilometers. A single tree can have a network of up to 100 species of fungus. The ability of these recycling specialists to metabolize waste has caught the attention of science as well as industry. Some experts see a great potential for sustainable innovation. Here, we present four of the many useful characteristics of fungi:

! Mysterious Mycorrhiza

The commonly recognized part of a fungus is the fruiting body above ground. The actual fungus – the mycelium – comprises the wide network of root-like filaments in the ground. The mycelium often enters a symbiotic relationship with trees and other plants: mycorrhizae improve the supply of the plant with water and minerals; phosphorous especially renders the fungal network better accessible to the plant. In exchange, the fungus receives sugar-containing compounds generated during photosynthesis. Mycorrhizae are also capable of serving the exchange of information of, for example, the need for water or nutrients. At this time, little is known about how the “Wood Wide Web” really works.

! Effective Killer of Harmful Substances

There is not another organism that matches fungi in terms of speed and efficiency when it comes to degrading plant materials. Special enzymes allow them to degrade lignocellulose – the substance that provides lignified plants with strength and stability, and which microorganisms find difficult to digest. Fungal enzymes are also highly efficient in dismantling other difficult to degrade substances. Among other things, they are capable of metabolizing harmful substances such as dioxin, oils, fats, certain pesticides, the explosive TNT, as well as residues of pharmaceuticals and plastics. Importantly, they do it in such a way that only carbon dioxide and water will remain – or at least substances which are significantly less toxic. As such, fungi can play an important role in cleaning up contaminated soil and bodies of water. Even today, fungi are used as effective killers of harmful substances in some water treatment plants and on fallow contaminated industrial lands.

! Houses Built from Waste

Fungi are of special interest to the building material industry as their hyphae can penetrate plant waste and thus interconnect it to form a solid structure. Researchers at the Fraunhofer Institute took waste materials such as sawdust, straw and duff and developed a paste which can be processed using a 3D printer. This is how it works: the addition of fungi solidifies the material; the fungi are subsequently killed by applying heat, and, voilà, you have a stable and sustainable building component. Researchers from Karlsruhe in Germany produced bricks made from waste wood and fungal mycelia that were not only considerably lighter than conventional materials but also less breakable and more durable. In addition, carbon dioxide is bound during the manufacturing process. The American start-up Ecovative has succeeded in building a complete small house which consists of mostly fungal filaments and waste materials. The Mushroom Tiny House is waterproof, fireproof, free from toxic chemicals and biodegradable.

! Healing Substance

Penicillin, the antibiotic developed by British scientist Alexander Fleming in 1928, is the best-known pharmaceutical of fungal origin. Since that time, researchers studying antibiotics have discovered a series of other substances with antibiotic properties in fungi. The antibiotics produced worldwide from the two mold species *Penicillium chrysogenum* and *Acremonium chrysogenum* are worth approximately 20 billion euros. New studies show that certain species also contain antiviral substances. The active substance cordycepin, isolated from the caterpillar fungus (*Cordyceps sinensis*) could potentially prove useful as a cancer therapeutic. Laboratory experiments showed that cordycepin was capable of effectively destroying leukemia, breast cancer and prostate cancer cells. However, this substance is not yet approved as a medication.

Friendly coexistence
Mushrooms grow virtually everywhere – and live in symbiosis with their environment

What We Really Mean

One term, multiple definitions – the same is true in the realm of science. With his glossary, Flávio Azevedo of the FORRT initiative intends to provide more clarity. We spoke with him about this idea and why it is so important in the era of Open Science.

Pre-Registration [pri:ˌrɛdʒɪˈstreɪʃən]

The social sciences: A time-stamped version of a research protocol which cannot be edited.

Healthcare: Advance registration into an accelerated course that qualifies students to fast-track into a medical profession.

Whether in everyday science, in teaching or within the context of the broader public: what are the problems that could arise from different interpretations of words?

Open Science has revolutionized the way in which we share research projects and processes with others. Consequently, these changes have increased the ambiguity of terminology, which creates barriers to effective understanding – among researchers within different disciplines as well as between experts and lay people. This is exactly where the FORRT glossary comes in: we want to remove such barriers in order to include as many people as possible. I am thinking of early-career scholars, but also stakeholders in industry and researchers from disadvantaged countries.

Can you give us some examples of terms with different meanings.

For example, in the social sciences, the term “pre-registration” refers to a time-stamped version of a research protocol which cannot be edited. In contrast, in healthcare fields, it refers to advance registration into an accelerated course that qualifies students to fast-track into a

medical profession. Another example: in the field of economics, “creative destruction” refers to the continuous restructuring of an economy through the replacement of old technologies, sectors and companies with new ones. In psychology research, this term appears in connection with the reproducibility of studies. If the results of one group are not only confirmed by another group, but also enriched through additional findings, we speak of “creative destruction”. These are only two examples when in fact there are hundreds.

To date, you have defined and classified more than 250 of the most common terms and abbreviations from the world of science. How did you and your team go about this?

First, we created a list of terms with a concise definition, related terms and any applicable alternative definitions. By the way, this first glossary was developed using a crowd-sourced methodology, with the involvement of over 100 contributors at various career stages and from a diverse range of disciplines, for example, psychology, economics, neuroscience, and also linguistics. In a second step, we invited additional scientists through social

Creative Destruction [kri:'eɪtɪv dɪ'strʌkʃən]

Economics: The process of continuous restructuring of an economy by replacing old technologies, sectors and companies with new ones.

Psychology research: This term appears in connection with the reproducibility of studies. If the results of one group are not only confirmed by another group, but also enriched through additional findings, we speak of “creative destruction”.

media and organizations such as “ReproducibiliTea” to participate in the project. We suggested new terms for which the contributors were asked to suggest main definitions as well as alternatives. They were also asked to once again review the definitions and alternatives already proofed and edited to date.

How does one manage to agree on definitions given the large number of contributors?

We consider definitions to be ready for dissemination when they have been reviewed by a sufficient number of contributors (typically five or more), and when consensus has been reached. Throughout this process, our common focus is deliberately centered around the open scholarship ethos – aiming to make scientific work and knowledge openly accessible and thus enable diversity, equity, inclusion and much more. With success: our glossary is being used by many, many Open Science stakeholders and the public, and it is an inspiration for many more glossary initiatives. At the same time, our work is of course open and freely available to everyone.

<https://forrt.org/glossary>

Diversity [də'vɜːsədē]

This is a frequently used term that mainly refers to differences between people; for example, with respect to gender, ethnic origin or sexual orientation. However, diversity can also refer to the variety of laboratory samples, or the opinions and beliefs that researchers introduce into their work.

You are encouraging all those interested to collaborate. How can one participate?

We are indeed far from finished! Everyone is invited to improve and expand the glossary. We are also in the process of translating terms and their definitions into different languages to improve accessibility. To this end, we have opened four “live” working documents on our website which are open to contributions by the community. Those interested are also invited to join our FORRT Slack channel (see “Get Involved” at the top of our webpage). We look forward to keen participation! ■

! MORE ABOUT FORRT

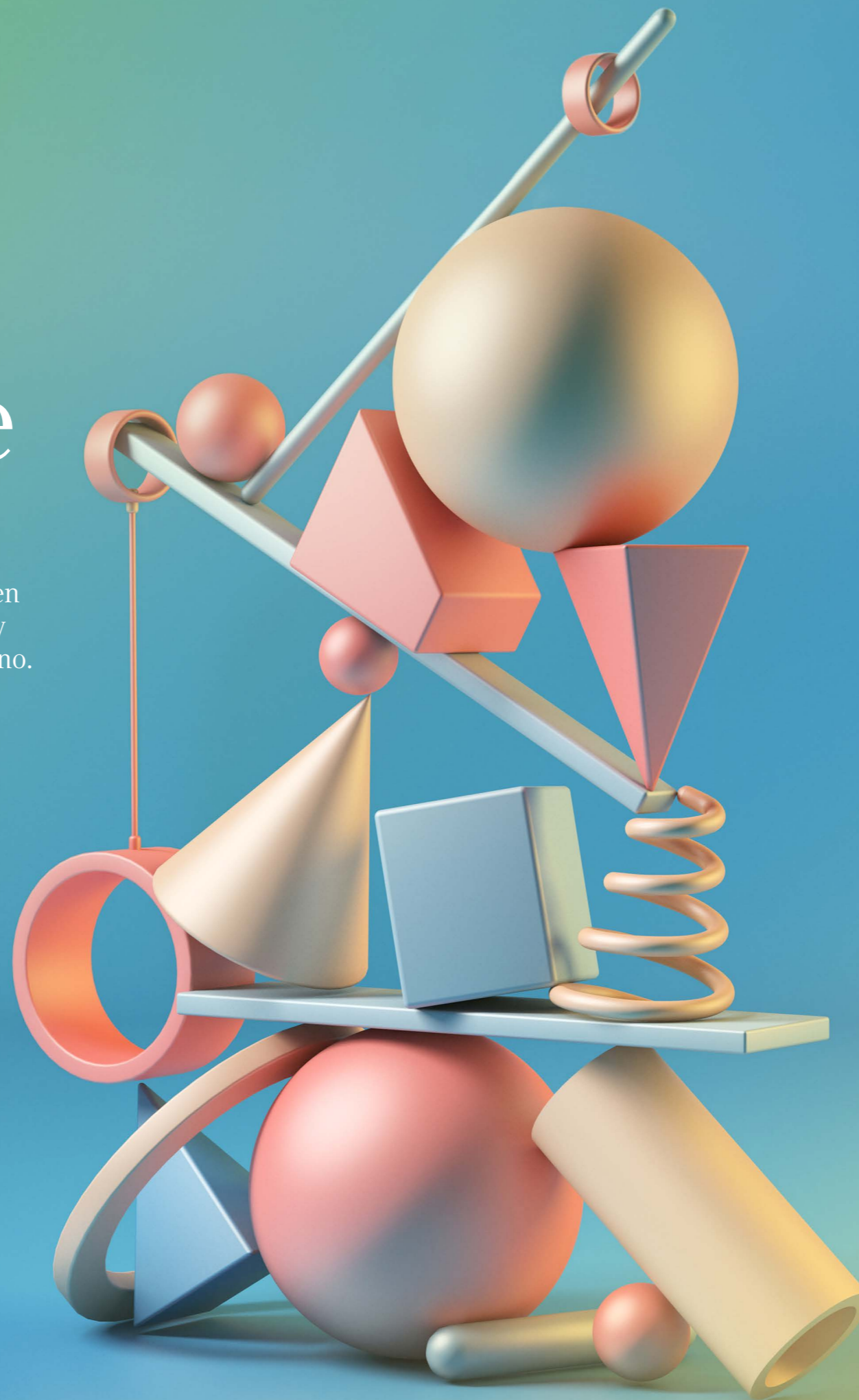
FORRT (Framework for Open and Reproducible Research Training) is an organization led by early-career scientists that works to integrate principles of open, transparent and freely accessible science into higher education. The initiative follows a collaborative approach: research teams from around the world come together to generate content that is freely accessible. Under the leadership of political psychologist Flávio Azevedo of the University of Groningen, the society has defined and classified more than 250 of the most common terms and abbreviations in a glossary. This work was published in the journal “Nature Human Behaviour”.

The Future Belongs to the Creative

Artificial intelligence can imitate music by Beethoven; it can write journal articles and even create paintings. Is human creativity on its way to becoming superfluous? The clear answer is no. Creativity is now more coveted than ever.

Novel entity

According to the definition, someone who creates something that is both novel and useful is creative. The human brain is particularly good at this



The work that Ludwig van Beethoven never had a chance to finish was to be taken over by artificial intelligence: the completion of the tenth symphony. For two years, the computer performed calculations for the AI project “Beethoven X”. It had previously been fed roughly 10,000 pieces of music from the Beethoven era. The result, which premiered in Bonn in 2021, was politely deemed “interesting” by experts. Conductor Dirk Kaftan concluded: AI processes the past. He seriously doubts its ability to create anything new and original.

Creativity is booming

A genius like Beethoven will never be replaced with any kind of AI. But even beyond the realm of prodigies and virtuosos, real creativity requires the human spirit. Despite all the advances in the field of AI, creativity is more important than ever before in the 21st century. Stephen Lamb, Professor of Education at the University of Melbourne and his team count creativity among the “key skills for the 21st century”. In practical terms: creativity is a clear favorite when it comes to the desired “soft skills” listed in countless job ads. Creativity is booming.

But what exactly is creativity? There is no definition that covers all aspects. The characteristics that make a person a “creative” lie predominantly in the eye of the beholder. While one person may perceive a successful painter or writer to be a genius, another may more easily recognize genius in an engineer, or the winner of the Nobel Prize in Chemistry. The spirit of the time (Zeitgeist) definitely plays a role as well – for example, many exceptionally gifted artists, including Johann Sebastian Bach or Vincent van Gogh, lived in the shadows until their deaths. The latter only sold a single painting during his lifetime, for 400 francs. Today, his art yields astronomical sums.

Novel and useful

Science, at least, was able to agree on one thing: creativity describes the ability to create things or solutions that are both novel and useful. Scientists found that children are born with the potential to be creative. According to Professor Sebastian Kernbach, humans are most creative during childhood (see his interview on page 20). In order to preserve this ability in later life, additional conditions have to be met. Gifts and talents, comprehensive knowledge in a specialist field, motivation, diligence and hard work – as well as personality traits such as a thirst for novelty and self-confidence, and a supportive and somewhat demanding environment that enables the development of a talent. “At the end of the day”, emphasize psychologists ►

Vlad Petre Glăveanu of Dublin City University and James C. Kaufman of the University of Connecticut, “everyone has what it takes to be creative. We are all creative – at least potentially. Being creative means to think of new and useful ideas or things. Being creative is not a luxury but rather a necessity in today’s changing world. Creativity is the key to success in almost all areas of life, be it personal or professional. It can and should be learned. In most civilized societies, there will never be enough of it.”

This is becoming evident, especially when looking at the variety of offers for appropriate techniques and brain training. But is it really possible to control creative thought? This is what psychologist Roger E. Beaty of Pennsylvania State University is studying. His finding: creativity is only partly based in controlled thought. Experience takes care of the rest. “We look at creative thinking as a dynamic interaction between memory and the control systems in the brain. Without memory, our minds would be blank slates – not at all conducive to creativity, which relies on knowledge and experience. That being said – without mental control, we would not be able to think in new directions or avoid getting stuck in learned knowledge”, says the American psychologist. Beaty regrets that the question whether creativity can be strengthened in the long term has not yet been subject to scientific study.

A change of scenery for novel thoughts

Despite all this, the demand for more creativity is ubiquitous. Even children should be taught skills that distinguish them from machines, demands Jack Ma, founder of the trade platform Alibaba. How will this stand up to everyday challenges? According to education scientists, children need creative adults. For those, in turn, countless tips are available on how to find creative solutions. Researchers at Stanford University discovered that exercising in the fresh air leads to the generation of fresh ideas – more than while sitting or even on the treadmill.

A change in location, too, and allowing your thoughts to wander; cellphone-free time and a little bit of chaos on the desk are said to spur on creativity. Breaking out of our daily routines also has the potential to inspire us: on your way home, simply take a different route and see what new discoveries it has to offer.

“

Creativity is the key to success in almost all areas of life, be it personal or professional. It can and should be learned ... ”

Vlad Petre Glăveanu,
Dublin City University

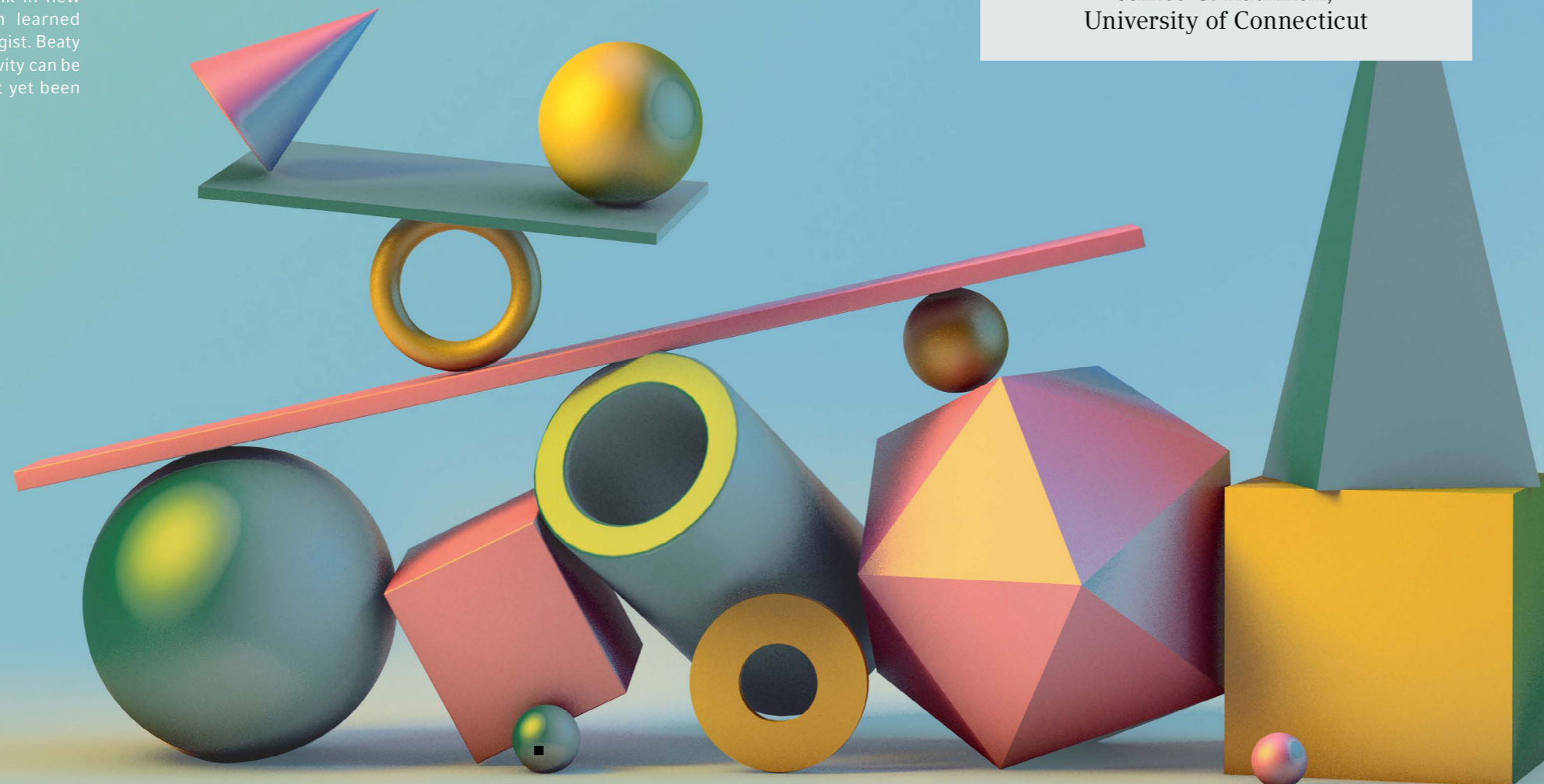
James C. Kaufman,
University of Connecticut

Whether in marketing, in research departments of companies or in universities: the professional world, in particular, is pining for a wealth of ideas and innovation. Established creativity techniques such as brainstorming (free association), mind maps (visualization of all ideas on a sheet of paper) or different design-thinking approaches have one thing in common: they are intended to guide one’s thoughts along a different path while fighting one’s old ways, as in: “we’ve always done it this way”.

Creating room for creativity

Whether such techniques and methods can increase creativity in the long term remains controversial. This may be another reason why doubts are increasingly expressed when it comes to the “boom of ideation workshops and creativity methods”. These exist to “routinely develop new products and services for the maximization of profit”, criticize the publishers of the trend study “Free Creativity” of the Frankfurt Future Institute. Truly future-proof innovations are thus strictly and consistently geared towards questions of meaning and usefulness – and independent thought, as well as empathy, are the most important prerequisites for true creativity.

Companies and research institutions should therefore focus on the basic creative potential of humans, which machines do not yet possess, and create an open and innovation-friendly environment. Not least, the creativity techniques from our childhoods, such as playing music or painting, can provide us with brand new ideas. Psychologist Beaty emphasizes that as long as there is no scientific answer to whether or not cognitive abilities can in fact be improved through neuroscientific methods and techniques, a tried and true art class can indeed be the best solution. ■



Playful approach

The foundations for creative thinking are laid in childhood. Above all, children need positive role models

creative as well. While some people's strength is marked creativity, creativity can, in principle, be learned by everyone.

So – ingenuity is not a question of personality?

Yes, it is! Some people are extroverted, open to new experiences, and they don't worry too much about what others think about them. They also say out loud what may sound strange, and they strive to improve themselves. Others prefer to work through things on their own. Especially people who have been working for the same company for a while must first be taken out of their familiar thought processes.

Are children more creative than adults?

The most creative age is between six and seven years old. This has been shown by the "Alternative Uses Test", during which one has a limited period of time to think about how, for example, an object like a paper clip can be used in different ways. Adults come up with a maximum of 30 ideas while children come up with up to 100! They have not yet been heavily influenced, and they still think in all dimensions. After that, they unlearn creativity. I often work with companies on regaining that freedom.

Is there a way to introduce more creativity into one's gridlocked life?

I advise everyone to search for their passion and find out what it means to them. There are lots

of options on how to integrate more of this into our futures. If, for example, I love photography, I don't have to quit my job and become a photographer. I can initiate small photography projects and thus invite more of this into my life. This fosters a positive attitude towards life, even if I have not actually changed my life or job. This is what we call "Life Design".

Everyday life is not conducive to creativity. What is it that puts a brake on our inventive spirit?

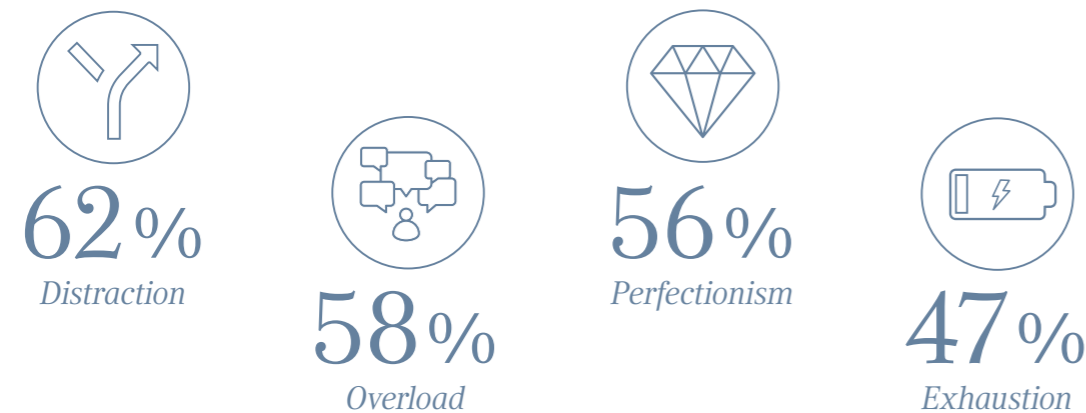
Our survey of more than 100 participants showed that the number one reason for procrastination is distraction – be it through the cell phone, e-mail, housework, or the noise in the office. Reason number two: the "cognitive load". Through overload and excessive demands, we end up in a kind of shock-induced paralysis because we are thinking: "I can't possibly do yet another thing." The third reason is the negative inner voice – like the one originating from perfectionism. While it is important when ideas are put into practice, perfectionism can initially block us.

What can help us overcome a lack of willpower?

We have defined seven strategies for getting from thought to action. One method, for example, is to formulate a "very initial ten percent version" in order to communicate to the subconscious that the result does not have to be good just yet. A list of everything I can think of at the moment can also be quite liberating: I will have more brainpower

Why do people procrastinate instead of putting their creative ideas into practice?

Source: Survey in accordance with www.LifeDesignLab.ch/actionbook



Knows the tricks
Visualizing creates space for new ideas, is one of the tips from creativity researcher Sebastian Kernbach

BRIEF PORTRAIT

Sebastian Kernbach is Assistant Professor for Creativity and Design at the MCM Institute for Media and Communication Management at the University of St. Gallen and Visiting Fellow at Stanford University. In 2018, he founded the Life Design Lab, won the HSG Impact Award and wrote two books on the topic: Life Design and the Life Design Action Book with seven strategies to help us move from thought to action and overcome the lack of willpower.

More on this topic at:

www.LifeDesignLab.ch

at my disposal to do what I actually want to do. Sometimes, you are simply tired emotionally. This is when a list of things that do me good, such as listening to music, or recharging my batteries, really helps me approach the topic from a different perspective.

Scientists in particular are under pressure to be creative. How can they achieve this without succumbing to stress?

Particularly when it comes to complex scientific topics, visualization helps as it renders implicit knowledge explicit. Einstein and Darwin visualized daily. Successful researchers utilize pen and paper – they extend the function of the brain to include the paper. Scientists should be aware that something new does not actually have to be

entirely new. If I replace, omit or newly combine things, something new will come into existence. Scientists must arrive at differentiated, multi-operational ways of thinking, that is, being aware that they have multiple options, and rethink things accordingly. Instead of evaluating the result of an experiment as either good or bad, they should ask themselves: "What can I learn from this?"

When you look towards the future: what is the role that creativity will play in society?

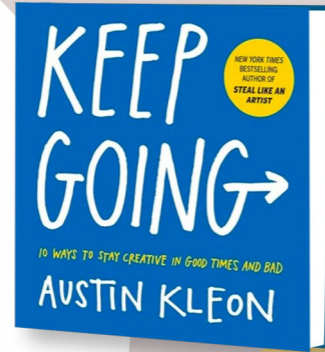
According to Robert Sternberg, creative intelligence is the way that we deal with different situations. These are ubiquitous and all around us – war, energy crises or natural disasters. In the future, we will need even more creativity to find answers to the world's problems. ■

Keep Going!

10 tips for more creativity on good and bad days

Creative work knows no end. Instead of having a clear finish line, it's more like a loop that takes you back to the start of a new project after completing the one before. But who can be that creative all the time? In "Keep Going", Austin Kleon shows, with the help of illustrations, how you can manage to be creative over and over – above all when you're burned out and creatively blocked. This book by the New York Times bestselling author lends a hand with practical and honest advice for a long-lasting creative (working) life.

224 pages, Workman Publishing, approximately \$14.00



Overcome Creatively!

Three pointers from coach Karsten Noack on solving creative blocks and getting good ideas flowing again:

- Brainwriting: Record your ideas in writing instead of expressing them verbally as it is often done. This method allows more ideas by circumnavigating barriers like fear and shame.
- The Reversal Method: Here the problem gets turned on its head. You want to win over new clients? Then think about the best way to send them packing. This technique can help overcome corporate tunnel vision.
- Visualization: Consciously picture an image of your desired result. This is how complex connections become clearer and ideas are kicked off.



The Creative Pep Talk

Creativity is a strange thing. It can be fun and deeply enriching but isn't always available at the press of a button. The illustrator and speaker Andy J Pizza is the founder and host of the English-language podcast "The Creative Pep Talk". With the help of inspiring monologues and interviews with creative luminaries, the host gives listeners heaps of pro tips to plumb their creative potential.

Find the podcast on www.creativepeptalk.com, Spotify and SoundCloud

New Impulses

Fallen into a creativity abyss?
No problem, there are ways back up.
Tips to read, listen to – and copy.



INSIDE Eppendorf

Eight pages of pure Eppendorf: professionalizing routine tasks with epMotion®, presenting projects through "Your Work Matters" – and staying current with news and entertainment.



SIMPLY LET IT WORK

Our epMotion instruments get routine tasks done in no time at all. And what are you doing?

GO, ACADEMIC RESEARCH, GO!

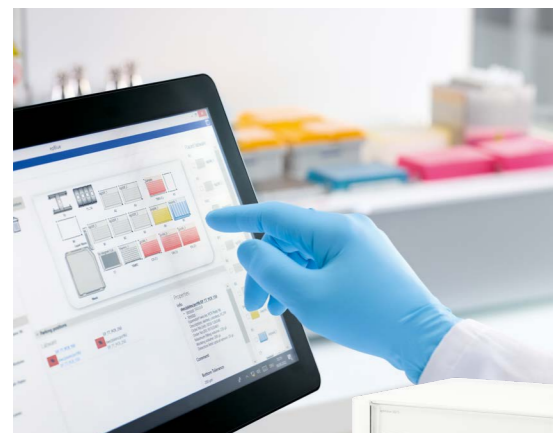
"Your Work Matters" makes people and their projects visible

May I Introduce: the New epMotion®!

You prefer not to work on your tasks in an assembly line fashion, but rather to invest your time in new ideas? It's time to start using our epMotion. Thanks to automation, you will now be able to concentrate on things that require your full innovative capacity.



Versatile and flexible
The epMotion can be loaded in various ways to adapt to your workflow



Stylish and intuitive
With the epMotion, modern design meets reliable and efficient technology with user-friendly software



Despite the growing number of new technologies and instruments that are available to researchers today, in every laboratory there are experienced staff who sit among all these smart instruments carrying a pipette in their hand and perform repetitive liquid handling tasks. This central, manual step is the basis for the experiments, tests and analyses that are executed in every laboratory. Unfortunately, however, this step is frequently a bottleneck. Eppendorf has a solution: the epMotion – automated liquid handling systems for the laboratory bench which take care of a variety of tasks and are easy to operate. In this new generation, more than 20 years of experience creating pipetting robots meets exciting design. What the epMotion can do – see box on the right.

FIND OUT MORE?



Watch the product film using the QR code on the left. Additional information on the epMotion is available through the link below:

www.eppendorf.com/unleash-your-potential



epMotion – here's what it is:

The epMotion systems are automated liquid handlers that can complete complex pipetting tasks in a fully automated fashion. The systems cover a volume range between 0.2 µL and 1,000 µL, depending on the dispensing tools used. In addition to transferring liquids, the systems, depending on equipment features, are also capable of cooling and heating, shaking and mixing, as well as performing vacuum steps automatically, thus enabling complex work processes to be completed in an automated manner from start to finish. Throughout this process, operation via an intuitive graphic surface is easy-as-pie.



epMotion – here's why you need it:

Automation eases your daily laboratory routine by taking repetitive, tedious or especially concentration-intensive tasks off your hands. And it does all this with consistent high quality, no matter whether it's Monday morning or Friday night. With this, the epMotion creates the freedom you need in order to be able to use your time for what really counts: developing new experiments and analyzing the results. The reduction of the manual pipetting steps can also help prevent work-related overuse injuries such as the repetitive strain injury syndrome (RSI).



epMotion – here's what you need it for:

The epMotion systems can be used in many ways; with a multitude of accessories, almost all conventional laboratory formats, from the 50 mL tube, down to the 384 well plate, can be accommodated. Common areas of application for the epMotion include liquid handling tasks such as reformatting, serial dilutions and normalizations. In addition to these supporting tasks, the systems, depending on their individual features, are capable of taking care of entire workflows: from PCR and qPCR setup to extraction of RNA, DNA and proteins, all the way to building libraries for sequencing.



Curtains Up for Academic Research

With “Your Work Matters”, Eppendorf is offering scientists the opportunity to present themselves and their projects. Expert tips and technical background knowledge bring true added value.

Those who work in academic research find themselves face to face with all kinds of challenges. Undergraduate studies or apprenticeships spanning several years are followed by jobs that demand a substantial time commitment, including – often – the weekend. Presenting one’s own work and laboratory findings in renowned journals is subject to lengthy review processes, and those who have the opportunity to speak at conferences

and present their own poster will realize that it’s only their scientific data that are of interest. Many may ask themselves: What about the person behind all this? What is important to them, and what drives them in their research?”

Your Project Matters

A platform which invites researchers to present themselves, their laboratory and their own research freely and openly, and with a



I contribute to the development of innovative treatment options, and I try to help people who suffer from bone defects.”

Carmen Nicolae,
Medical Engineer, Bucharest,
Romania



It is my goal to identify proteins that interact with septins which, in turn, are responsible for the pathogenesis of fungi. Those fungi include, for example, Magnaporthe oryzae, which causes rice blast.”

Rinalda Proko,
PhD Student, Arkansas,
USA

personal note, has been lacking up to now. With “Your Project Matters”, Eppendorf is now putting faces to the names of academic scientists. They talk about what motivated them to enter academia and how they manage to stay on target with long-term projects. We are curious to find out from you: How do you motivate yourself and your team and colleagues to keep going – with the aim of improving human living conditions? How do you discover new things? And which solutions are you close to discovering that will make the world a little better? If you, too, would like to tell your story, please feel free to scan the QR code below.

resources or enable team members to attend conferences requires writing many grant applications. But where to find the time? Our experts support you in improving your efficiency – including optimizing experiments or selecting the appropriate instrument for your individual needs. Our videos, webinars and expert articles are meant to ease your life in the lab as well as show the way to increased time savings, efficiency and success. We invite you to visit us on our new website. ■

REGISTER NOW!



Become a part of “Your Project Matters”!

www.eppendorf.com/yourproject



Learn more about “Your Work Matters”!

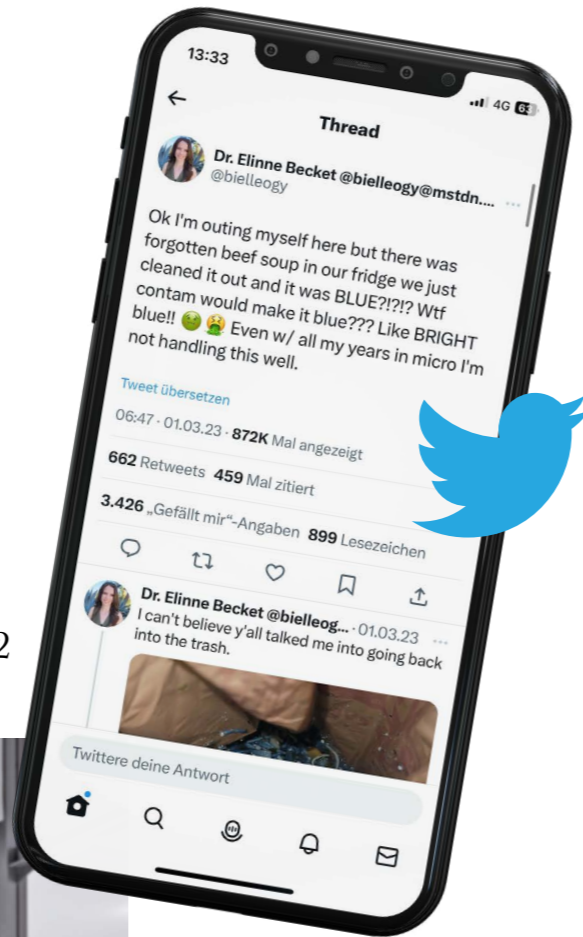
www.eppendorf.com/academia



Lab Lifestyle



1



2



3

2 Mysterious Blue Soup

Those who forget food in the fridge must be prepared to face the worst – for example, the fact that the once delicious soup will develop a squirming life of its own. This is what happened to Elinne Becket who was startled as she retrieved her beef soup from the fridge after some time had passed. Its color had turned to blue. How did this happen?

This was the question this microbiologist from California State University San Marcos asked her followers on Twitter – which, back in the spring, earned her more than 30,000 views as well as countless likes and comments. The Twitter-researchers discussed the wildest theories: some participants suspected a certain type of bacteria – which also alters soft cheese in this way – of coloring the soup blue. Whichever way the case was solved: it made it into C&EN (“Chemical & Engineering News”) as a note – and into “Off the Bench”!

<https://t1p.de/yq4xb>

1 The Many Faces of Science

What are they like – typical scientists? In order to portray them, media like to resort to the same old stereotypes over and over again – irrespective of the broad variety of people in this profession. Media scientist Petra Pansegrau of the University of Bielefeld studied this phenomenon by closely analyzing more than 200 feature films. She identified four clusters of stereotypes: +++ The crazy magician who comes up with ideas that are completely removed from reality. This scientist is awkward, forgetful and confused. +++ Often, researchers are portrayed as nerdy “experts”. They are eminent authorities in their

fields, very ambitious, and extremely polite. +++ The “hero and adventurer” solves the problems and miracles of nature, most of all through bravery and an urge for conquest. +++ Most of the time, however, media depict scientists as “evil creators”, or even “destroyers”. The “mad scientist” is obsessed with his ideas, and he is frequently unscrupulous.

You don’t recognize yourself in any of these stereotypes? We invite you to identify yourself as a scientist with a sticker from the accessories line “This is what a scientist looks like”:

<https://t1p.de/7mx57>

3 Eppendorf Lab Channel: Webinar Recommendation

The Eppendorf Lab Channel offers a virtual event platform for registered participants to take part in live and on-demand webinars – free of charge. With experienced Eppendorf experts as speakers, participants have the opportunity to broaden their knowledge and gather tips and tricks for their daily laboratory routine. They can also have their questions answered directly by the experts. **For example, at the popular webinar on “Essentials in Exosome Production Using Ultracentrifuges”.** Those who have registered on the portal can view it there (see link at the end of the text). We asked Marc-Manuel Hahn, our Global Marketing Manager, a few questions about this webinar:

Marc, why are you offering a webinar on this specific topic?

The study of exosomes and extracellular vesicles is an exciting field that offers many opportunities, including ones for clinical applications. We have already shown that the reproducible production of exosomes can be carried out reliably using Eppendorf bioreactors. Here, we want to go a step further

and address the issue of efficient exosome purification. In particular, following the acquisition of the centrifuge business of Koki Holdings Co. Ltd., Eppendorf is now in the position to be able offer its customers ultracentrifuges in this area which represent the gold standard when it comes to exosome purification.

Why should one view this session?

In this webinar, you have the unique opportunity to learn more about the workflow and the separation solutions and discuss these with our experts Pascal and Sugish.

In your opinion, who will benefit from participating in this webinar?

Everyone who is interested in scalable exosome production and purification solutions and the gain in efficiency made possible through this process.

<https://event.eppendorf.com/labchannel>

<https://event.eppendorf.com/labchannel/pastevents>

Short and Sweet

Eppendorf produces solutions for the laboratory which take sustainability aspects into consideration as much as possible. This is also true for its partnerships.



Centrifuge 5427 R – Now with “Green” Cooling Agent

Global warming and its consequences are among the major challenges of our time. Due to their chemical structure, fluorinated hydrocarbons, which have thus far been used in cooling systems, can contribute to global warming when released. It is therefore important to switch to more environmentally friendly “green” cooling agents – hydrocarbons – in laboratory environments as well. In comparison with conventional cooling agents (such as, for example, R134a), hydrocarbons feature a very low global warming potential, which means that upon release, their impact on global warming is much lower. For this reason, starting in March 2023, Eppendorf is offering the new Centrifuge 5427 R with hydrocarbon cooling – the first centrifuge in our portfolio with a natural cooling agent. For the protection of your samples – and our planet.

◀ www.eppendorf.com/sustainable-centrifuge



New Project with Plan International

In 2023 as well as 2024, the Eppendorf Improving Life Program is supporting the work of Plan International Germany. A total of 140,000 euros will benefit a project for sustainable farming and climate protection in Laos. The project region Bokeo is characterized by dire poverty. Access to most villages is difficult as they are located in mountainous regions. The opportunities for earning a living are scarce; many people are rice farmers. Increasing periods of drought cause substantial agricultural damage and impair the water supply. Among other projects, Eppendorf is supporting the establishment of two agricultural learning centers in which 192 young people will be trained in sustainable agriculture. Their newly acquired knowledge will then allow the farmers to improve their livelihoods in the long term.

The Best of Both Worlds



Ann Kennedy unites the fields of biology and mathematics like no one else. With the help of computer modeling, she describes real-life processes. And this is how the neuroscientist has recently discovered how mice regulate aggression. ▶

Ann Kennedy is among the few theoretical neuroscientists who are capable of translating their mathematical work into real experiments”, says Larry Abbott, “this is a gift!” Abbott was her PhD supervisor at Columbia University – and he is not the only contemporary who is full of praise. The online portal “Spectrum” of the Simons Foundation Autism Research Initiative has published an extensive article featuring the researcher who is currently working as an assistant Professor at Northwestern University Feinberg School of Medicine in Chicago. The magazine describes her as a “rising star” in the academic firmament. It describes her as bridging a gap between biologists and computer scientists, and it mentions that she is great at finding just the right mathematical approach for every problem.

Ann Kennedy is soft-spoken. During the interview, she comes across as almost shy. Almost as if it would be easier for her to let others speak about her and her successes – even though she is an eloquent storyteller, which may seem unusual for someone who is so deeply immersed in the world of numbers, data and codes.

In fact, she has always pursued a multipronged approach, as she was interested in biological processes in the brain as well as in mathematical modeling. She uses the following analogy to describe her motivation: “You can look at a cup on your desk and see a cup. But one could also consider the intricacies of how a software must be designed so that it will be able to recognize the cup.” It’s the latter approach that sums up her passion.

Successful breakthrough

As a result, Ann Kennedy’s major accomplishment is the fact that she can literally look behind the

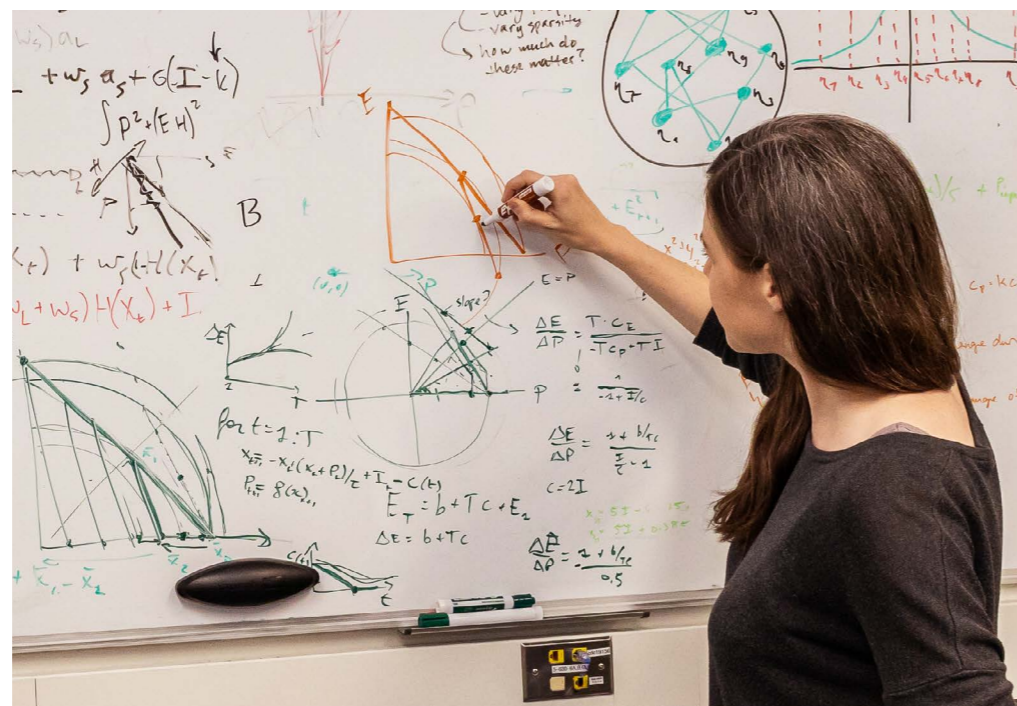
cup – by developing tools that help us understand how the brain works. This unique skill has also earned her the “Eppendorf & Science Prize for Neurobiology 2022”, worth USD 25,000.

Kennedy’s research provides new knowledge on how the mouse brain regulates social behaviors – for example, aggression. The results, she says, are a “culmination of many other works”. Are they a breakthrough? “I think so”, she says with a cautious smile. “Because this one specific brain region can be stimulated to trigger an attack in a mouse, biologists used to think that in this area, a specific subgroup of neurons existed that would make the decision to attack – similar to flipping a switch.” In contrast, her work now shows that this brain region acts more like an indicator for the aggressive motivation of the animal, and that it exists independently from the situation, whether a fight occurs or not.

“We saw activation in a large number of neurons which were active over a prolonged period of time.” Phrased in lay terms:



Black on white
Despite all the digital resources, it often helps Ann Kennedy to visualize formulas and thoughts on a whiteboard



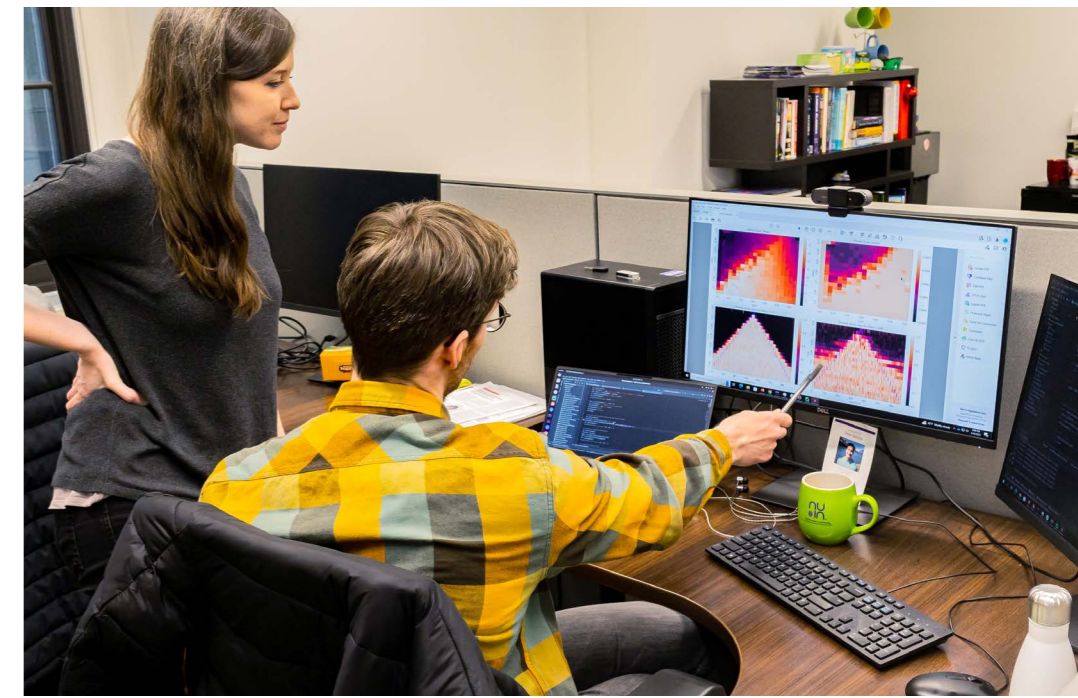
archetypal behaviors of animals, which include aggression, are not simply up- and downregulated in the brain region of the hypothalamus using an all-or-nothing switch. The motivational drive for these behaviors is finely tuned via a “population of neurons” – similar to a volume dial, the intensity of which is increased or decreased slowly.

In order to understand what goes on between sensory input and motor actions in the brain, Kennedy and her team used micro-endoscopes which they fastened to the heads of the mice. While mice were free to run around, the team of researchers observed which types of neurons were active. “The results helped us understand how the brain maintains states of motivation”, says Kennedy. When, for example, the mouse sees a predator – in this study, a rat – or enters an altercation with another mouse, it will not forget these events right away. “Increased excitation remains, and it changes the animal’s behavior.” The neuron population discovered by her team thus correlates with the sustained willingness of the animal to fight – and not with the fight itself.

A born explorer

Ann Kennedy grew up in a suburb in northern Virginia. Both parents worked as engineers in the computer industry – her mother developed operating systems for the first ATM machines – and they taught Ann and her brother programming when they were only in elementary school. But she also played soccer, was active in the Girl Scouts and took piano lessons. Her grandfather, also an engineer, was another formative influence in her life, and it was in his workshop that she was often found tinkering.

Even when she was small, she always wanted to get to the bottom of things and understand



A team effort, of course!
Research projects are always a joint effort. Here, Ann Kennedy discusses with postdoc Richard Gast, who simulated neural networks on the computer

how things work. She took every opportunity to learn something new. While still in school, Kennedy did a practicum in a stem cell laboratory at Children’s National Hospital, and she went on to study biology and biomedical technology at Johns Hopkins University in Baltimore, Maryland. She took as many courses as possible in subjects that were new territory for her: signal processing, information theory, linear algebra. In this way, she built a broadly designed toolbox which would prove to be helpful in her later research.

How would she describe herself as a person? “That’s a strange question”, she says and pauses for a few seconds. “Recently, I have invested so much time in building my own lab that my thoughts generally revolve around my work”, she answers. Her laboratory, which she started in 2020, is located on the 5th floor in a building in downtown Chicago. “Some people are surprised when I take them here. All you can see are people sitting at desks”, she tells us. “We spend most of our time looking at monitors; we program, we write publications and we

discuss our work.” Data, codes and diagrams are her world. From time to time she also teaches postdocs and students, which she considers a welcome change.

Crazy about science

She would not mind traveling more. Sometimes, she manages to tack on a few extra days to a conference, for example, following a workshop in Puerto Rico. In California, where she worked as a postdoc, she learned to appreciate hiking. “Here, in Illinois, mountains are not so much part of the scenery”, she says, but still, she tries to get out into nature as much as possible to go for long walks with her husband. And yes, when time allows, she loves to cook to relax, and beyond that, she is a book fanatic, reading fictional novels as well as nonfiction. “What I love most is to immerse myself in the world of ideas of scientists. I love discovering books about scientific theories from past decades and find out how our thinking in the different disciplines has changed”, reveals Ann. After all, science is her dream job. ■

LEARN MORE?



<https://annkennedy.github.io>

Head in the Clouds

Greenhouse gases continue to heat up our climate. They also influence cloud formation. A conversation with Bjorn Stevens, director of the Max Planck Institute for Meteorology in Hamburg, Germany.

Dr. Stevens, with the help of climate models you simulate the formation of clouds. What role does global warming play in this process?

Bjorn Stevens: In order to regulate the surface temperature of the Earth and thus safeguard life-sustaining conditions, the energy balance of the planet must be in a state of permanent equilibrium. If the Earth's surface receives more energy than it loses, it will warm up. If it gets too warm, Earth will radiate energy through its atmosphere into space. Clouds influence the amount of energy Earth receives from the sun as well as the ability of the Earth to reflect energy from its surface back into space. A changing cloud formation will alter this balance and, as a result, the temperature on the surface. At the same time, clouds themselves respond to changes in temperature. We must be aware of these interrelations so that we will be able to draw concrete conclusions about the climate.

Current climate models are not sufficient?

Conventional climate models represent an incomplete picture of reality. They are unable to precisely depict circulation systems in the atmosphere that are the result of clouds and storms; at best, they can provide a rough approximation. In fact, these models are of limited use when it comes to understanding how clouds and

storms change, as well as understanding their effects on global warming.

You were one of the main authors of the fifth world climate report in 2013. The sixth report from 2021 is also based on the findings by your research team. How do clouds change as more and more carbon dioxide, methane and other greenhouse gases enter the atmosphere?

We are not entirely sure yet, but we have already excluded a number of possibilities. At the moment, it looks like this: the influence of clouds will change in such a way that global warming is not mitigated but instead will increase slightly. The exact impact of clouds on the reaction of Earth to changing greenhouse gases is very complicated. I have recently thought about the question of what it would mean if clouds were to not change at all – if they neither shrank nor grew in size.

As part of an international research project, you are studying the Passat clouds in the Caribbean. What are you hoping to find out?

These are very small clouds over the ocean that are capable of reflecting more solar radiation back into space than they are capable of absorbing radiation originating from Earth's surface. Even

minor changes in their number could drastically influence how intensely Earth will warm up as a result of increasing CO₂ concentrations. In order to find out more about these clouds and the factors which influence them, we are using Barbados as a base to study the Atlantic to the east of this island. To this end, we measure the clouds using probes on airplanes and ships. It seems clear even now that these clouds amplify Earth's warming less than previously assumed. This is good news, but it should not lead us to believe that all is well.

With an appeal published in the journal "Nature Climate Change", a team of researchers under your leadership pleaded for an alliance of major climate data centers to share their research findings. What else is needed to allow

more precise predictions?

Unfortunately, people, through their actions, have a strong influence on Planet Earth. People have become a geological factor. To best understand increasing CO₂ concentrations and other global environmental changes, concentrated international efforts are needed. Only together will we be able to develop more and more precise climate models with the help of high-performance computers. This task is complex, and it should not be performed predominantly by young people, in particular PhD students, as is currently the case. In every respect, we simply need more and better resources. How can we expect to work together to mitigate the catastrophic consequences of climate change – if we are not capable of studying and understanding it collaboratively? ■

Data from above

Bjorn Stevens' research explores the extent to which cloud formation and climate change affect each other

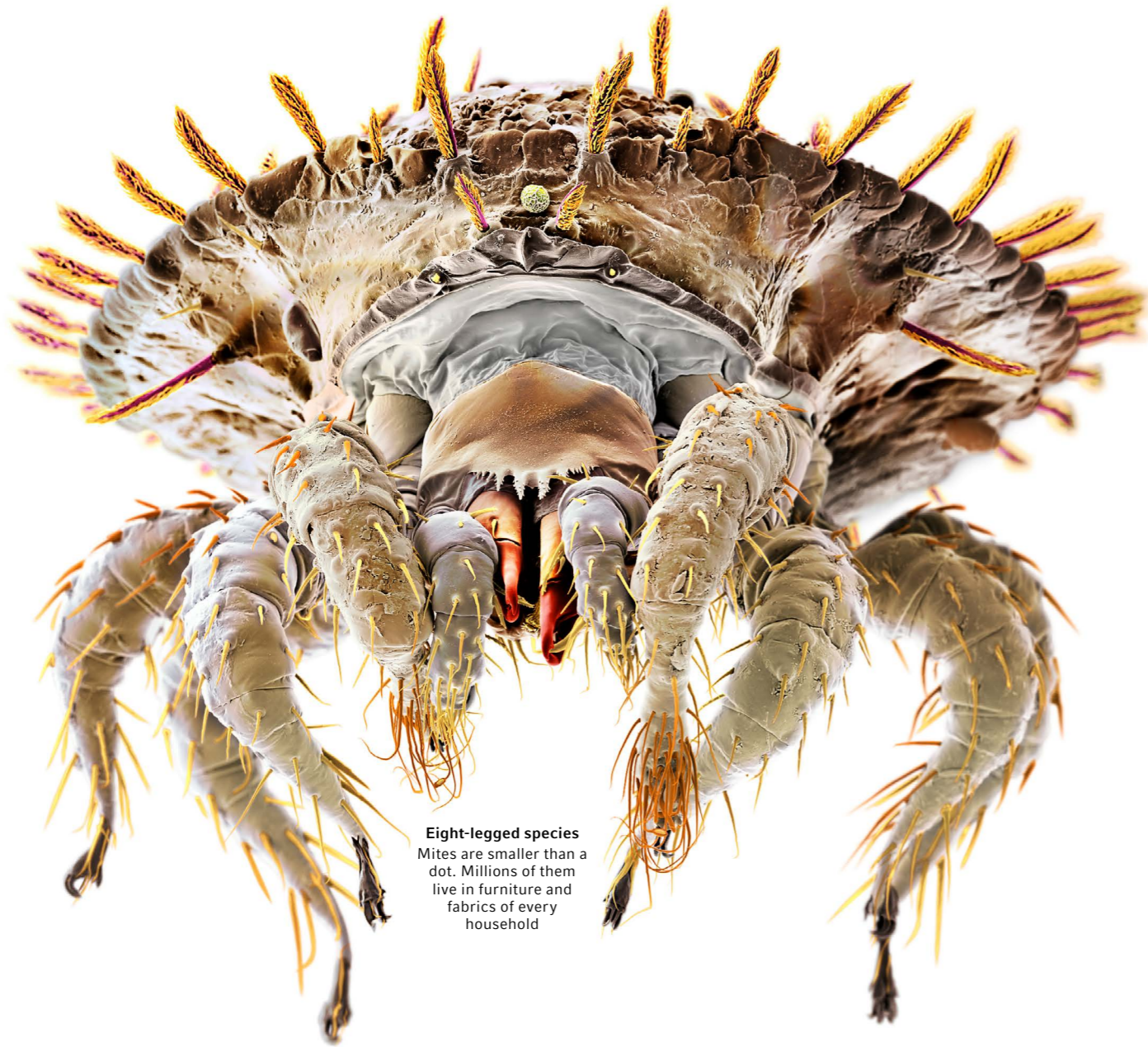
BRIEF PORTRAIT



Bjorn Stevens is the director of the Max Planck Institute for Meteorology in Hamburg. Following his MSc in Electrical Engineering at Iowa State University, the German-born American earned his PhD in Atmospheric Science at Colorado State University in 1996. Until 2011, the climate scientist taught dynamic meteorology at the University of California, Los Angeles.



Expedition into the Microcosmos



Eight-legged species
Mites are smaller than a dot. Millions of them live in furniture and fabrics of every household

With a great love of detail, Martin Oeggerli brings microscopically tiny creatures and objects to life. Through his art, the prize-winning scientific photographer draws attention – and builds knowledge.

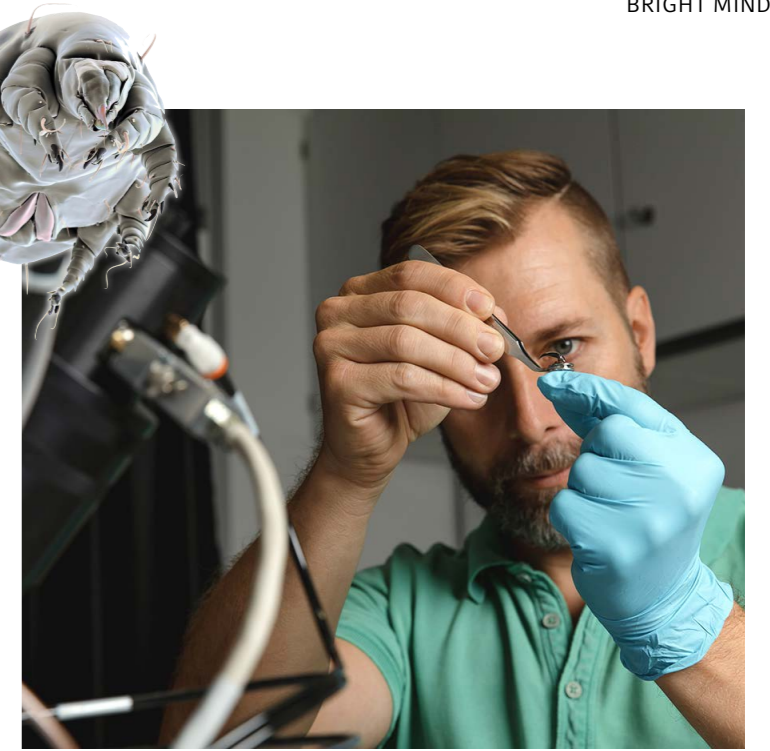
When Martin Oeggerli looks through his microscope, he embarks on a journey into another world. He discovers grotesque monsters, primeval forests and strange planets, enlarged by a factor of a thousand. His surreal-seeming photos could be used as inspiration for sci-fi novels, yet they are not only real, but often also amazingly ordinary. The forest is revealed to be a cross-section of the leaf of a fire potato, the planets are actually pollen, the monsters turn out to be mites. As a scientific photographer, Oeggerli has taken on the challenge of making the microcosmos – the world of microorganisms – visible and presenting it in an aesthetically pleasing form.

However, the 49-year-old, who lives near Basel, is innately a scientist. The microbiologist worked in cancer research at the University of Basel for seven years – until his father gave him a camera. “I had already taken thousands of pictures with it for my work within a few weeks”, reports Oeggerli. But the scientific perspective has since retreated ever more into the background: “Nowadays I’m one hundred percent an artist.”

Scanning instead of photography

The Swiss photographer, who receives his microscope slides from research colleagues, is no longer working with commercial digital cameras. These days he uses a scanning electron microscope; its electron beams scan the surface of the image section and, with that information, create a highly detailed three-dimensional image. However, this process also has a drawback when compared to photography: it does not reveal color. That means a lot of manual work for the artist on the computer in his studio: “For coloring, I do need up to 100 hours per image – with that, I get up to twenty completed works a year at maximum,” estimates Oeggerli.

First, the image is cropped. Pixel for pixel, level for level, the photographer assigns colors to the motifs in Photoshop, so that the different details become as visible as possible through these contrasting colors. “Humans have learned to differentiate, categorize, and assess what we see through color. That’s also reflected in my work.” Though he explains that the colors are not always faithful to the original, but rather down to artistic liberty: “That’s how I bring the scenes to life and make the invisible visible.”



Every detail fits
Martin Oeggerli at the scanning electron microscope with which he depicts the subtleties of nature in greatly magnified form

Oeggerli’s shots are often featured in renowned publications, such as National Geographic, where they amaze laypeople as well as scientists. This attracts attention: Martin Oeggerli was recently awarded one of the world’s most prestigious prizes in scientific photography, the Lennart Nilsson Award. “It’s an honor and an acknowledgement of me and the images that I have created,” he says happily but modestly. The prize creates interest and informs people about a world that is itself little known in science and not universally appreciated.

Prizewinning mites

Mites, for example, make up one of the most species-rich categories of life. They exist underwater, on every continent, and, when it comes to eyelash mites (Demodex), also on humans. And thanks to Oeggerli, they have also made it into art galleries. On the colorized shots, the tiny arachnids gleam with their multiformity, their intricate body characteristics and sometimes downright loveable appearance. “We don’t know much about these species as yet. Most of them are completely harmless to humans,” says Oeggerli. “The ones that usually stick in our minds are the ones that bite us, attack our plants or help themselves to our food.” It is always difficult, he says, to understand things that we cannot see or touch.

Oeggerli wants to raise awareness and awaken sympathy. The jury of the Lennart Nilsson Award agreed in their statement: “The stunning images help us understand the intricacies of nature’s designs and make biology accessible to everyone.”

www.oeggerli.com / www.micronaut.ch



A Tasty Treat for the Climate

The things we eat definitely impact the climate – which is why researchers worldwide are working to design a climate-friendly diet. The consensus: meat should be consumed sparingly. But what are the alternatives?

Our food supply is responsible for more than a third of all global greenhouse gas emissions. These are the conclusions drawn by the “Global Food Policy Report”, an annual publication by the Washington-based International Food Policy Research Institute, published in September 2022. The reasons for this are multilayered: for example, the consequences of deforestation for the purpose of creating farmland include high emissions. Energy and resource intensive production processes, trade, consumption and disposal also contribute to rising CO₂ concentrations. “Global food production not only threatens climate stability; biodiversity, the water supply and ecosystem resilience as a whole are also in danger. Therefore, our food must be part of the solution”, demands agricultural scientist Britta Klein of the Federal Center for Nutrition in Germany.

The planet on a diet

Most experts agree on what should be on our plates in the future: the basic ingredients of a climate-friendly diet include more fruit, vegetables and legumes such as lentils, beans and peas. These ingredients are also suitable for forming the foundation of plant-based alternatives to animal products which stress the climate to a much higher degree. One example: according to the Federal Information Center for Agriculture, the production of cow’s milk generates three to five times higher greenhouse gas emissions than the production of

plant-based alternatives. Within this context, the balance sheet is especially poor when it comes to the consumption of meat: according to a study published in the journal “Nature Food” in 2021, plant-based foods are responsible for only 29 percent of the greenhouse gases emitted during food production overall. In contrast, 57 percent are generated by the breeding and husbandry of livestock, including the production of their food. The production of beef alone makes up roughly a quarter of global greenhouse gas emissions generated by the food industry.

With the “Planetary Health Diet”, the EAT Lancet Commission – a panel of experts from different fields – has developed recommendations for nutrition and diets that are meant to be environmentally friendly for the planet as well as healthy for people. According to this diet, people should eat approximately half as much meat and twice as much fruit and vegetables, legumes and nuts. At the same time, however, there are certain differences even among vegetables. In 2020, the Institute for Energy and Environmental Research Heidelberg in Germany (ifeu) determined the CO₂-footprint of 200 food items. With only 0.1 kilograms of CO₂ equivalents per kilogram, carrots and cabbage took first place. Many other types of fruit and vegetables, such as apples, eggplant, cauliflower, fennel or potatoes, were also ranked as especially climate-friendly, registering at most 0.2 to 0.3 kilograms of CO₂ equivalents per kilogram.

Eating with a clear conscience

Vegetables are considered to be far more climate-friendly than meat – but select with care here too

A taste of the future?

The Future Institute, located in Frankfurt am Main, issued its tenth “Food Report” in early 2023. This, too, bears witness to the protection of our climate. Lead author Hanni Rützler is considered one of the most distinguished experts on the subject of food. She forecasts a “New Glocal”, i.e., a reorganization of the global food trade with regional agricultural structures, along with the following food trends: “veganized recipes”, for example, reinterpret traditional dishes whereas “regenerative foods” prioritize soil regeneration and biodiversity. Once again: less meat – or choose alternatives!

Insects, for example, have long been established as important sources of protein on menus in Asia, Africa and South America, and they are now slowly being sampled in industrialized nations. There are many reasons insects could serve as alternatives to conventional meat. If they are killed by temperatures below freezing, this will resemble their “natural fate”. In addition, husbandry would allow many insect species to be housed in large numbers under more species-appropriate conditions than, for example, pigs, cattle or poultry. While pigs and cattle need between five and close to 20 kilograms of feed to build one kilogram of meat, insects will, on average, require only two kilograms. Even water consumption, which is high in traditional livestock farming, is greatly reduced when it comes to breeding insects.

Open to new experiences

For the Food Report, food expert Hanni Rützler took a closer look at different countries and their culinary traditions. She concluded that those nations which can look back on a long tradition of food culture, one that has become part of their “national identity”, have greater reservations towards novel foods. These countries include Italy, France, Thailand and Japan. Countries like the US, Great Britain or Germany, on the other hand – countries which did not develop a dominant national cuisine – were more open to culinary globalization and novel foods. As for mealworms and locusts, the EU has been allowing processed crickets and buffalo beetles in food since early 2023, and it tweeted: “Enjoy your snacks – with or without crickets or worms!”

The Sound Makes the Music

Even if we choose our words carefully when we speak, the way in which we say them plays a much more prominent role: phonetician Oliver Niebuhr talks about the charisma in our voices – and how it influences the way we are perceived by others.

It can strengthen the arguments we bring up in discussion, it can betray us, and it may allow our fellow humans to sense how we are feeling. It can make us appear small and insecure but also confident and dominant. We are talking about our voice, or rather, our vocal quality, which is determined, among other things, by our mood. We are also looking at prosody – also known as speech melody, or intonation. It is characterized by the volume and pitch, as well as the speed of our speech, and whether we pause throughout. How we employ speech melody plays a crucial role: “It is still the prevailing opinion that one must, above all, choose one’s words carefully and that tone is of secondary importance, but in fact, the opposite is true”, explains Oliver Niebuhr, who holds a PhD in phonetics and conducts research at the University of Southern Denmark. After all, the voice is among our first means of communication.

The power of the charismatic voice

It is clear that our voice is capable of transmitting more than just information. The level of competence, self-confidence and passion that it radiates during speech will determine its charisma. Competence,

in particular, instills trust. “I believe this person is capable of keeping their promises”, explains Niebuhr. When speakers radiate self-confidence through their voices, they motivate their conversation partner. “You will feel that now you are capable of doing something”, elaborates the researcher. Passion, on the other hand, has a predominantly mesmerizing effect. “It can “infect” others – it will affect them on a predominantly emotional level.”

That being said, according to Niebuhr, even people who present themselves in a manner that is extremely competent, passionate through and through, and entirely confident, will experience one limitation: “The charisma of our voice is only effective if the person speaking and the person listening share similar values. Even a charismatic politician will not be able to convince their audience if the audience adheres to different values.”

How can one make the most competent impression while speaking? The most important tips: include pauses, aim for a pleasant rate of speech, and pay attention to clear pronunciation. According to Niebuhr, the latter is especially important when it comes to transmitting confidence. The pillar of passion, however, is mostly

based on the strength of intonation, the vocal range and the register of a person. Perhaps contrary to expectations, it should be high rather than low: “Dominant speech intended to project authority is aided by a low register. In contrast, charisma is less about pushing something on people and more about engaging them”, explains Niebuhr. Very effective: the “deep drop”. “It is important to lower the voice deep enough at the end of a sentence. In its absence, one may come across as weak. Statistically speaking, this problem is affecting mostly women”, remarks Niebuhr.

Society’s mirror

This is not the only gender-specific difference when it comes to the charisma of the voice. Due to societal stereotypes, women typically need to overcompensate with respect to charisma. This means that women must transmit a higher degree of competence through their voice than men in order to be perceived as equally competent. This difference, however, is shrinking, observes Niebuhr: “The voice is always also a mirror of a changing society. Especially in Western cultures, the voice register of women has shifted along with

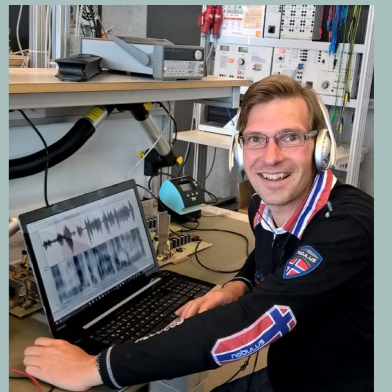
women’s altered role in society.” Over the past decades, women’s voices have become deeper – a development which illustrates the growing gender equality.

The art of speaking

In his acoustics laboratory, Oliver Niebuhr teaches people to increase the charisma in their voices – after all, charisma is something that can be learned. Over the years, Niebuhr has collected, and analyzed via artificial intelligence, several thousand speech samples. “There wasn’t a single person who performed badly in all three categories of charisma”, he recounts. “Everyone has certain strengths and then has to learn how to develop other aspects.” Above all, it is important to be aware that elements including pitch and pauses have a strong influence on the effect of the voice, and that it is possible to consciously control these factors.

Niebuhr’s training courses were developed predominantly for the founders of companies who had to raise private investor capital through pitches. A study was able to show that more charismatic sales conversations resulted in a higher probability of financial investment. At times, a pleasant tone can help the till. ■

BRIEF PORTRAIT



Oliver Niebuhr is a professor at the University of Southern Denmark, where he leads the acoustics laboratory at the Centre for Industrial Electronics. Niebuhr has been studying the voice for more than 20 years, and he is considered a specialist of the forms and functions of speech melody and intonation overall, with a focus on acoustic charisma. An example: he rates former US President Barack Obama to be an exceptionally charismatic speaker.

Wallpaper, or Work of Art?

With its approximately 160 exhibition centers and more than 2,000 sculptures, statues and monuments in public spaces, Paris resembles one giant museum. Any stroll inspired by the arts will always lead back to Claude Monet, the once underestimated originator of impressionism.

Surrounded by Claude Monet
At the Musée de l'Orangerie, eight large-format water lily paintings form the unique Nymphéas collection

Claude Monet would have been amazed! The Musée Marmottan Monet, a city house painted in eggshell white, just outside the center of Paris, houses the largest collection of his works worldwide. Among them: an oil painting showing the Normandy port of Le Havre with its ships and factory chimneys. Like a red pier, the sunlight leads up to the gray, washed-out sky. This painting, representing the impressions of a sunrise, helped coin the term "Impressionism", which was initially derogatory. In 1874, its author, art critic Louis Leroy (1812–1885) wrote about Monet's work: "A preliminary drawing for a wallpaper pattern is more finished than this seascape." Today, tourists line up before the gallery named after collector and patron of the arts, Paul Marmottan (1856–1932), to admire Monet's art. Works by Auguste Renoir, Edgar Degas and Camille Pissarro are also on display. No wonder: these works created from the mid-19th century onward allow the Belle Époque to come back to life – a time that shaped Paris like hardly any other.

Nostalgic green space in the city center

Following the visit to the Musée Marmottan, we take the Métro to the city center – passing stations adorned with beautiful tiles, curved inscriptions and ornate wrought-iron entrances. All this is as characteristic of Paris as the traffic on the Place de la Concorde that circles the Egyptian obelisk with its gold-plated tip at all times of the day and night. Leaving Métro Tuileries, it's only a few steps to the Tuileries Garden. In this baroque palace garden, imbued with the scent of crepes, which is located not far from the Louvre, a historic merry-go-round with wooden horses captivates not only children. Claude Monet also painted this Jardin des Tuileries, named after the "Tuileries" – brickyards. In 1876, he moved into the 5th floor apartment of an art collector to immortalize the view on his canvas: the flower beds organized in straight lines, the pond, and the Marsan pavilion by the Tuileries Palace – the residence of most French kings and emperors, from Louis XIV to Napoleon III. Four of Monet's paintings of the Tuileries have survived, with one on display in the Musée Marmottan.

A love of water lilies

The Musée de l'Orangerie offers another opportunity to immerse oneself in Monet's paintings. On the ground floor of the building, once used as winter storage for temperature-sensitive plants, the ►

images of water lilies form a spectacular panorama: along the walls of the oval-shaped exhibition space, oil shimmers across the canvas, and sunlight across the water. The flower petals' delicate pink merges with the light green of the leaves. Powerful turquoise suggests mysterious depths. Over a period of 30 years, Monet created this piece of art as a complete work, for this very room – inspired by his pond of water lilies in Giverny, nearly 80 kilometers from Paris.

Outside the Orangerie, and next to the Tuileries, the blue-gray river Seine flows westward towards the English Channel. Those who wish to continue their tour of the arts with the Musée d'Orsay, likely the most famous museum in the city after the Louvre and located between the Eiffel Tower and Île de la Cité, must cross the river. The Pont de la Concorde, with its stone arches, was constructed in 1791, during the French Revolution, with hewn stone obtained from the Bastille – the federal prison which had been stormed in 1789 by angry citizens in a revolt against their king. The prison was demolished not long after.

A station for the arts

We're almost there. This classicist edifice featuring an airy steel and glass roof, immediately recognizable by its two large clocks with Roman numerals, is definitely worth a visit. The clocks reveal the original purpose of the building: on the occasion of the 1900 Paris Exposition, it had been constructed as a railway station and hotel. When the Gare d'Orsay was officially opened, Claude Monet, already 60 years old, regularly traveled by train from his house in Giverny to London to paint the river Thames. His journeys started right here, at the Gare d'Orsay.

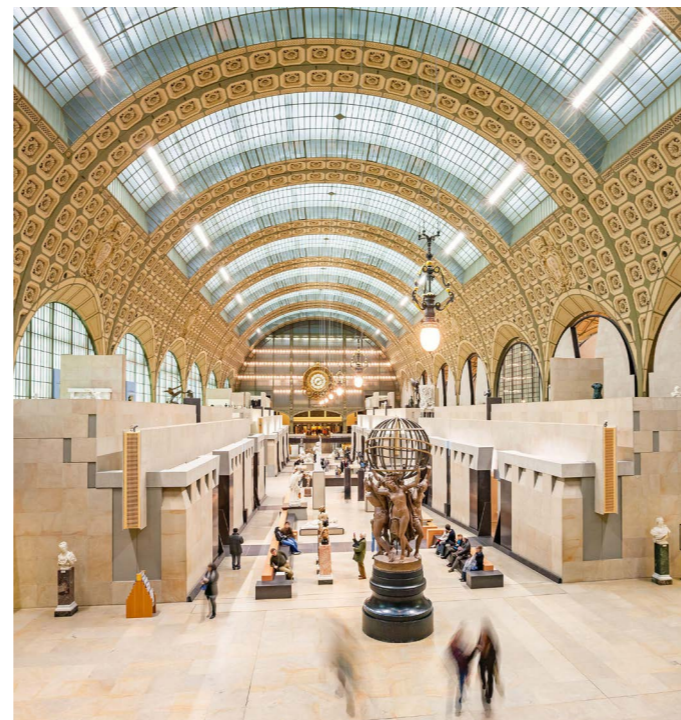
Those who enter the museum will initially find themselves in a vast concourse with a center boulevard of sculptures. Statues of marble and bronze stretch out on pedestals; the rooms to the left and right display oil paintings in close proximity. One strolls among the art or, in the words of Monet's contemporary, poet Charles Baudelaire, one allows oneself to drift. Everything is inspiring, everything is beautiful. And this is why one must make sure to leave enough time to visit Monet's works on the second floor. One will be fascinated by a blue water lily – as well as the Houses of Parliament in London and a Luncheon on the Grass, inspired by Édouard Manet's famous "Luncheon on the Grass". And one will see Monet's first wife Camille on her deathbed. As an old man, this famous impressionist painter temporarily lost his sight. The world as he saw it, however, has survived in Paris through his many paintings. ■



Jardin des Tuileries
Not far from the Louvre, the Baroque palace park invites you to linger



House of Impressionism
The Musée Marmottan is home to 100 Monet works



Former terminus
The Gare d'Orsay station is home to the Musée d'Orsay with its many works by Monet

! EPPENDORF IN PARIS

Eppendorf France SAS ensures the marketing of all products and services in France and the Maghreb (via local vendors). The team supports partner vendors and customers prior to, during and after the sale. The services at the Montesson location – roughly 20 kilometers northwest of Paris – include everything from sales support to quality management and controlling, all the way to marketing. Its proximity to the market provides Eppendorf France SAS with excellent knowledge of customer needs. And thanks to a smart channel strategy, it is possible to respond to specific questions and thus be able to offer individual solutions.

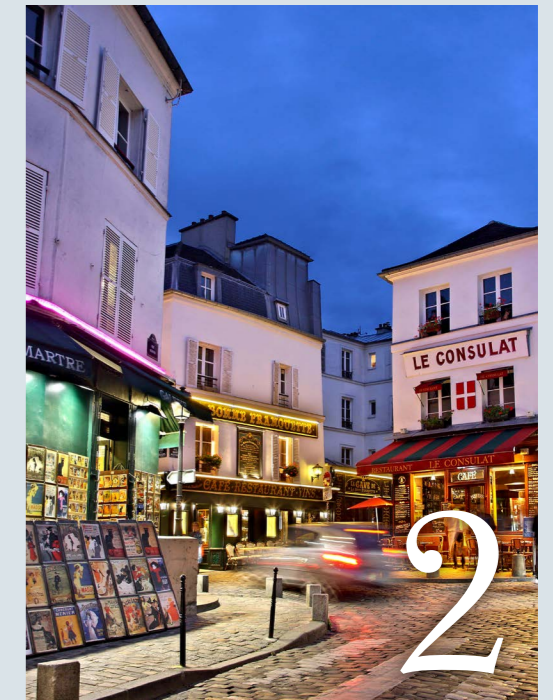
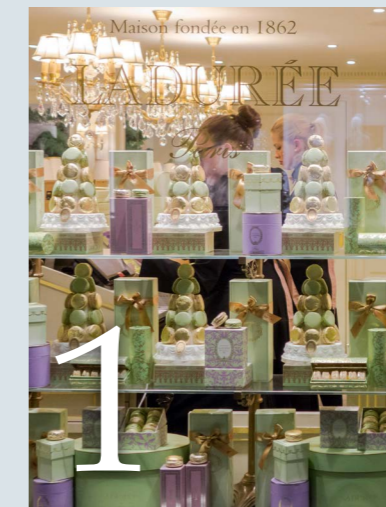
LET'S GO!

France – artistic and delicious

No visit to Paris is complete without **macarons**, those candy-colored almond meringues which, after the first bite through their wafer-thin crust, will melt in your mouth. They actually originate in Italy and were made famous in France by Pierre Hermé in the 1980s. Vogue recently named this star confectioner the "Picasso of Patisserie" in recognition of his artful creations. Macarons are for sale practically everywhere in Paris. Apparently, however, they are particularly tasty in one branch of the **high-end patisserie Ladurée**.

Ladurée, 75 Av. des Champs-Élysées, 75008 Paris

www.laduree.fr



Montmartre is well-known as the artists' quarter of Paris. Throughout the Belle Époque, artists including van Gogh, Matisse, Degas, Modigliani and Cézanne lived in small, picturesque alleys surrounding the Sacré-Coeur Basilica. Life is still colorful here – the Cabaret Moulin Rouge is located in Montmartre, as is the café featured in the famous movie "Amélie". The Rue Véron is a little less crowded with tourists. Almost every house features street art.

Rue Véron, 75018 Paris

The **Centre Pompidou** is a center for art and culture co-designed by Italian architect Renzo Piano. Located in the 4th arrondissement, it is home to one of the most impressive art collections of 20th century Europe. After appreciating the works of art, the rooftop restaurant **Le Georges** awaits with coffee and delicious food – and a panoramic view across the capital city, including the Eiffel Tower. For this occasion, the Pink Bar is well stocked with a large selection of vodkas.

6th floor, Centre Georges Pompidou, Place Georges Pompidou, 75004 Paris

<https://restaurantgeorgesparis.com>



Learning How to Pivot

After 5 years as a postdoc and co-principal investigator in an academic research lab, I am about to start my own company. It's a big step, and I'm excited – and a little anxious – about how it will work out. I am very aware that things might not go the way I envision. But pivoting does not feel as intimidating as it could – because I've done it before, starting early in my career. In doing so, I've learned that career changes should not be feared. Instead, they are valuable opportunities for professional development and growth.

When I finished my under-graduate training 14 years ago, I wanted to continue in academic research. But none of my applications for Ph.D. programs was successful. I wondered whether spending time in an industry job might help me stand out. At the same time, I worried that going to industry would compromise my chances of ultimately pursuing an academic career. Colleagues and professors told me that a move to industry would be a path of no return, and that big career changes could be rough. It felt like a momentous decision that would set the tone for the rest of my career.

Nonetheless, I decided to take the leap and accept a position at a biotech company. To my surprise, I loved working there. In fact, my experience was so positive that I changed plans. I did not want to do a Ph.D. anymore; I wanted a career in industry. I thought I had found my vocation, and that my path was clear.

But my position was just a 1-year contract, and when I started to look for my next industry job, I hit a bureaucratic obstacle. I was searching for jobs across Europe, and in many countries my undergraduate degree was not considered sufficient training for the positions I wanted. So much for that supposedly clear path.

It looked like it was time for another pivot – back to where I had started, applying to Ph.D. programs. Again, I wondered whether moving back and forth between industry and academia might put me at a disadvantage with potential future employers. But my previous transition had taught me I should be open-minded and embrace opportunities as they come, even if they are not my top choice at the time. You never know how things are going to turn out. So, I tried not to be too anxious about changing course again.

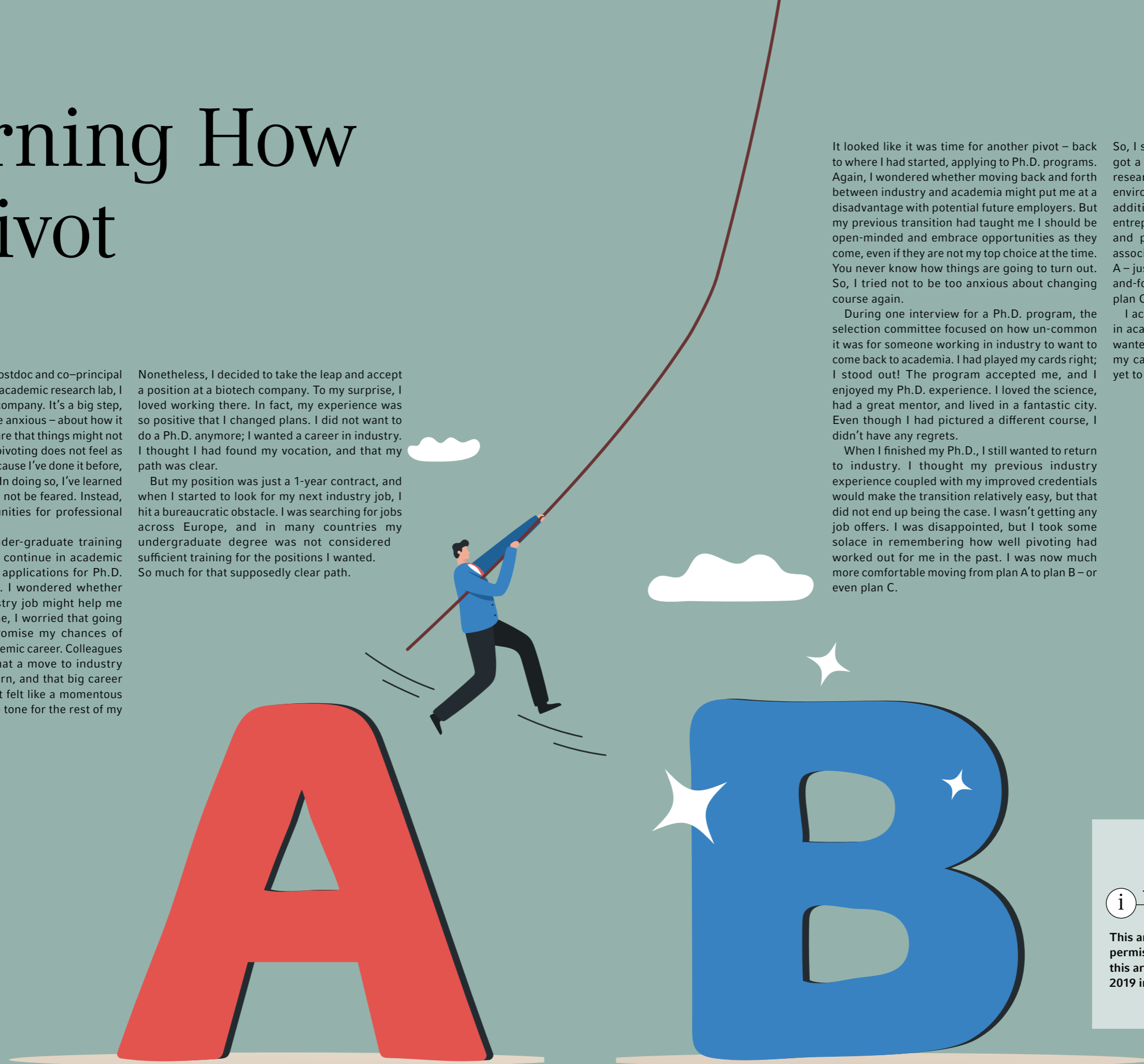
During one interview for a Ph.D. program, the selection committee focused on how un-common it was for someone working in industry to want to come back to academia. I had played my cards right; I stood out! The program accepted me, and I enjoyed my Ph.D. experience. I loved the science, had a great mentor, and lived in a fantastic city. Even though I had pictured a different course, I didn't have any regrets.

When I finished my Ph.D., I still wanted to return to industry. I thought my previous industry experience coupled with my improved credentials would make the transition relatively easy, but that did not end up being the case. I wasn't getting any job offers. I was disappointed, but I took some solace in remembering how well pivoting had worked out for me in the past. I was now much more comfortable moving from plan A to plan B – or even plan C.

So, I started to apply for postdoctoral positions. I got a great offer to start an independent line of research in a group with an outstanding working environment, and my time there has been great. In addition to my research, I've developed my entrepreneurial and leadership skills as co-founder and president of my Ph.D. program's alumni association. Looking back, plan B feels like a plan A – just as it did so many times before in my back-and-forth career. And now I'm ready to embark on plan C: setting out as an entrepreneur.

I accepted a job in industry when my mind was in academia. I found a job in academia when all I wanted was a job in industry. Yet I feel happy with my career path, and I look forward to the pivots yet to come

Pedro Resende is a research associate at i3S (the Institute for Research and Innovation in Health) in Porto, Portugal. Send your career story to SciCareerEditor@aaas.org.



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