The Costs of Terrorism

How attackers inflict great social and economic
damage with meager financial means > page 4

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Yearly Report 2015: The Numbers Stand for People

The positive development of the University of Freiburg cannot be represented by means of numbers alone, because the numbers stand for people and their achievements. All the same, the university would like to give you an idea of these developments in compact form. The detachable yearly report presents data and facts from the past year.

Mitgezählt

Jahresbericht 2015

UNI FREIBURG

Albert-Ludwigs-Universität Freiburg

Vorwort des Rektors
Entwicklung der Studierendenzahlen
Studierende und Absolventen
Abschlüsse, Promotionen, Habilitationen
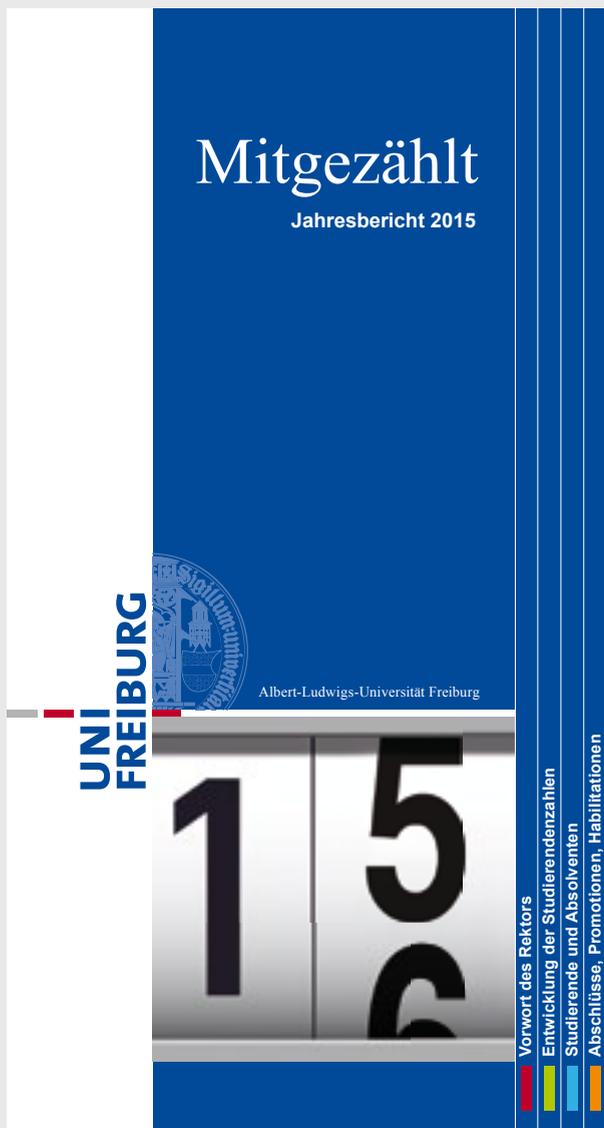
The Yearly Report 2015 of the University of Freiburg should be attached to this page. The report is also available on the university website:
www.pr.uni-freiburg.de/go/jahresbericht_2015

Research

Teaching

Small Budget, Great Damage

Tim Krieger is studying the financial aspects and consequences of terrorist attacks

by Annette Kollefrath-Persch

The World Trade Center in New York was destroyed in the attacks on 11 September 2001. It cost between 10 and 15 billion US dollars to rebuild the site – so-called Ground Zero. Photo: Eric J. Tilford/Wikimedia Commons

In the aftermath of terrorist attacks, the country affected usually frees up large sums of money for military and security measures. The United States government spent around 16 billion dollars per month on the wars in Afghanistan and Iraq.

Photo: Mike Pryor/Wikimedia Commons

On 13 November 2015, attackers with Islamist motives spread fear and terror at five locations in Paris. The massacre in the French capital claimed the lives of 130 innocent people and injured 352 more, 97 of them severely. Seven of the terrorists also died in the attacks. They had contact with the organization Islamic State (IS) and were armed only with semiautomatic weapons and explosives. Thus, they succeeded in traumatizing Europe as a whole with a comparatively small budget.

Emotional and Economic Consequences

For France, however, as for the USA following the strikes by the Islamist group Al-Qaeda on 11 September 2001, the consequences of these attacks were not just emotional but also economic. Prof. Dr. Tim Krieger calculates the costs for

"A strong economy can deprive terrorism of a fertile breeding ground."

countries struck by terrorist attacks. "The shocking thing is that these terrorists can impose enormous social and economic costs on a country in order to pressurize the government into meeting their demands. The Paris attackers, for instance, were interested primarily in stopping the French military operation in Syria," explains the University of Freiburg economist. He and his research

team are studying the economic consequences of global terrorism.

The holder of the Wilfried Guth Endowed Chair in Regulation and Competition Policy makes a distinction between direct and indirect costs. The obvious direct costs are the human suffering caused by casualties and injuries as well as damage to buildings and infrastructure. It is easy to quantify these financial consequences by calculating the cost of reconstructing buildings and infrastructure. The cost of human lives can be estimated on the basis of the victims' life insurance policies. In the case of the attacks on the World Trade Center, for instance, the insured costs alone amounted to more than 40 billion US dollars, and rebuilding Ground Zero cost between 10 and 15 billion US dollars.

Budgetary Redistribution

In the long term, countries hit by terrorist attacks also have to bear additional indirect costs, explains Krieger: "These indirect costs are much higher than the direct costs." The most critical factor is the redistribution of the government budget. "Money originally earmarked for productive investments like education is redirected to military and security measures. However, these measures only have a short-term impact and do nothing to remove the causes of the terrorism."

In the direct aftermath of attacks, there is an emotionally motivated change in public opinion and behavior, says the economist. After 11 Sep-

Mayor of Paris Anne Hidalgo, French President François Hollande, and US President Barack Obama (from left) mourn the victims of the attacks in Paris on 13 November 2015: The goal of the attacks was to hit the country hard and attract media attention.

Photo: Mike Pryor/Wikimedia Commons

tember 2001, the majority of the American population called for or at least welcomed tighter security measures. As a result, the US government freed up immense sums for police, military, and secret service to take action against terrorists. According to Krieger, several studies have estimated spending for the resulting wars in Afghanistan and Iraq at around 16 billion dollars – per month. The government in Paris also reacted with military operations in November 2015: The French air force began bombing IS positions in Syria just two days after the attacks.

"Conflict research has been overlooked in regulatory policy."

Moreover, there are so-called reaction costs. They result from the fact that people change their lifestyle, their consumption or saving patterns, or their means of transport for fear of further attacks. In the USA, the Freiburg researcher observed an interesting avoidance reaction that also had an economic impact: Many people were afraid of flying and began instead using their cars even for long-distance domestic travel. This led to more than 300 additional road casualties per month in the time after 11 September 2001, because there were more accidents on the roads. "On account of the emotions aroused by the attacks, people

had a hard time correctly assessing risks." In their fear of falling victim to a terrorist strike themselves, the Americans overestimated this risk – disregarding the fact that the probability of getting into an automobile accident is much greater.

A Vicious Circle

These costs slowed down the economy and also had an impact extending beyond mere economic aspects, says Krieger: "It might be difficult to measure the costs of people feeling less comfortable and happy as a whole in terms of typical economic categories, but these costs are nonetheless present." The citizens of unstable countries like Northern Ireland, which was regularly targeted by terrorist attacks in the past, or Israel are more liable to act in accordance with short-term interests and save less money. Moreover, when countries are hit regularly by attacks they become less interesting for foreign business investments. "This leads to a vicious circle," the economist explains, "because a strong economy can deprive terrorism of a fertile breeding ground." Plus, not every country has the financial resources available to the USA or France: "Poor countries have no means of defending themselves against terrorist attacks and therefore have to reckon with economic consequences that are even more severe."

Even though France is currently shouldering great expenses as a result of the November 2015 attacks, Krieger does not see a threat for the country's economy: "We know from research that people's life satisfaction decreases sharply after an attack but rises again rapidly." Terrorism only becomes a problem for the economy when it becomes a constant threat like in Israel. "France and Europe are very far from being threatened to this degree."

Krieger places great emphasis on developing a modern interpretation of regulatory policy, a research field that has previously been confined to Germany. He wants to extend the scope of his research across boundaries – both geographically and with regard to its content. "Conflict research in particular has been overlooked in regulatory policy," he says. But a change in perspective is vital precisely in view of transnational terrorists fighting against the current global order.

The Terrorists' Cost–Benefit Analysis

The Terrorist Attacks of 11 September 2001: Selected Financial Factors

US dollars (in billions)	0	10	20	30	40	50
Loss of four civil airplanes:	385 billion dollars					
Damage to buildings and infrastructure:	10 – 13 billion dollars					
Cleanup work:	1.3 billion dollars					
Direct loss of jobs (ca. 83,000):	17 billion dollars					
Loss of insurance policies:	40 billion dollars					
Loss in sales in aviation:	10 billion dollars					
Government emergency funds (e.g., increased airport security, sky marshals, military operation in Afghanistan)**:**	40 billion dollars					

The attacks cost the United States more than 100 billion US dollars. The sum includes the value of lost human lives as well as that of damages to real estate and losses in production. If one also takes into account the fact that profits were lower on the stock market due to economic fluctuations and that the interest rate was raised, the costs soar to two trillion US dollars. Source: Institute for the Analysis of Global Security; Graph: Kathrin Jachmann

In the future, the economist plans to concentrate his research efforts primarily on determining which economic policies are necessary to fight terrorism. His reflections on the costs of terrorist attacks have also made him conscious of the terrorists' cost–benefit analysis. Krieger sees the Paris attacks as "poor people's terrorism," because it is possible even for people of modest means: The combination of weapons and explosives available at a low cost and highly violent people provides "a simple means of spreading fear and terror." However, less wealthy terrorist groups need to calculate carefully, because a large-scale attack designed to attract as much attention from the media as possible rapidly depletes their financial resources. The terrorists thus select their targets with great care. The objective is to hit the country hard and frighten the population, as in the case of the raids and attacks by the Islamist terrorist group Boko Haram in Nigeria or attacks by terrorists living in Western industrial nations who identify with the IS.

Al-Qaeda is an exception to this rule, as the group was relatively well funded. But even their attacks show how terrorists can succeed in causing great damage with little means: The attacks on the US Embassy in Nairobi, Kenya, in 1998, which claimed 224 lives and injured thousands more, for example, cost Al-Qaeda a mere 10,000 US dollars. The attack on the aircraft carrier USS Cole in Yemen in 2000, which killed 17 American soldiers, cost only 5000 US dollars.

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Prof. Dr. Tim Krieger studied economics at the Universities of Kiel and Wisconsin–Eu Claire (USA). He earned his PhD at the University of Munich in 2004 with a dissertation on the political economy of migration in aging societies. In 2007 he accepted a position at the University of Paderborn as a junior professor of international economic policy. Following stints at the Universities of Mainz and Marburg, Krieger took over the new Wilfried Guth Endowed Professorship in Regulation and Competition Policy at the University of Freiburg in July 2012. His research builds on the ordoliberalism of the "Freiburg School" founded by Walter Eucken, which laid the foundation for Germany's social market economy.
Photo: Hanspeter Trefzer

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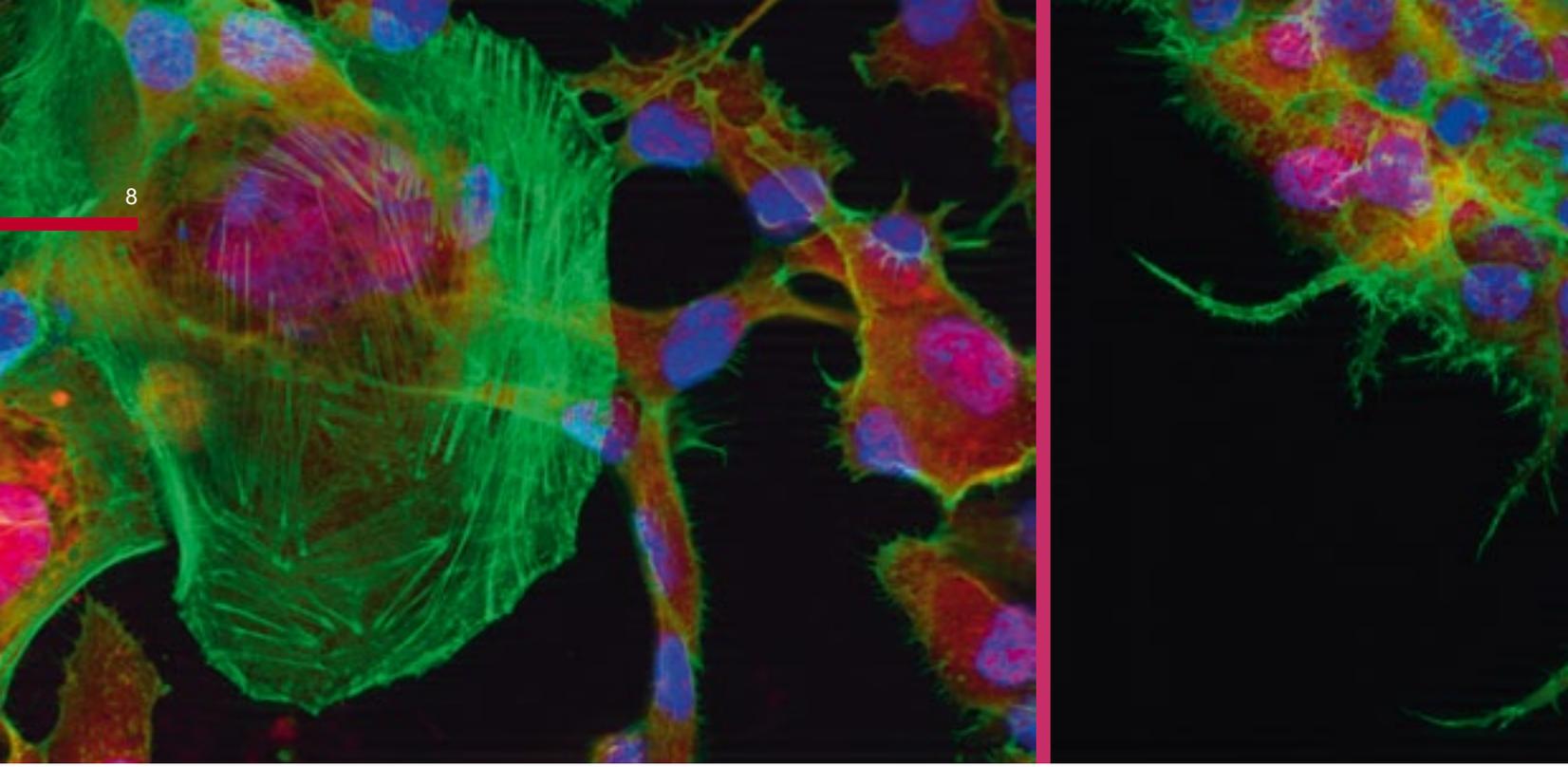
The Tumor's Weak Spot

Scientists are developing targeted therapies to act on disrupted signaling networks and fight cancer

by Katrin Albaum

The 35-year-old man has only just recovered from an operation in which the doctors removed his bladder tumor. A few months later he gets sick again: another tumor in his bladder. To make matters worse, the cancer cells have spread in his body and are relentlessly multiplying. The disease can be attributed to his mutated histiocytes – cells of the immune system that normally defend the body against invading germs. The doctors discover that there are two mutations in the cancer cells, including the mutation $BRAF^{F595L}$, about which there is still only little research. Which of the two is causing the tumor to grow, and what is an appropriate therapy to halt the progress of the disease? To find out, the doctors turn to the Freiburg biologist Dr. Tilman Brummer. He studies the signaling in cells and determines what processes cause a tu-

mor to appear and spread – for instance due to $BRAF$ mutations.

Not Always the Same Pattern

Brummer and his team are searching for substances for targeted therapies that can take action at the right points on disrupted signaling paths. When a gene in a cell is mutated, the proteins developed according to its blueprint also change. "We're testing whether and how already existing substances interact with the modified proteins," explains Brummer. Cancer does not always follow the same pattern: A substance that halts the growth of a tumor in cells with one mutation can accelerate its development in other cancer cells. The researchers thus gather as much information as possible about a tumor to
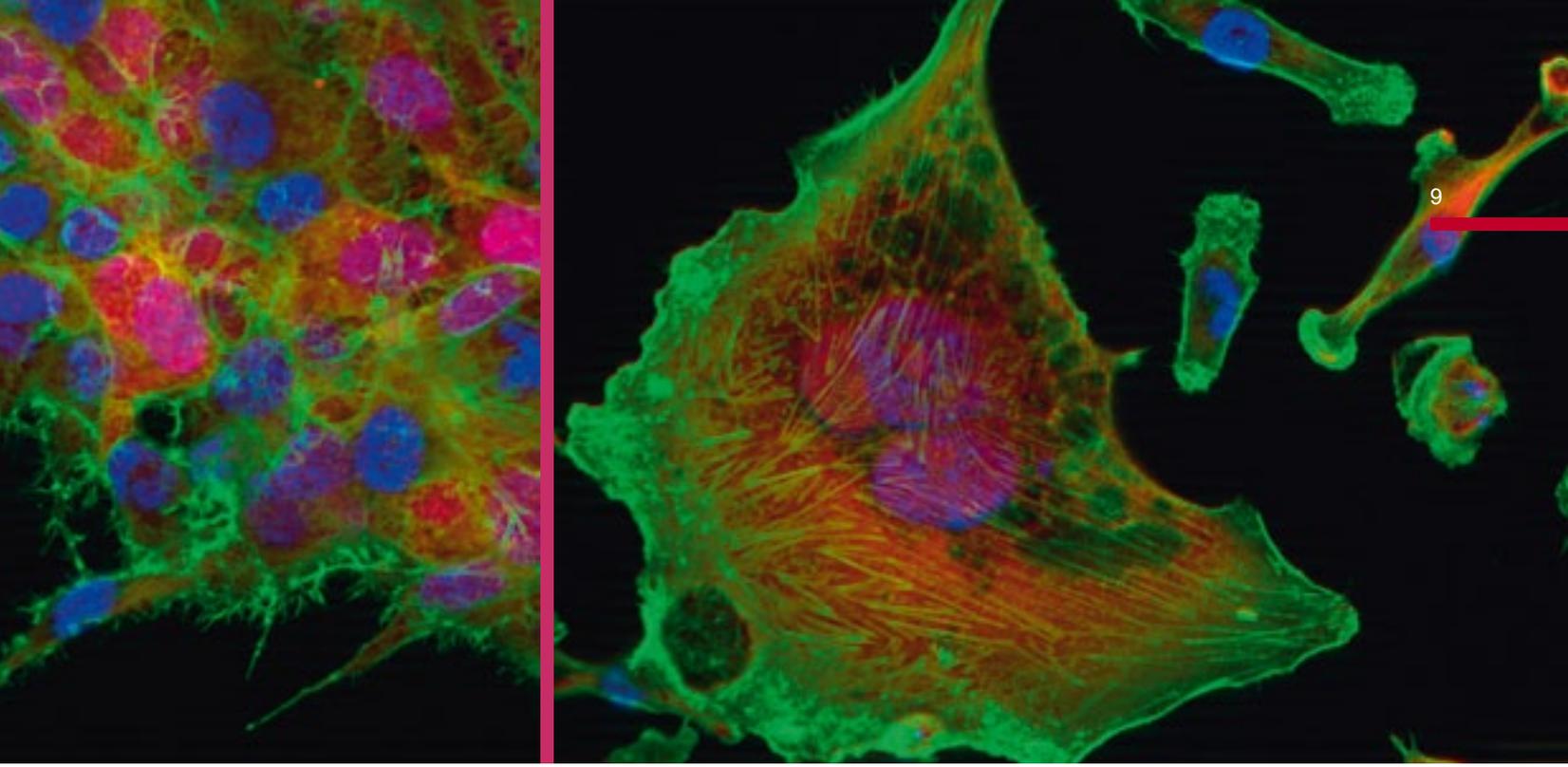
Lung cancer cells with a so-called Ras mutation under the microscope. The cell nuclei are shown in blue, the cytoskeleton in green.

find its weak spot. Brummer sees a personalized medicine that treats each patient individually as only achievable through interdisciplinary cooperation. Tumor conferences hosted by members of the German Consortium for Translational Cancer Research are one means of promoting such cooperation.

Cancer typically begins with the mutation of a gene belonging to one of two classes: the oncogenes or the tumor suppressors. An oncogenic protein drives the growth of a cancer tumor. When the underlying gene is not mutated, it is referred to as a proto-oncogene. Its products are proteins that play an important part in the transmission of signals in the cell. In wound healing, for example, the Ras/B-Raf/MEK/ERK pathway

"A tumor suppressor product is like the brakes of a car."

interacts with several proto-oncogenes. Brummer is focusing on an important component of this signaling pathway, the protein B-Raf: He is conducting research to determine how the body of mammals regulates this protein, when a mutation appears in the *BRAF* gene, and which mechanisms enable a tumor to spread.

For a wound to close, the skin cells must multiply and move toward each other. The blood platelets secrete so-called growth factors that switch on a receptor in cells in the wound. This receptor then activates the protein Ras to set the signaling chain in motion: Ras activates B-Raf, B-Raf activates MEK, and MEK activates ERK. ERK migrates to the cell nucleus and causes the cell to divide. This involves a series of steps: "The protein ERK controls hundreds of different processes in the human cell," says Brummer. When the *RAS* or *BRAF* genes mutate and become oncogenes, the signaling pathway is always switched on, and the cells keep on multiplying: A cancerous ulcer develops.

The Antagonist's Blueprint

Tumor suppressors are genes that provide the blueprint for the antagonist of the proto-oncogene proteins. The body uses the proteins transcribed from these genes to protect itself from mutated cancer cells. For example, they can initiate their cell death. "A tumor suppressor product is like the brakes of a car," Brummer explains. "Proto-oncogenes, on the other hand, work like a gas pedal." The car needs to increase its speed from time to time to keep moving, but it can't keep on accelerating forever. "You might say an oncogenic mutation blocks the gas pedal. If the brakes don't work either, you'll soon have an accident."

A common mutation of the *BRAF* gene is the V600E mutation. When the cell fails to repair this modification, it assembles the protein in B-Raf

incorrectly during transcription. In its normal, non-mutated state, B-Raf has a kind of closed mouth when it is not active. Ras stimulates B-Raf to attach itself to phosphate groups, a process known as phosphorylation. B-Raf opens its mouth and is in an active state, enabling it to activate the next link in the signaling chain, MEK. The V600 mutation always has its mouth open: "The mutation puts the molecule in a state that imitates the effects of phosphorylation perfectly. Its mouth is and remains open, although B-Raf has in reality not been activated at all."

"The tumor doesn't change the drug but the dealer."

This type of mutation is present in more than 50 percent of humans suffering from melanoma skin cancer. Tumors caused by the V600E mutation can be treated with substances that inhibit B-Raf. However, the tumors are often resistant. "We speak of an oncogenic dependency: The tumor is addicted to the cancer-inducing signal, so to say." Since cancer cells are often genetically unstable, they can continue to develop and reactivate the Ras/B-Raf/MEK/ERK signaling path-

way. In some patients, the *MEK* gene mutates in such a way that it can bypass B-Raf in the signaling chain. In others, the cancer cells succeed in increasing the quantity of Ras. Continuing to administer a B-Raf inhibitor in such a case would be fatal: "Ras then works together with the blocked B-Raf, which is still bound to the drug, to activate another variant of Raf, a cousin of B-Raf, as it were. The signaling pathway is thus activated again, often more strongly. The tumor doesn't change the drug but the dealer."

Brummer and his research group showed in a study what happens with the mutated gene BRAF[V600E] leaves the cell again or is blocked by B-Raf inhibitors. It was already known previously that V600E is an oncogenic driver and therefore causes cancer. Brummer's team confirmed this and went one step further: "You might say we fixed the blocked gas pedal. In this way, we demonstrated that cells do not stop growing when the mutation is bypassed but differentiate again." This means that the cells specialize, and as a result they behave less aggressively. The probability that they will leave the tumor to form metastases somewhere else in the body decreases. The researchers applied methods from synthetic
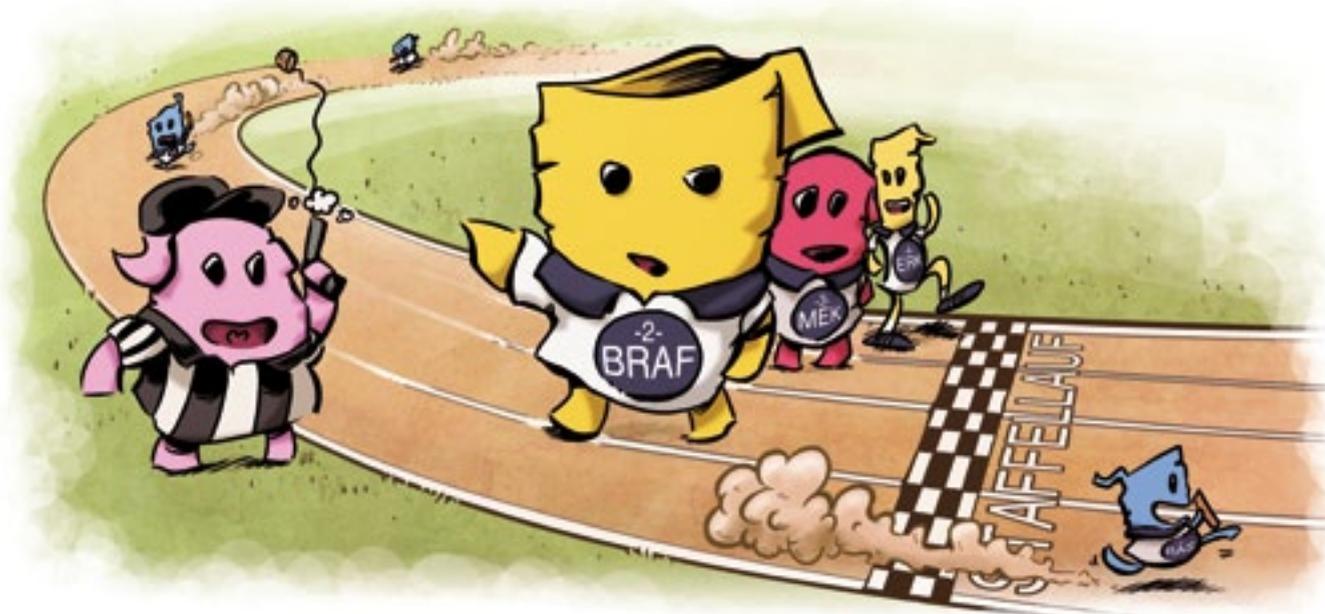
Relay race in the cell: The proteins on the Ras/B-Raf/MEK/ERK pathway activate each other in succession, passing on the baton, so to say. This signaling chain plays an important role in numerous processes in the body, such as wound healing.

Illustration: David M. Malambré – DSQ Comics + Design
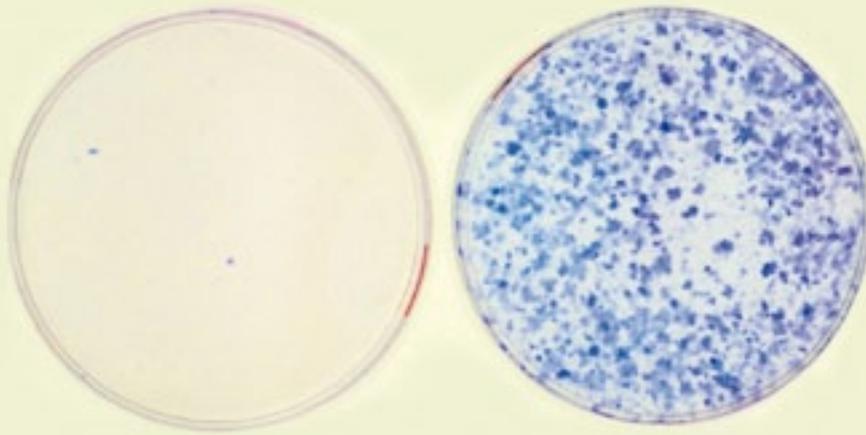
One of these petri dishes contains cells with the normal BRAF *gene as a control, and the other contains the same cells with a* BRAF^{F595L} *mutation. The cells in the control dish (left) stop growing as soon as they make contact with their neighbors. They thus appear "colorless" here. The cells with the* BRAF^{F595L} *mutation (right) grow uncontrollably over one another – the blue-colored cell clusters are visible with the naked eye. Photo: Sandra Braun/Tilman Brummer*

biology for the study: They built a molecular switch into tumor cells with the BRAF^{V600E} gene, enabling it to switch off the assembly instructions for the mutated B-Raf^{V600E} protein. "But our results only apply to cell cultures. This principle cannot yet be applied to humans. However, such experiments can help to improve therapies with the existing B-Raf inhibitors."

A New Weak Spot

Brummer and his team have also discovered a possible weak spot that could be targeted to eliminate several mutations unrelated to V600E. The researchers introduce a so-called AVKA mutation to the gene. It causes the lips of B-Raf's mouth to remain closed, making it much more difficult to activate. This approach could serve as an alternative to the existing B-Raf inhibitors, which are only approved for V600E or V600K mutations. "Our results show that the AVKA mutation is effective at blocking B-Raf and hardly has any side effects at all." Brummer hopes that the discovery of this weak spot will lead one day to an active substance for treating cancer. "We are continuing to investigate the consequences of this mutation for the regulation of B-Raf."

As a biologist, Brummer is interested in fundamental research. However, he doesn't believe in separating medicine and biology: "There's a lot to be learned about biological mechanisms from the study of diseases, and doctors can also profit from fundamental research" – as in the case of the 35-year-old patient with the *BRAF*^{F595L} mutation. Brummer and his team discovered that this rare mutation sends out signals that can cause cancer. However, the man died before an appropriate therapy could be found. Nevertheless, the researchers gained new insight that can help the next time a patient is diagnosed with a tumor with this BRAF mutation.

www.mol-med.uni-freiburg.de/mom/brummer
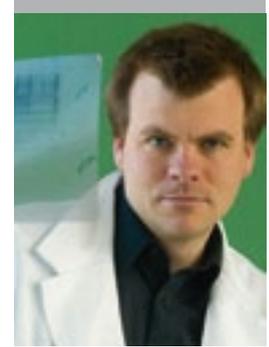
Dr. Tilman Brummer studied biology in Freiburg and wrote his dissertation at the former Max Planck Institute of Immunobiology. In 2003 he accepted a position at the Garvan Institute of Medical Research in Sydney, Australia, and in 2008 he came to Freiburg's Cluster of Excellence BIOSS Centre for Biological Signalling Studies on a grant from the German Research Foundation's Emmy Noether Program. He leads a research group at the Institute of Molecular Medicine and Cell Research and is also a principle investigator at the Spemann Graduate School of Biology and Medicine (SGBM) and collaborative research center 850, "Control of Cell Motility in Morphogenesis, Cancer Invasion, and Metastasis," at the University of Freiburg. In 2015 he was appointed to a Heisenberg Professorship by the German Research Foundation. His research focuses on signaling in cells, especially cancer cells.
Photo: Klaus Polkowski/BIOSS

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Stars, Waves, Cascades

Peter Fischer is using Twitter to analyze
how information spreads on social media

by Claudia Füßler

*With Twitter, it's generally clear which
users are connected with each other.
The messaging service is therefore
particularly well suited for the scientific
analysis of dissemination paths.*
Photo: Sandra Meyndt
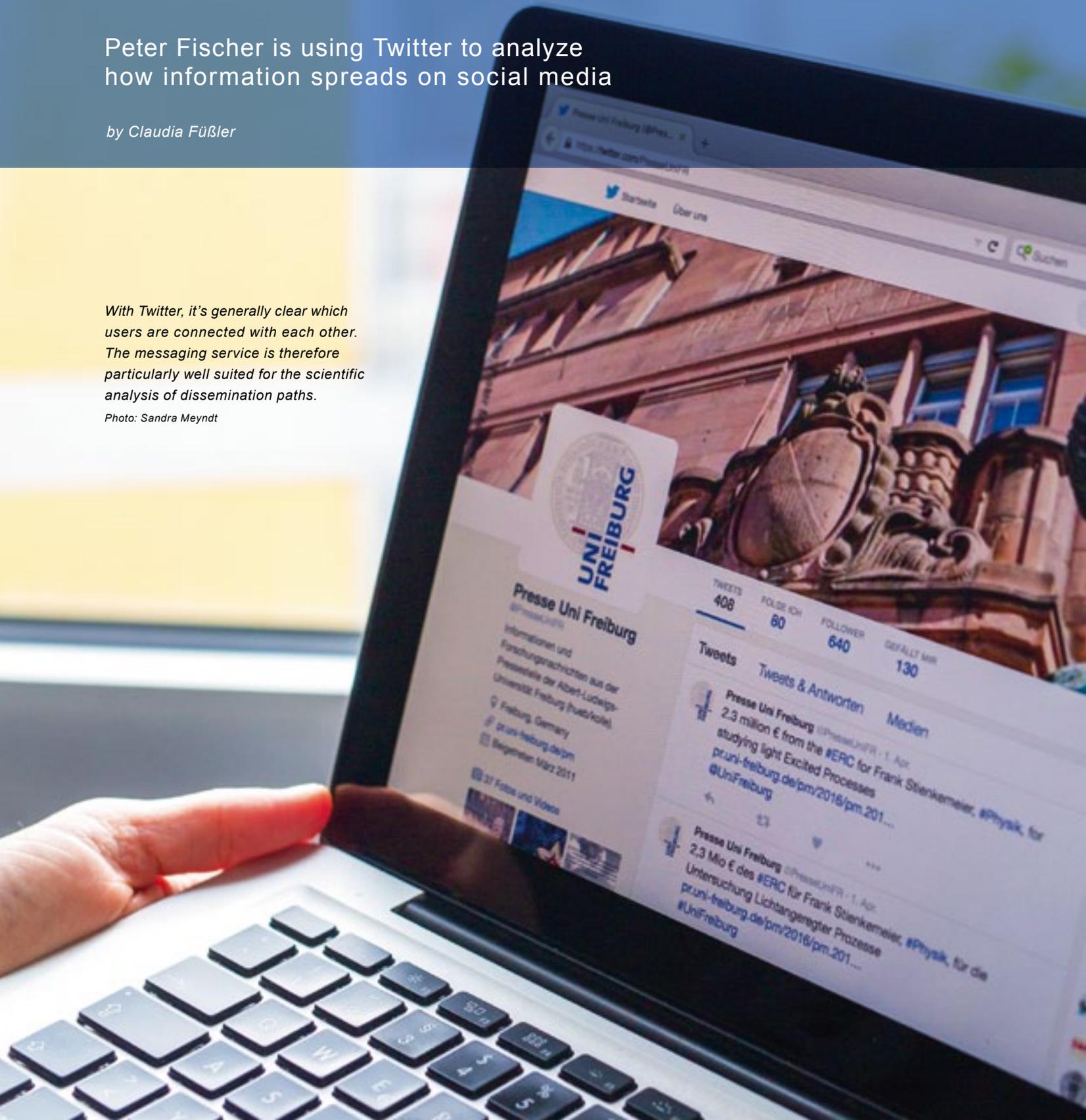
"We leave the content out of our analyses."

Scientists will never be capable of predicting precisely how fast a freshly sent tweet on Twitter or a new message on Facebook will spread and how far it will travel, of that junior professor Dr. Peter Fischer is certain. But there's another prediction the Freiburg computer scientist and his colleagues can make: Once a message has been circulating on social media for a certain period of time, they can say with relative precision how long it will continue to spread in the same way – in terms of speed as well as the number of people it will reach. "We have managed to reach 85-percent accuracy on this point," says Fischer.

Confirming Rumors

Nowadays, social channels catapult information to all corners of the earth at the blink of an eye – from breakfast in Japan to dinner in Canada, from mountain climbing in Norway to surfing in South Africa. It's not possible to reconstruct this dissemination process, much less control it. Some find this idea disturbing, while others find it fascinating. Peter Fischer is of the latter sort. The junior professor at the University of Freiburg's Department of Computer Science is interested in the logic of the World Wide Web, especially the question of how and in what form information spreads. At the same time, he wants to find out what role users play in disseminating information and whether some people have more influence on the process than others. And if this is indeed the case, how can one find them?

"Once we have reached a better understanding of how information spreads on social media, it will be possible to identify the source of a piece of information in a matter of seconds," says Fischer. This would benefit journalists, enabling them to confirm the truthfulness of rumors spread online more quickly, but it would also allow all other users to determine where a piece of information originated. Another thing Fischer finds fascinating is our subjective perception of how frequently particular information appears on social media. Journalists cite well-known hashtags like #aufschrei or #einearmlaenge – both referring to the topic of sexism and sexual assault in the wake of the incidents during the 2016 New Year's Eve celebrations in Cologne – and then use them to piece together a story to show that this is a topic of great concern on social media and is therefore important for society. "The amazing thing is that these hashtags usually aren't nearly as widespread as we would think they should be," reports Fischer.

Big Data

Where does information come from? Who spreads it? Whom does it reach? In their quest to find answers to these questions, Fischer and his team deal with the bread and butter of computer scientists: big data. Twitter has more than 300 million users who post over 500 million tweets a day. Facebook has more than a billion users worldwide. That's a lot of data. Under normal circumstances, a couple of thousand messages flow through the veins of the social networks each second.

When there's something important to communicate, for instance when a celebrity dies or a terrorist attack happens somewhere, the network's heart rate skyrockets to around 150,000

Type, send, share: Thousands of messages flow through social networks each second – up to 150,000 at peak periods.

Photo: Syda Productions/Fotolia

messages per second. Experts speak in such cases of an information cascade. This may be seen when a pop star tweets a piece of news into the world, such as the announcement of a new album or a pregnancy. The news is registered and disseminated at lightning speed by the star's fans and followers – but it doesn't reach many people beyond this group. "We refer to this as a star," says Fischer. "The message spreads from a central point – in this case the pop star – in one or, at most, two waves. Then, only a short time later, it all collapses again."

What is much more fascinating for the researchers is information that spreads through the social networks over a longer period of time and in several waves. A good example of such processes is chain messages. They travel through the Internet for weeks before finally winding up in the big data trash heap. Then someone suddenly finds one of these messages funny again and shares it – sometimes years later.

As an essential precondition for conducting their research, Fischer and his colleagues need access to the shared data and information on how the individual users are connected with one another. The messaging service Twitter has proven to be particularly practical for this purpose.

Since Twitter messages can be collected by keywords and users, it's easy to follow how they spread. In addition, it's clear for every user who is following whom, how many followers each user has, and how they are connected with each other. Facebook, on the other hand, is much less accessible from outside. The researchers come up against a brick wall as soon as someone sets their account to "private." "We don't have access to profiles set to 'private' on Twitter either, but this is less common on Twitter."

Retracing the Path of a Message

So Twitter it is. This social network has a "retweet" function for forwarding a message one has received. It and all freely viewable connections between users allow the researchers to follow the path of a message – in the best case all the way back to its source. The more times a message has been forwarded, the longer it takes. Once he has collected all the necessary data, Fischer can identify the most influential users for well over 90 percent of the cascading tweets and thus retrace the precise path of the message. In the remaining cases, factors other than retweeting play a role in the forwarding of messages, such as keyword searches – but it is not yet possible to determine these factors with sufficient

accuracy. The researchers can use the information to predict how the message will continue to spread in the next hours and days. What they don't know is which topics will become a trend and which won't. "We leave the content out of our analyses," says Fischer. It would be much too time-consuming to ask each user individually about their motives for sharing something.

A second important aspect of Fischer's research is the question as to the role of individual users. He analyzes the behavior of Twitter users and attempts to identify which ones play a key role in the circulation of particular messages. Which users act as disseminators, actively sharing content they find interesting? Who is primarily a passive consumer, reading information but not spreading it any further? Identifying such users could be interesting for companies. "Let's say you want to advertise a new product and reach a million people with your message. You have a certain budget at your disposal – and it would of course be very helpful if you could reach precisely those people who find the message interesting and pass it on to others." Ideally, the company would use an app to display in real time how the message spreads – and the original sender could influence who receives it and how. But developers are still a long way from being able to write such a program.

What Peter Fischer is focusing on at the moment is determining the connections between the dissemination patterns and the roles of the individual users. If he succeeds, the users might be able to better differentiate between trustworthy and untrustworthy information. It would also make it possible to expose spam more quickly. The predictions will not be definitive, however, because another factor that has thus far eluded all attempts at scientific analysis plays too large a role in the dissemination of messages: chance.

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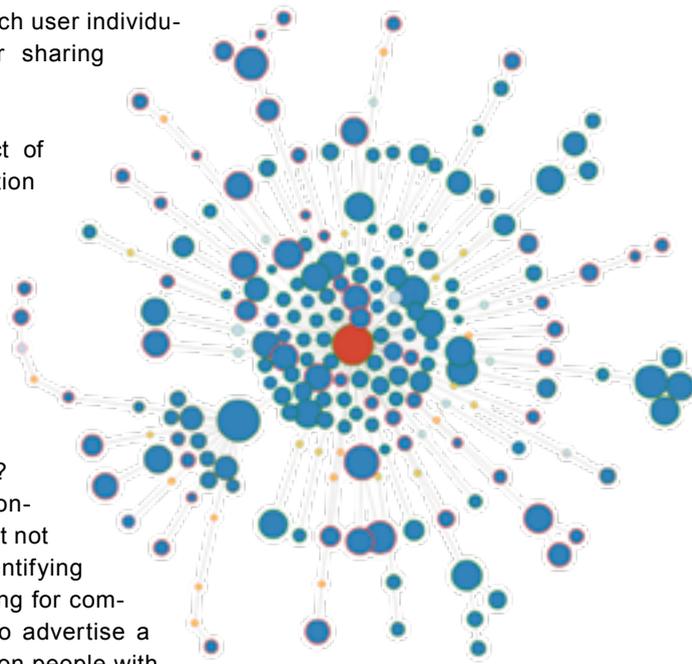
A message spreads through the Internet: The illustration shows the reconstruction and visualization of an information cascade. The red circle represents the source.
Source: Peter Fischer

Dr. Peter Fischer
has served as junior professor at the University of Freiburg's Department of Computer Science since October 2011. He studied at the Technical University of Munich and also began his dissertation there, completing it – following a stint at the University of Heidelberg – at ETH Zurich, Switzerland. Fischer focuses primarily on system-oriented work in data management, for instance with real-time analyses and the structure of information systems. His research on the analysis of social networks is currently being funded by Baden-Württemberg's state junior professorship program.
Photo: private

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Allowing rebel groups and the government to share power after an armed conflict might seem plausible, but such peace agreements are often short-lived. Illustration: Svenja Kirsch
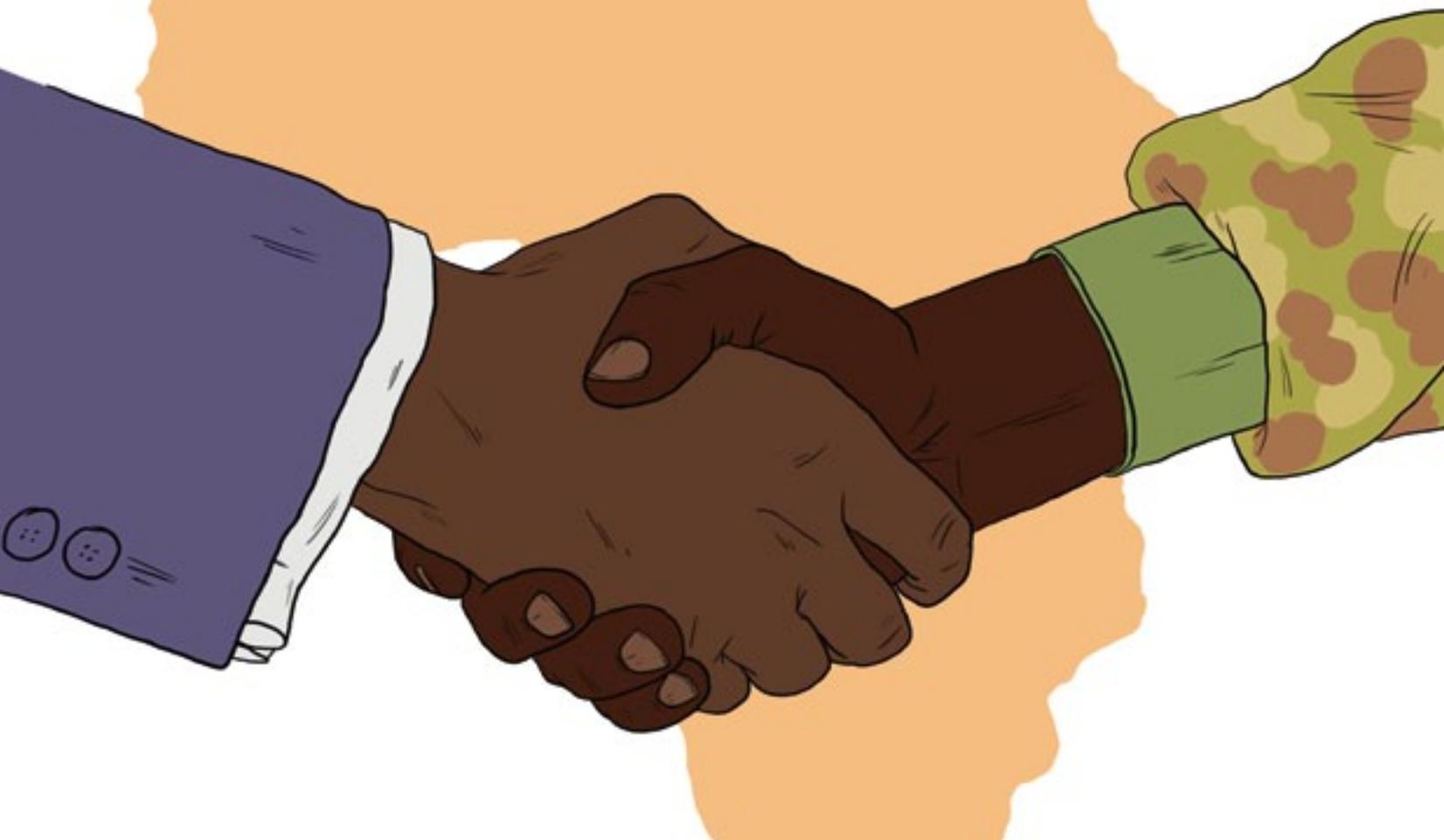
Unstable Power

Andreas Mehler is studying the pitfalls of peace negotiations in Central and West African countries torn by civil war

by Anita Rüffer

If only I did," sighs Andreas Mehler. The University of Freiburg professor of developmental theories and developmental policy and director of Freiburg's Arnold Bergstraesser Institute for Socio-Cultural Research doesn't have a solution for the conflict in Syria either. His research focuses on the countries south of the Sahara. However, his findings might one day also help to overcome the Syrian Civil War, which has come to claim the attention of the entire world. But if there's one thing Mehler's research has demonstrated, it's that "there's no standard formula for resolving civil conflicts."

The countries in francophone Central and West Africa he studies have provided plenty of illustrative material in recent years on how to manage conflicts and on what can go awry even with peacemaking efforts motivated by the best of intentions. Power sharing, for example, is a magic formula on which many hopes rest after civil wars – both in the region itself and internationally. It seems reasonable to include both rebel groups and the country's government in peace talks following an armed conflict – if possible with an external mediator – and it seems plausible to allow them to share power. But why are peace agreements based on such negotiations often so fragile and short-lived?

Bombing Oneself to Power

Mehler cites Ivory Coast as a classic example. Founded in 1960 out of a former French colony, the nation found itself divided by the turn of the century. A collective feeling of discrimination in the north precipitated a rebellion that quickly overwhelmed large parts of state territory after the outbreak of the civil war in 2002. In 2007, the president of Burkina Faso helped the country to negotiate a transitional peace agreement for the time up to the 2010 elections. It helped the only 35-year-old former student activist Guillaume Soro to ascend to the position of prime minister, an office he had practically bombed himself to as rebel leader. Today he's the second most powerful man in the country as president of the national assembly. But how does that benefit the political rank and file and the civil opposition?

As a standard resolution to civil wars, whether in Ivory Coast, in Chad, or in the Central African Republic, power sharing "is often more a part of the problem than the solution," says Mehler. For rebel leaders like Soro, the prospect of receiving a high government post provides a perverse incentive: If you want to come to power, all you need to do is attract enough attention with violence. This reduces the worth of civil opposition. The situation is similar in Congo, where the violent parties prevailed at the negotiation table. This marginalization of civil opposition is one of the difficulties facing peace development today. Moreover, it is almost impossible to get all parties to participate in a comprehensive solution to conflicts: "Those who aren't sitting at the negotiation table feel excluded and keep fighting" – in the hopes of at least receiving as much material compensation as possible if they agree to stop. And so, everyone speculates about snatching whatever pieces of the pie are still available.

Cushy Jobs for the Elites

According to Mehler's observations, the assumption that the main protagonists in peace negotiations are actually interested in achieving peace and establishing a democratic state is more a pious hope held by the international mediators: "Power sharing is usually not much more than a matter of distributing cushy jobs among ambitious elites." In his eyes, Soro is practically the

Interviews with local informants is one method the political scientists are using to analyze the current situation in the Central African Republic.
*Source: Tim Glawion*

embodiment of one of these military-political entrepreneurs who cannot claim to have any kind of legitimacy at all as the spokesman of discriminated groups. Thus, the important thing is to know whom you're dealing with and whom you should be dealing with. Instead of the elusive and often illusory goal of power sharing, a peace treaty should attempt above all else to resolve the causes of the conflict, recommends the political scientist.

"The significance of peripheries is grossly underestimated in peace negotiations."

And it's not enough to negotiate only with the elites in the capitals and major cities, as is all too often the case. "You need to go down to the local level and take a look at the centuries-old power structures." Which actors are involved in the peace process? Are they using their authority to promote peaceful coexistence, or are they mobi-

lizing the citizens against the state? In large, sparsely populated territorial states like the Central African Republic – where Mehler and his team are currently working on a project with funding from the German Research Foundation (DFG) – the state is often not even in the position to maintain its control over its entire territory. The neglected periphery then develops its own power structures, which do not always observe national borders. Sometimes, like in the northeast of Congo near the border to Ruanda, these areas produce conflicts that can spread to the entire country. The world is currently looking on at horror as the terrorist group Boko Haram commits atrocities in the neglected northeast of Nigeria. This region lacks streets, schools, and hospitals, as Mehler emphasizes, and it is easy to mobilize rebels from among the spreading Salafists. "The significance of peripheries is grossly underestimated in peace negotiations."

The state's monopoly of violence, taken for granted in our society, is not the norm in African societies according to the political scientist's findings. "The power has always been divided up

VIOLENT CONFLICTS IN 2014 (NATION-STATE LEVEL)

INTENSITY
- WAR
- LIMITED WAR
- VIOLENT CRISIS
- NO VIOLENT CONFLICT
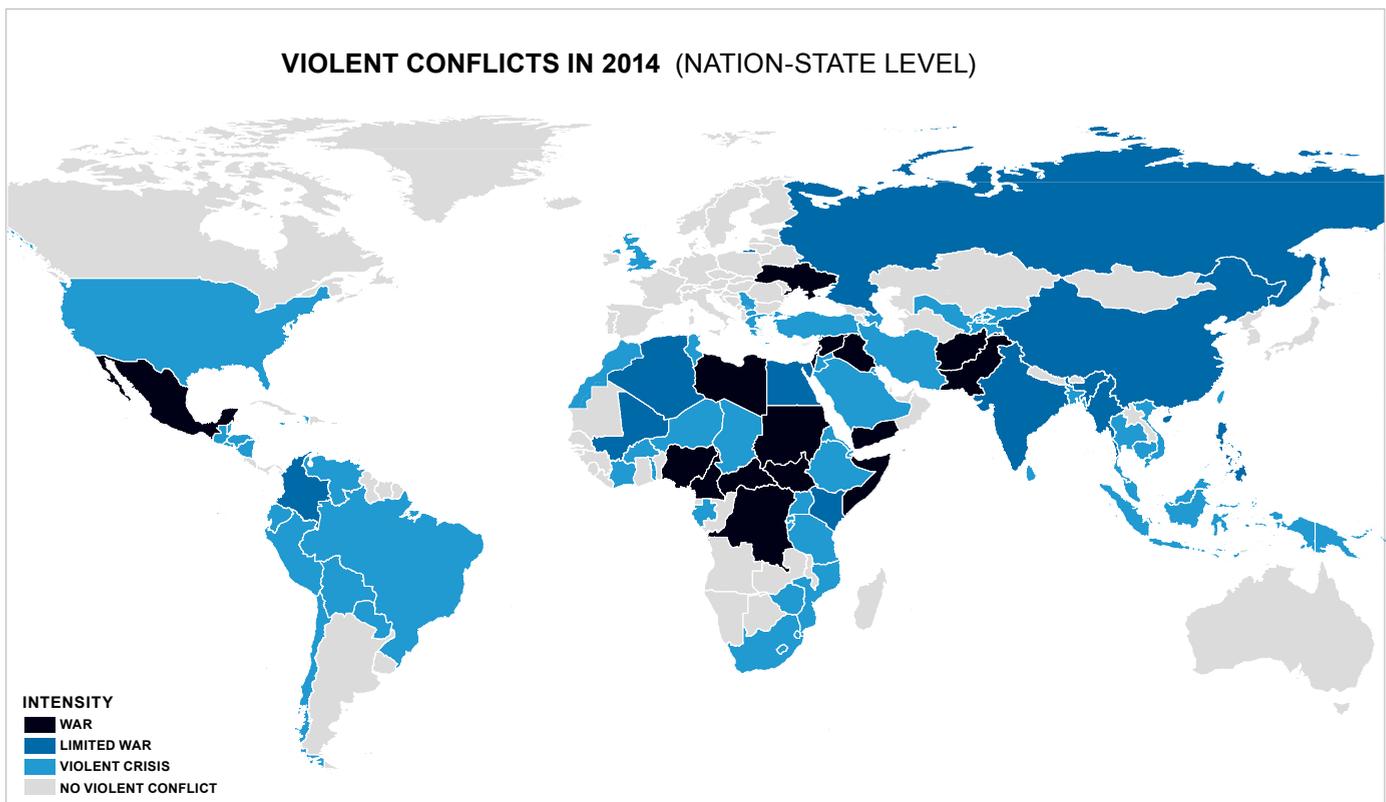
Many African countries experienced violent conflicts of varying intensity in 2014.

Source: Heidelberger Institut für internationale Konfliktforschung, Conflict Barometer 2014

Village in South Sudan: Regions far from capital cities and other urban centers often develop their own power structures. *Photo: Wollwerth Imagery/Fotolia*

Prof. Dr. Andreas Mehler studied political science and history at the University of Mannheim. He earned his PhD at the University of Hamburg, where he also went on to complete his habilitation thesis in 2011. He served as director of the GIGA Institute for Africa Studies from 2002 to 2015, and he was appointed director of the Arnold Bergstraesser Institute and professor of development policy and theory of development at the University of Freiburg in 2015. Mehler is a board member of the African Studies Association in Germany and is co-editor of the journal Africa Spectrum. *His research focuses on Central and West Africa and deals with power sharing after peace treaties, violent conflicts, crisis prevention, states and statehood, and German and French Africa policies.*
Photo: Arnold Bergstraesser Institute

among various authorities." The monopoly of violence is often replaced by an oligopoly of violence: "It encompasses a fluctuating number of violent agents of various quality that compete in some cases and cooperate in others." The people recognize whoever can provide for their safety and solve problems. Democratic legitimacy is of lesser importance. Those who are interested in achieving peace are well-advised to find out who has the people's trust, recommends Mehler. These are the groups that peacemakers need to meet with and seek the cooperation of, even if they are not exactly paragons of democratic virtue. That sounds like a lot of detailed work on a local scale and nuanced scrutiny of unfamiliar conditions. The simplistic categories in which the western world thinks, classifying conflicts either as ethnic or as religious, do not lead to viable solutions in many notoriously crisis-ridden areas, as Mehler has verified in his research.

Comparative Research

The political scientist's aim is not to "make sweeping conclusions on the basis of singular situations." He has thus turned to comparative research: "We focus on places where we assume that these problems exist. But we can't go everywhere, because some regions are too dangerous." For his DFG-funded research project "Alternatives to State-Sponsored Security in Areas of Extremely Limited Statehood," he decided to concentrate on the Central African Republic and South Sudan. These two countries rank among the weakest states in the world with regard to the capacity of their institutions to solve problems. He asks questions like these: Have there been national peace agreements? How were they interpreted locally? Were there incentives to shape politics outside of the urban centers, through measures like giving more autonomy to municipal councils? Then he compares the situation

before and after the agreement: Has something improved, or are the embers of the conflict still smoldering?

In February 2016, Mehler spent ten days in the Central African Republic. His colleagues were there for up to two months to conduct interviews. He also included local assistants in the research work, for instance to help conduct surveys among the population. Moreover, he organized roundtable discussions with selected groups – well-informed market women, teachers, and youth organizations that are being mobilized for the struggle – to gain insight into local power constellations.

Mehler has become a much sought-after expert on the refugee crisis among members of the national and state parliaments. After all, he knows a lot about why refugees leave their native country behind.

www.pr.uni-freiburg.de/go/entwicklungspolitik

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From Flower to Flower

Honeybees and many other winged insects play an important role in the pollination of crops

by Eva Opitz

A bumblebee forages for nectar in a marigold. Photo: Eva Opitz

The passion flower offers its nectar to a wasp species that is perfectly suited to this flower.
Photo: Catalina Gutiérrez Chacón
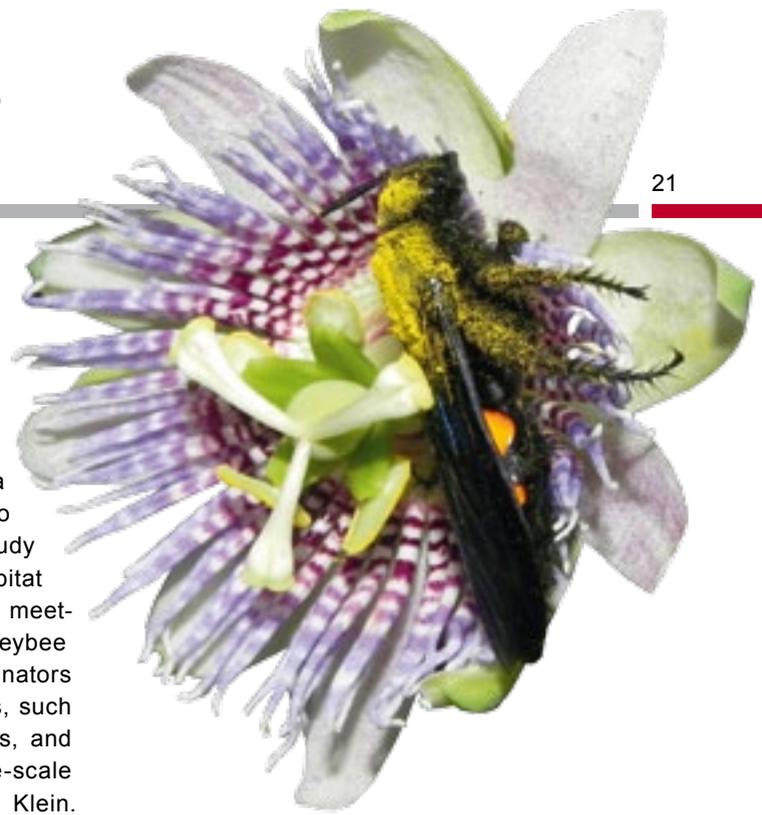
Hardly anyone wants to imagine a world in which there are no bees to pollinate crops. We therefore need to study bees' needs with regard to food and habitat and factors that could prevent them from meeting these needs. Besides various honeybee species, however, the community of pollinators also includes many other winged insects, such as wild bees, bumblebees, flies, beetles, and butterflies. That is the finding of a large-scale study co-authored by Alexandra-Maria Klein. The University of Freiburg professor of nature conservation and landscape ecology studies the entire process of pollination and all actors involved in it. "We should not ignore the role of pollinators that do not belong to the typical bee species, as has often been done in the past," demands the ecologist. These insects have a much larger part in the pollination process than previously assumed, even though the effect of an individual fly on a flower is a lot smaller than that of a single bee.

The European honeybee is only one of more than 570 bee species in Germany and 20,000 worldwide. Since they live in sheltered colonies with up to 70,000 workers, they are at an advan-

"Not every plant with a pretty flower is useful for the insects."

tage even just in terms of numbers. Plants can also be pollinated by wind or water, but most crop plants profit when insects visit their flowers, particularly when they are bees. A worker from a hive of honeybees, for instance, makes contact with the male organ of a flower, the stamen, when foraging for food. It collects pollen in its bright yellow "pollen basket" on its hind legs. Then it flies to the next flower. If it has brought the right kind of pollen, it lays the foundations for the development of fruit in the gynoecium, the female part of the flower.

Bees have received increased public attention in recent years due to so-called colony collapse disorder. This phenomenon was first observed in the USA, says Klein, and has become more frequent in the past ten years. It involves honeybees leaving their hive, never to return, for reasons as yet unknown. Tested insects have been found to be infested with *Varroa* mites, but scientists do not believe that these parasites alone are responsible for the loss of entire colonies. "The question is what causes these mites to spread," says the ecologist. It probably involves an interplay between many factors. Possible candidates include combinations of bacteria and viruses, pesticides like neonicotinoids, malnutrition, or climate change. Bees are known to change their behavior when they come into contact with pesticides. These substances bring about a change in the sex ratio of bumblebee colonies, and they cause some species of wild bees to stop reproducing.

Besides honeybees, says Klein, wild bees have also experienced a severe population decline in Germany. The reasons include intensive agriculture, an increase in monocultures, and a resulting loss of biodiversity. "Wild bees and bumblebees can't find enough food, nesting sites, or material to build their nests in the extensive cultures." In addition, several wild bee species and bumblebees have special needs with regard to foraging resources, as the ecologist points out: "The pollinators need the right kind of flower." Long-tongued bumblebees, for instance, are ideal pollinators for red clover, whose nectar is buried deep in its long floral tubes. The morphology or external structure of the pollinator determines how it can achieve optimal access to nectar and pollen, says Klein.

Alexandra-Maria Klein and her team are observing apple orchards on Lake Constance to study what effect biological agriculture as well as flower strips and hedges have on pollination and pest control by insects.
Photo: Peter Maszlen/Fotolia

The ecologists are studying the insects primarily in their function as pollinators of crop plants with fruits like apples, pears, plums, and berries, as well as several species of vegetable. "But it shouldn't be forgotten that we also need insects for seed production," says Klein. The pollination process begins with fertilization, and then the seeds develop. Without them, there would be no new plants, no new seeds, and no new cultivation. The decline in small cultures in agriculture is detrimental to wild bees such as mining and mason bees. Like the 36 bumblebee species native to Germany, including earth and cuckoo bumblebees, they contribute to biodiversity and thus to ensuring the best possible pollination of crop plants. These insects may be found above all in areas where they can maintain a natural habitat next to the cherry grove or apple orchard. Klein and her team have been observing 28 ecologically and conventionally cultivated apple orchards on Lake Constance since April 2015 to study what effect biological agriculture as well as flower strips and hedges have on pollination and pest control by insects. Among other things, the scientists are attempting to determine the best pollination conditions for wild bees.

According to Klein, some wild bee species have the advantage of being able to fly in conditions that are too wet, too cold, or too windy for honeybees. The honeybee returns to its hive and reports that the weather outside is too rough, causing other bees to stay in the hive. "A farmer

"The pollinators need the right kind of flower."

who promotes bumblebees, mason bees, and flies in addition to honeybees will not lose everything in a rainy spring," explains Klein. Experience has also shown that flies can cope well with intensive agriculture and are less sensitive to changes in the landscape than bees.

Southern Germany already provides good protection for honeybees, as it is home to most of Germany's beekeepers. Still, the ecologist would like to see greater emphasis on biodiversity in agriculture and more flower patches over the entire year to provide food for insects. She recommends hedges with perennial blackthorn

Honeybees (top), wild bees (middle), and other insects (bottom) all have a similar degree of effectiveness worldwide (A). However, honeybees and other insects visit more flowers than wild bees (B). In addition, honeybees and wild bees pollinate each flower they visit more effectively than other insects (C).
Source: modified from Rader et al. 2016; bee illustrations: Anika Hudewenz

A	B	C

Overall effectiveness — Visits in percent — Effectiveness per visit

Prof. Dr. Alexandra-Maria Klein studied biology in Göttingen and earned her doctorate with a dissertation on the pollination of coffee plants in Indonesia. After stints in Ecuador, the USA, and at the Universities of Göttingen and Lüneburg, she was appointed as professor of nature conservation and landscape ecology at the University of Freiburg. Her research group focuses on the ecology, socioeconomics, and nature conservation of ecosystems and landscapes. Klein has received a number of awards for her research, including the Cultura Prize from the Alfred Toepfer Foundation, whose mission includes advocating sustainable land use in Europe.
Photo: Thomas Kunz

and hazel shrubs as a complement to flower strips in agricultural landscapes. However, the combination of flowers has to meet the needs of the winged visitors. "Not every plant with a pretty flower is useful for the insects."

Billions of Euros in Damage

Klein is well aware of how important pollinating insect species are for ecosystems. Were winged pollinators to have disappeared entirely by 2005, the cost of the damage would have amounted to 153 billion euros worldwide, as French and German scientists calculated in a study presented in 2008. According to a 2013 study co-authored by Klein, the damages would cost around 1.6 billion euros a year in Germany alone. "Apart from the financial damages, we can also calculate the negative consequences on human food production," says the researcher. If there weren't any bees to pollinate apple trees, for example, the apple harvest would be reduced by 75 percent, because only few apple tree varieties are self-pollinating. The disappearance of crops dependent on pollination would leave us without an important source of vitamins and minerals and encourage the development of diseases caused by malnutrition – which could become a major problem particularly for developing countries. Moreover, hand pollination or induced

self-pollination would cause an undesirable shift in the vitamin spectrum of the fruits. "Strawberry plants pollinated by insects show their appreciation by producing fruits that keep longer."

www.nature.uni-freiburg.de

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Peace and Quiet in the Anxiety Centers

Hypnosis and meditation have measurable effects on human brain activity

by Petra Völzing

Hypnosis is directed outward: The hypnotized person needs to be kept in a trance by means of suggestion. Photos: Sandra Meyndt

"That's better than swallowing pills."

The methods have been around since time immemorial, their effectiveness known for centuries. Even thousands of years ago, people put other people into hypnotic trances to cure them of illnesses. The technique experienced a renaissance in 19th-century Europe as a treatment for so-called hysteria. But hypnosis was also abused, for instance at variety shows and carnivals, where people were put in a trance before a sensation-seeking audience as a means of entertainment. However, evidence from numerous studies indicates that conditions as wide-ranging as phobias, chronic pain, and post-traumatic stress disorder can indeed be treated with a hypnosis therapy. The technique is now used even outside of psychotherapeutic contexts. Thanks to its soothing effect, it can also serve as an alternative to anesthetic drugs.

Another practice that has long been known in many cultures is meditation, associated for millennia with the image of a meditating monk. Meditation is thought to help people calm their mind and collect their thoughts. It is a useful means of coping with stress and can also help treat various types of headaches, but it requires a lot of practice. One big difference between hypnosis and meditation is that a person is completely alone and directed inward while meditating, whereas a person under hypnosis is directed outward and needs to be kept in a trance by means of suggestion. An exception is self-hypnosis or autosuggestion, which does not require another person. What all these methods have in common is that they are means of reaching an altered state of consciousness.

Using Positive Resources

Despite a large body of evidence pointing to their effectiveness, scientists are still often skeptical of hypnosis and meditation or deride them as esoteric methods. But that doesn't scare off

Zen meditation from Buddhism has been the subject of the most research, but the image of the meditating monk has been known for millennia in many cultures.

University of Freiburg neuropsychologist Prof. Dr. Ulrike Halsband. She has made the two methods into the subject of her research. "Hypnosis and meditation have a lot of advantages," she says, emphasizing above all the fact that they are non-invasive treatment methods that do not involve making incisions or introducing devices or tubes into the patient's body. Instead, they harness the positive resources available in every person. "After all, that's better than swallowing pills." Halsband has set about investigating the effects of hypnosis and meditation on brain activity from a scientific perspective. She wants to use her findings to develop the methods further and enhance their effectiveness.

One of the topics she is concentrating on with regard to hypnosis is anxiety disorders, such as dental phobia. People with this disorder have an excessive fear of going to the dentist. For example, they show a very strong reaction to typical drilling noises or to graphic images of dental treatment. Dental hypnosis is already being practiced successfully today. Halsband's studies have demonstrated that the brain does indeed undergo plastic changes under hypnosis. The researcher

Human brain activity can be measured by means of functional magnetic resonance imaging. *Photo: Britt Schilling/Freiburg University Medical Center*

measures the brain activity of test subjects in a waking state and under hypnosis. The subjects are confronted with brief film sequences of dental treatment in each of these two states, as well as with sequences showing similar but neutral stimuli, such as a hair dryer.

"We have determined that an individualized form is helpful."

Halsband uses various methods to measure brain activity. In this case the test subjects are pushed into a magnetic resonance imaging machine. With the help of functional magnetic resonance imaging (fMRI), Halsband can precisely localize their brain activity. The test subjects are briefly placed under hypnosis, either live via microphone or by means of recordings. "When we confront the test subjects with video clips and sounds from a dental procedure in a waking state, the neurons in the amygdala, the insula,

and other anxiety centers light up like crazy," says the researcher. Under hypnosis, on the other hand, the activity in these areas is much less pronounced. The anxiety circuit in the brain is down-regulated, as it were. Halsband also points out that there is a reduction of neural activity in the hippocampus, an important brain region for memory. As a possible explanation, she notes that many of the phobic patients have traumatic memories of previous trips to the dentist that are reactivated when they are confronted with the short films on dental procedures.

The type of hypnosis is also plays a role. "We have determined that an individualized form is helpful," explains Halsband. This involves having the test subjects choose keywords they associate with relaxation beforehand. For many people, these may be terms like "sun," "beach," and "sea," while others might choose "dog," "soccer," or "balcony." "The important thing during hypnosis is then to use these terms to evoke various sensory impressions," she explains, because the brain
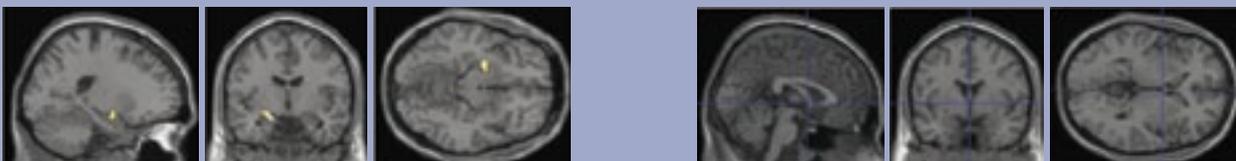
Ulrike Halsband studies the brain activity of people who are afraid of going to the dentist while they watch these film sequences of dental procedures. In a waking state (left), the activity of the amygdala (in color), one of the brain's anxiety centers, is much higher than under hypnosis. *Source: Ulrike Halsband*

regions most active under hypnosis are those that process images. Thus, one might say, "You feel the sand beneath your feet and hear the waves crashing on the shore."

Hypnosis has a calming and soothing effect on patients during treatment, because they can separate themselves mentally from their pain in this state. But that's not all: A hypnotherapeutic treatment can also reduce the patient's underlying anxieties. To do so, the therapist guides the phobic patient to a point in the future during hypnosis and suggests to his or her subconscious mind that the trip to the dentist wasn't that bad after all. This subconscious experience then relieves the patient of his or her anxiety during the actual trip to the dentist. "The subconscious mind knows what the conscious mind needs to do," summarizes Halsband.

In the case of other illnesses, however, the jury is still out on whether hypnosis is a useful form of therapy. This is particularly true of psychoses, such as paranoia or schizophrenia. "Scientists usually recommend staying away from psychotics," says Halsband, because suggestions under hypnosis are regarded as counterproductive for people who are already suffering from a feeling that their surroundings are not real. However, the researcher warns against lumping all such cases into a single category. She points out that there are hospitals that use the method for such patients as a complement to drug therapy and claim to have achieved good results with it. In case of doubt, however, Halsband would decide against using hypnosis.

Help against Stress

The scientist is also cautious about using meditation for therapeutic purposes. For patients with bipolar depressions and thoughts of suicide, she advises against it. However, meditation can do a lot of good for those plagued by stress in our society, as Halsband has shown by measuring the brain activity of meditating test subjects. She uses electroencephalography (EEG) for these measurements, because the necessary device is portable and hence more flexible. It is not as good as imaging techniques at localizing the various brain regions, but many test subjects would find it difficult to meditate in the tube of an MRI scanner, where it is also rather loud. Halsband conducts some of her experiments in her office, which she has shielded from electromag-

netic fields. "The test subjects can even use the utensils they need there, such as a singing bowl."

Her colleague Prof. Dr. Thilo Hinterberger from the Regensburg University Medical Center has already put an electrode cap on meditating monks in the Himalaya. He demonstrated that the activity of the brain regions in the frontal cortex, which are responsible for thinking and planning, is measurably lower during meditation than in a normal waking state. There are even studies indicating that people who meditate regularly lose brain mass less quickly than those who do not meditate as they age. As one of her next projects, Ulrike Halsband aims to study what consequences this has for cognitive performance.

www.psychologie.uni-freiburg.de/abteilungen/Neuropsychologie

Dread of drills? Hypnosis and meditation can help treat a dental phobia. People with this disorder have an excessive fear of going to the dentist.
Photo: Robert Kneschke/Fotolia

Prof. Dr. Ulrike Halsband
Halsband studied experimental psychology at the Universities of Sussex and Oxford, Great Britain, and earned her PhD in Oxford in 1982. She then went on to teach and conduct research at many different institutions, including a two-year stay in Japan. She completed her habilitation thesis at the Department of Neurology of the Düsseldorf University Medical Center in 1996 and has served as professor of neuropsychology at the University of Freiburg since 1999. She conducts neuroscientific research on the effect of meditation and hypnosis and behavioral research on dogs.
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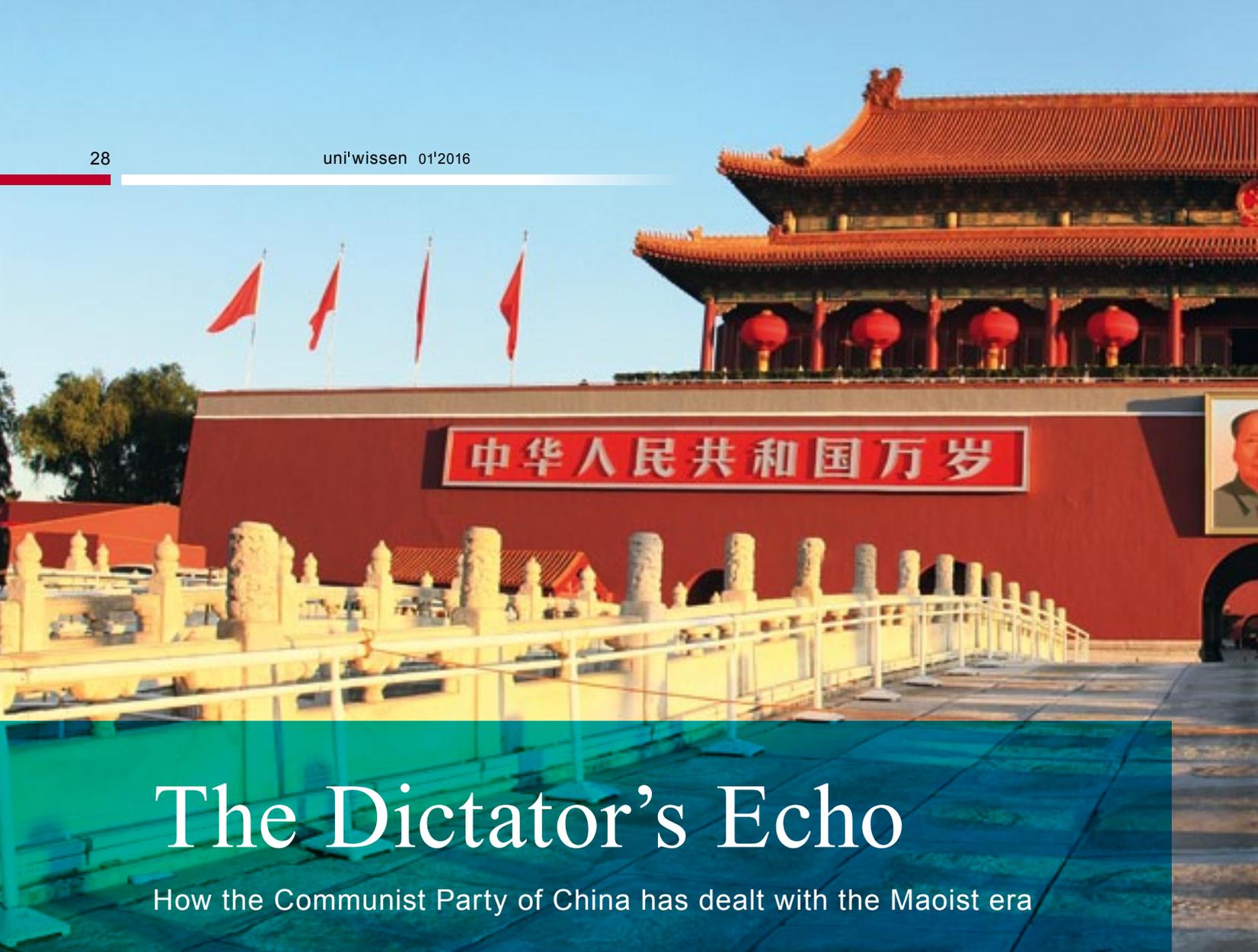
The Dictator's Echo

How the Communist Party of China has dealt with the Maoist era

by Yvonne Troll

Beijing, China, August 1976. The 57-year-old worker Ms. Wang goes to a meeting with her production brigade. The topic is the devastating earthquake that recently struck the city of Tangshan, but Ms. Wang is having trouble concentrating. She has heard a terrible rumor: The Chairman of the Communist Party of China (CPC), Mao Zedong, whose colossal portrait adorns the gate to Tiananmen Square, is said to have died. She leans anxiously to the man sitting next to her, Mr. Hao, and says, "Have you heard the news? Chairman Mao is dead." A short time later she is arrested for slander. Mr. Hao has dutifully reported her words to a party cadre. Ms. Wang is now a condemned counterrevolutionary.

Forty years later, Mao's portrait still hangs over the same gate. The CPC is still in power as the state party. There is hardly a family in China today that was not affected in some way by Mao's politics. In the course of his political cam-

paigns, millions and millions were arrested, sent to labor camps, executed, or starved to death. Ms. Wang was lucky: She was released from custody and rehabilitated – half a year after Mao died for real in September 1976. A Beijing court ruled that she had been confused by the death of another well-known party functionary and attributed the misunderstanding to her lack of education. Her case file is now in the possession of Daniel Leese at the University of Freiburg. The Sinology professor is studying how the CPC has dealt with the injustices suffered by millions of citizens under Mao's dictatorship.

"In light of the large number of victims, answering this question is crucial if one wishes to gain an understanding of Chinese society," says Leese. Roughly 36 million people and their relatives were persecuted for political reasons during the Cultural Revolution alone. In this last large-scale campaign, Mao called for the destruction of his

世界人民大团结万岁

A colossal portrait of Mao Zedong hangs to this day over Tiananmen Square in the center of China's capital Beijing. Photo: Feedzhyu/Wikimedia Commons

own party's bureaucratic apparatus and mobilized the youth against the temptations of capitalism. The resulting student paramilitary organization, the Red Guards, spread terror across the land. The Cultural Revolution got out of hand, and China sank into chaos. In the end, Mao only managed to restore order and stay in power with the help of a rigid military dictatorship.

Archives Remain Closed

After the end of the Cultural Revolution and Mao's death, the CPC instituted a reform phase involving the review of millions of historical case files. Many of those who had been convicted were symbolically rehabilitated and could thus again take part in social life, receive a work permit, or be admitted to universities. Others received compensation payments or pensions. The Chinese leadership even returned some of the property that had been taken from persons who had been

accused of being capitalist class enemies. "The way the cases were judged varied," explains Leese. "Those who were important for the new political line, for instance because they possessed capital or technical know-how, received privileged treatment." The CPC had to perform a balancing act: They wanted to distance themselves ideologically from Mao's reign of terror on the one

"Those who were important for the new political line received privileged treatment."

hand, while not jeopardizing their monopoly on power on the other. The strategy worked. The revised cases played a big part in stabilizing the party's power. The CPC did not denounce Mao as a criminal but characterized him as a tragic hero who had made ideological mistakes in the last years of his life.
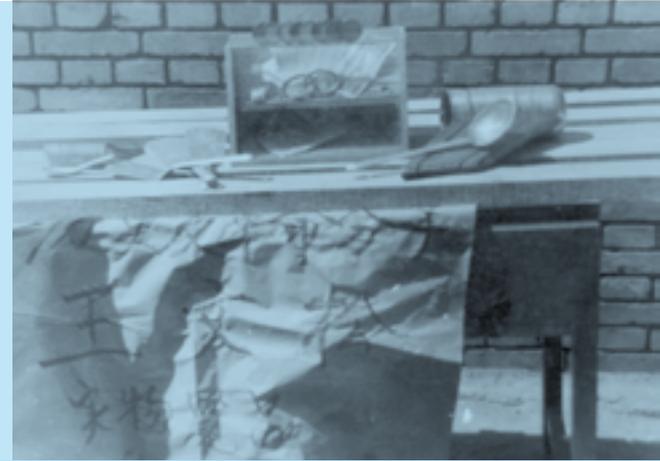
During the Cultural Revolution, the Communist Party of China dispossessed alleged capitalists of their property for keeping hidden wealth. Some of the property was given back to the owners after Mao's death. Source: Institute of Sinology/University of Freiburg

A public discussion and critical examination of the Maoist era and its consequences is almost impossible in China to this day. Even outside the country, hardly any research has been conducted on this topic. Thus, Leese is breaking new ground with his project. While researchers studying other historical contexts in which a regime was overthrown have received access to archives, such

"It's important for me to show that the Chinese society of the time wasn't just a conformist mass."

as after the end of apartheid in South Africa or the dictatorship of Augusto Pinochet in Chile, the CPC does not grant access to its files. This means Leese has to resort to unusual methods to conduct this research at all: He has spent the last 15 years combing through used book stores, private

A handwritten personal court case file: China's government does not grant official access to its files to this day. Photo: Thomas Kunz

collections, and flea markets to find documents from the dissolved archives of courts or work units. "The Chinese government was somewhat more careless in the late 1990s and the early 2000s. They often made material they no longer considered important available to the public," says the Sinologist.

Leese has already collected around 6000 documents in this way. Internal orders explaining how courts or party committees should renegotiate verdicts made during the Cultural Revolution form the core of the collection. These directives were often based on sample cases that appeared in handbooks. The general approach was to seek the reasons for the wrongful convictions in individual misunderstandings of the political reality – as illustrated by the case of Ms. Wang. In public, the blame for the injustice was placed squarely on the shoulders of the so-called Gang of Four, a group of party officials led by Mao's wife Jiang Qing that wielded great power during the Cultural Revolution. While the party did commission investigations to establish who was responsible for various offenses, the results were only rarely made known to the public.

Leese and his team are using case studies to determine how the party leadership dealt with those who had been wrongfully sentenced. In addition, the researchers want to use the example of the cities Beijing and Shanghai, the province Jiangsu, and the autonomous region Guangxi to show how differently courts revised cases depending on local political constellations. In addition to the court case files, their sources include interviews with contemporary witnesses, statistical data from regional authorities, and official party publications. It is the personal stories like that of the simple worker Wang that give Leese the motivation to pore over thousands of mostly hand-

In 1969, children in a people's commune are coerced into finding local class enemies.

Prof. Dr. Daniel Leese
studied early modern and modern history, Sinology, and economics in Marburg, Munich, and Beijing. After earning his PhD in Bremen, he returned to the University of Munich as a research as-sistant. In 2010 he accepted a deputy professorship at the University of Freiburg's Institute of Sinology, where he went on to be appointed as junior professor in 2012 and as full professor in 2015. His research interests in-clude the political, social, and cultural history of China in the 20th century, Chinese legal and environmental his-tory, and the history of the Qing dynasty.
Photo: Tristan Vostry

written Chinese documents. "It's important for me to show that the Chinese society of the time wasn't just a conformist mass, but that the case files reflect individual lives caught up in a conflict between conformity, resistance, and also the knowledge of having committed an offence."

A Difficult Situation for Researchers

All of the sources are being collected in a digital archive that will be made available to other researchers after the project ends, for instance for comparative studies on transitional justice. This is a theoretical concept Leese believes should be extended to include different forms of transition from one social order to another, even when – as in the case of China – the old system is not overthrown altogether. In addition, the most important documents will be translated into English. The plan is to compile the first compre-hensive database to document both the original atrocities of Maoism and how China dealt with its victims, because Leese is also interested in taking stock of the offenders. "Essentially, we are dealing with two topics at once. We can't just concentrate on the rehabilitation but must also take a look at who was responsible for the vio-lence." However, research on the offenders is precisely what has been missing in China so far. It is particularly dangerous for those currently in power and is therefore frowned upon.

The situation for researchers has become more difficult since Xi Jinping assumed office as party leader and head of state in 2012, says Leese. Under Xi's leadership, the CPC passed a directive stipulating that the history of the first 30 years of the People's Republic must not be negated on the basis of the political reforms of the second 30 years. By the same token, Mao's politics must be not be idealized and this posi-tion used as a basis for distancing oneself from the party's current course. This put a stop to what little research into the Maoist era had been

conducted so far. Leese was forced to discon-tinue existing partnerships – such as that with the Chinese Academy Of Sciences, which the CPC alleged had been partially infiltrated by foreign powers. Nevertheless, Leese continues to conduct his research openly. "We are highly dependent on maintaining good relations with our Chinese colleagues, but at the moment this is only possible in an unofficial context and at a personal level. We are observing the politics very closely so that we don't place our Chinese project members and dialogue partners in any danger." He has yet to be prohibited explicitly from either conducting his research or entering the country, but expects that he could very well experience more opposition in the future. In Europe, on the other hand, Leese's research has met with a decidedly positive response. The European Research Council is providing him a Starting Grant worth 1.44 million euros for his project.

www.maoistlegacy.uni-freiburg.de

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Watch a video interview with Prof. Dr. Daniel Leese on the research portal Surprising Science for more information about his project on the legacy of Maoism:
www.pr.uni-freiburg.de/go/mao

SURPRISING SCIENCE

Agents against Parasites

Epigenetics could help to improve the treatment of malaria and other tropical diseases

by Verena Adt

The Asian tiger mosquito has already reached us," says Prof. Dr. Manfred Jung. Isolated sandflies have also been sighted. Indigenous to Asia and the Mediterranean region, respectively, these insects are feared because they carry Chikungunya fever and leishmaniasis – infectious diseases that were unknown north of the Alps just a few years ago. Global warming and globalization have resulted in once exotic parasites spreading to parts of Northern Europe and North America, explains the researcher from the University of Freiburg's Institute of Pharmaceutical Sciences.

Together with his group of scientists, Jung is participating in the international project "Antiparasitic Drug Discovery in Epigenetics," A-PARADDISE for short. The goal is to lay the foundations for the development of new drugs against tropical illnesses. Sixteen universities and external research institutes are collaborating on the project, which is receiving six million euros in funding from the European Union (EU). The scientists hope to render many disease-carrying parasites harmless – including those that cause malaria, Chagas disease, leishmaniasis,

The Asian tiger mosquito (left) and the sandfly carry infectious diseases – and are pressing ever farther north due to global warming.
Photos: James Gathany/Centers for Disease Control and Prevention's Public Health Image Library

and bilharzia – with the help of epigenetics. This discipline focuses on the control mechanisms that determine which function within a genome is activated or deactivated at a particular point in time.

Like Bookmarks

Jung uses an analogy to illustrate the way these epigenetic switches work: Like bookmarks, they ensure that the cell is opened to a particular "page," a particular epigenetically relevant protein responsible for a specific function. Epigenetic markers determine things like when a caterpillar will change into a butterfly or whether genetically identical bee larvae will develop into workers or queens. The markers are also responsible for seeing to it that divided muscle cells grow into muscle cells again rather than into nerve or bone cells, because every cell includes the complete

genome necessary for all cell types present in the organism.

A potential means of fighting the parasites is to selectively inhibit their epigenetic processes without causing harm to the infected human. The goal of A-PARADDISE is to find substances capable of this feat. In their lab, Jung and his team are testing hundreds of agents that have been filtered out of millions in a computer screening and found to be worth studying in more detail. "Around one to two hundred proteins serve as genetic regulators in a narrower sense. We are testing selected enzymes with methods from molecular biology and biochemistry to see how they function and what kinds of inhibitors it might be possible to develop," the scientist explains. "You might compare the search for inhibitors to the process of trying out hundreds

Two developmental stages of Morpho peleides:
Epigenetic markers determine when a caterpillar changes
into a butterfly. Fotos: Maggi_94/flickr, Doug Schnurr/Fotolia

or thousands of keys and optimizing them to fit perfectly in a particular lock."

A Kind of Language

The long term goal is to develop epigenetic therapies "that can be used to target only particular areas of the genome." To return to the bookmark analogy, this means the following: "We remove only a single red bookmark, for instance from page 300 of the book, and leave all the other red bookmarks in the book." One of the difficulties is that the epigenome is not a fixed code like DNA but more akin to a context-dependent language. When one hears the word "lock," for example, it only becomes clear in context whether one is talking about a device for fastening doors or a tress of hair. Epigenetics confronts scientists with similar questions to interpret.

The epigenetic proteins Jung is using for his experiments are delivered by project partners from France, but one searches in vain for the names of large pharmaceutical companies on the list of institutions participating in A-PARADDISE. "We're conducting fundamental research," Jung stresses. Epigenetics is a young field: The first detailed studies in this area were conducted in the mid 1990s, and the first drugs to be developed on the basis of epigenetics research are now being used to treat leukemia and other types of blood cancer. It is not yet foreseeable whether clinical studies on patients will be conducted within the context of A-PARADDISE.

The tropical diseases transmitted by parasites are by no means rare medical phenomena. "Millions of people contract them every year, and several hundred thousands die of them," says Jung. According to data from the World Health Organization (WHO), schistosomiasis, also known as bilharzia, is alone responsible for up to 200,000 deaths per year. For the year 2013, the WHO registered 40 million cases of the disease in 75 countries. This makes schistosomiasis the

"You might compare the search for inhibitors to the process of trying out hundreds or thousands of keys."

most common tropical parasitic disease after malaria, yet only a single drug has been developed to combat it so far. A-PARADDISE is now raising new hopes. In the course of several optimization cycles, Jung and his team have developed highly potent inhibitors of the bilharzia pathogen that deactivate its epigenetically effective enzymes but do not damage important human enzymes. They now plan to test these new inhibitors in mouse infection models.

Not a Lucrative Market

There is a large market for drugs against tropical diseases, but it is by no means a lucrative market. In other words, it is not worth it for pharmaceutical companies to make large research investments. This makes it all the more important for public institutions to fund the fundamental research, stresses Jung. A-PARADDISE, launched in 2014 and set to run until 2017, is already the second EU-funded project in this area the scientist has participated in. "Both projects included first-rate research institutes from around the globe."

Jung's team is one of two German partners in A-PARADDISE. Another area his group is focusing on is epigenetic inhibitors in tumors. This research is also being conducted within the context of large-scale joint projects, such as the Medical Epigenetics collaborative research center at the University of Freiburg. Together with the University Medical Center and the Max Planck Institute of Immunobiology and Epigenetics, this center forms an internationally visible cluster for research on epigenetic regulation in Freiburg, says Jung: "I'm at the best place in Germany for this type of research."

http://a-paraddise.cebio.org

The Freiburg researchers are testing selected enzymes that could potentially serve as agents against parasites. *Photos: Sigrid Gombert*

Prof. Dr. Manfred Jung studied pharmacy at the University of Marburg. He earned his pharmacist's license in 1990 and his PhD in 1993 in Marburg. After a year conducting postdoctoral research in Ottawa, Canada, he switched to the University of Münster, where he began concentrating on epigenetics and completed his habilitation thesis in 2000. Since 2003 he has served as professor of pharmaceutical chemistry at the University of Freiburg. In 2004 he received the Eugen Graetz Prize, which the University of Freiburg awards to researchers engaged in fundamental and developmental research in chemistry, pharmacy, and medicine. Jung's research centers on chemical epigenetics, a field the Freiburg Institute for Advanced Studies (FRIAS) is promoting with a research focus in 2016/17.

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Goodbye scroll, hello PC: Digital tools enable research on a new level. It's possible to view comments on historical, grammatical, and stylistic aspects of an ancient civilization studies text at the click of a button.

Illustration: Svenja Kirsch

The Next Turn

A research group is studying how digital humanities is changing scholarship

by Rimma Gerenstein

Robert Busa was a man of God by profession, but science remembers him as one of the forefathers of the Internet. At the end of the 1940s, the Jesuit priest began compiling an index of the work of the philosopher Thomas Aquinas. The task was to collate 10,000,000 words in such a way that philologists could analyze, dissect, and combine them in endless variations. Busa soon realized that his bold idea exceeded the practical abilities of a theologian. The researcher had an unusual idea: What if he could collect the philosopher's tractates, commentaries, and hymns on a computer? He consulted Thomas Watson, the man who had founded the technology corporation IBM. With the businessmen's help, Busa managed to complete the gargantuan task within the space of a mere seven years, although it had originally been planned for 40.

The priest was the first person to combine computer science with the written word. He is regarded as the originator of the discipline known as digital humanities, which sparked off a revolution in research – at least as far as theory is concerned. In practice, on the other hand, digital humanities only gradually gained traction: Although computer linguistics has been around for almost 30 years and classical philology has made use of digitalized sources for decades, it was not until around ten years ago that digital humanities became a real trend in the humanities, say Dr. Stylianos Chronopoulos, Dr. Felix K. Maier, and Dr. Anna Novokhatko from the University of Freiburg. They are the joint heads of the project "The Digital Turn in Ancient Civilization Studies: Perception – Documentation – Reflection," funded by the Heidelberg Academy of Sciences and Humanities. The project studies how research changes when elementary technical innovations make it possible to conduct analyses that were previously unthinkable.

No Robot Takeover

The new digital tools open up endless possibilities. Take the epistolary novel, for example: It is now possible to search in a matter of hours for all instances of the word "friendship" in 5000 novels – no matter what language they are written in. Moreover, it only takes a few days for a computer to search through all published editions of the books and show which words or even sentences were changed by the editors from edition to edition. However, Novokhatko stresses that it's not just about speed but about an entirely new level of work: "I can use the search systems to view commentary on things like historical, grammatical, and stylistic aspects of a text, all at the click of a button. I used to need ten thick books on my desk to do this – and several weeks time."

Although Chronopoulos, Maier, and Novokhatko – all three of them specialists in ancient civilization studies – have already long worked with digital media in their own research, they are taking a key step backward in the project: "There is still a lack of fundamental theoretical reflection on the topic," says Chronopoulos. "Articles on digital humanities appear from time to time in Germany, the USA, or England, but there is no communication between various disciplines," Maier adds. One factor in this lack of communication is age. "It's a generational question. Around 95 percent of scholars over 40 work with traditional methods.

> "There's nothing more human than a computer."

The younger researchers are simply more willing to try out new things." Hence, the "conservatives" and the "innovators" need to finally engage in a dialogue with each other. The trio is giving them ample opportunity to do so: They are inviting scholars from around the world to workshops in Freiburg over the next three years. The first conferences have already taken place.

"We want to observe ourselves and our work as researchers," stresses Chronopoulos. The questions they are asking themselves include the following: What rules do researchers need to observe in creating digital editions of texts, and what should they include in such editions? How does the role of researchers change when they

use digital tools? Do they need to reconsider their approaches, or can they combine long-established methods with the new ones? And finally, there is the provocative question of whether the powerful and seemingly infallible machines could

"We want to observe ourselves and our work as researchers."

soon even make classical philologists or historians superfluous. "Many are afraid that our entire humanist tradition, which has in Europe taken the form of a print culture for the past 500 years, might be in danger," reports Novokhatko. But there is no reason to fear a robot takeover, of that

Chronopoulos is convinced: "There's nothing more human than a computer – a constantly growing collection of knowledge that can be recalled by means of various commands." No matter how much data computers become capable of spitting out, it is all largely useless if there is no researcher around to scrutinize and interpret the information.

The elements the Freiburg research group is assembling piece by piece to construct a theoretical framework are diverse – and they reveal major problems already plaguing research practice. For example, one subgroup of the project is examining possible open-source models. There have long been freely accessible editions on the Internet that anyone can comment on or translate. But how should these comments be weighted?

Useful skill or passing fashion? The project is studying the influence of digital humanities on teaching. Photo: highwaystarz/Fotolia

Is the word of a professor from a little-known college worth more than that of a student working toward a degree at an internationally renowned university?

Accumulated Results

The team is also taking a look at academic structures: There is a trend among researchers toward online publishing. But what consequences does this have? "If I publish my dissertation on the Internet, I have the chance of reaching the largest audience in principle," notes Maier, "but I also reduce my visibility among researchers, because most established professors – and this is perfectly alright – prefer the printed version they find in a library." Last but not least, the project is studying the influence of digital humanities on teaching. It has become popular to offer seminars that work with digital tools. But does this make the teaching better? And is it worth it to remove valuable modules from the already tightly packed curricula of bachelor's programs to train students in the principles and practice of digital humanities?

At the end of 2017, the team plans to publish an edited volume collecting the results of the three conferences and describing the opportunities as well as the limits and dangers of digital developments in ancient civilization studies – thus giving the many actors involved in the field a voice for the first time. Chronopoulos, Maier, and Novokhatko hope to eventually reach a larger audience. After all, digital humanities are also revolutionizing large parts of print culture even beyond the walls of the university, for instance in the publishing industry. Initial cooperation agreements arising from the project demonstrate that the gap between theory and practice isn't always unbridgeable even in the short term. A sports historian and a data analyst who met at one of the conferences, for example, are now collaborating on a project in which the former is using a program developed by the latter to study where ancient athletes came from and where they trained.

www.texte-messen.uni-freiburg.de

Dr. Stylianos Chronopoulos studied classical philology in Athens and earned his PhD in Freiburg in 2010 with a dissertation on ridicule in drama. Between 2005 and 2011 he worked as a research assistant at the Institute of Legal History, the Institute of Medical Ethics and Medical History, and the Department of Classical Philology of the University of Freiburg. Since April 2011 he has served as a research fellow in Greek studies at the Department of Classical Philology while working on his habilitation thesis. Chronopoulos's research interests include Greek comedy, the philological tradition, ancient grammar and lexicography, and the phenomenon of Atticism.

Photos: Sandra Meyndt

Dr. Anna Novokhatko studied Ancient Greek and Latin in Moscow and Berlin. She earned her PhD in Moscow in 2003, following research stays in Padua, Italy, and Oxford, England. In her dissertation, Novokhatko studied the transmission history of two polemical pamphlets attributed to Sallust and Cicero, respectively. From 2007 to 2011 she worked as a research assistant at the Department of Classical Philology in Freiburg, where she has stayed on in the function of research fellow in Latin since 2011. Novokhatko is currently working on her habilitation thesis on the development of Greek philology in the 5th century BC. Her research interests include the old Greek comedy, ancient grammar, textual and literary criticism, and ancient theories of metaphor.

Privatdozent Dr. Felix K. Maier completed a teaching degree in Latin, Greek, and history at the Catholic University of Eithstätt-Ingolstatt and the University of Freiburg. Following a stint in Oxford, England, Maier submitted his doctoral dissertation on the contingency of historical processes in the works of Polybius at the University of Freiburg. In his habilitation thesis, he studied the consequences and the end of the so-called imperator dilemma in the 4th century BC. Since 2011 he has served as a research fellow in ancient history and conducted research on Greek and Roman history writing, constitutional forms in the Hellenistic period, and the foreign policy of the Roman Empire in late antiquity.

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Learning with Lego

Simulations can help improve work and process flow and reveal behavior patterns

by Nicolas Scherger

Four stations, four tasks: Students simulate the production process in a chocolate factory.
Photos: Thomas Kunz

Black, red, and white Lego bricks stand for the raw materials for making chocolates – chocolate, cream, and cherries.
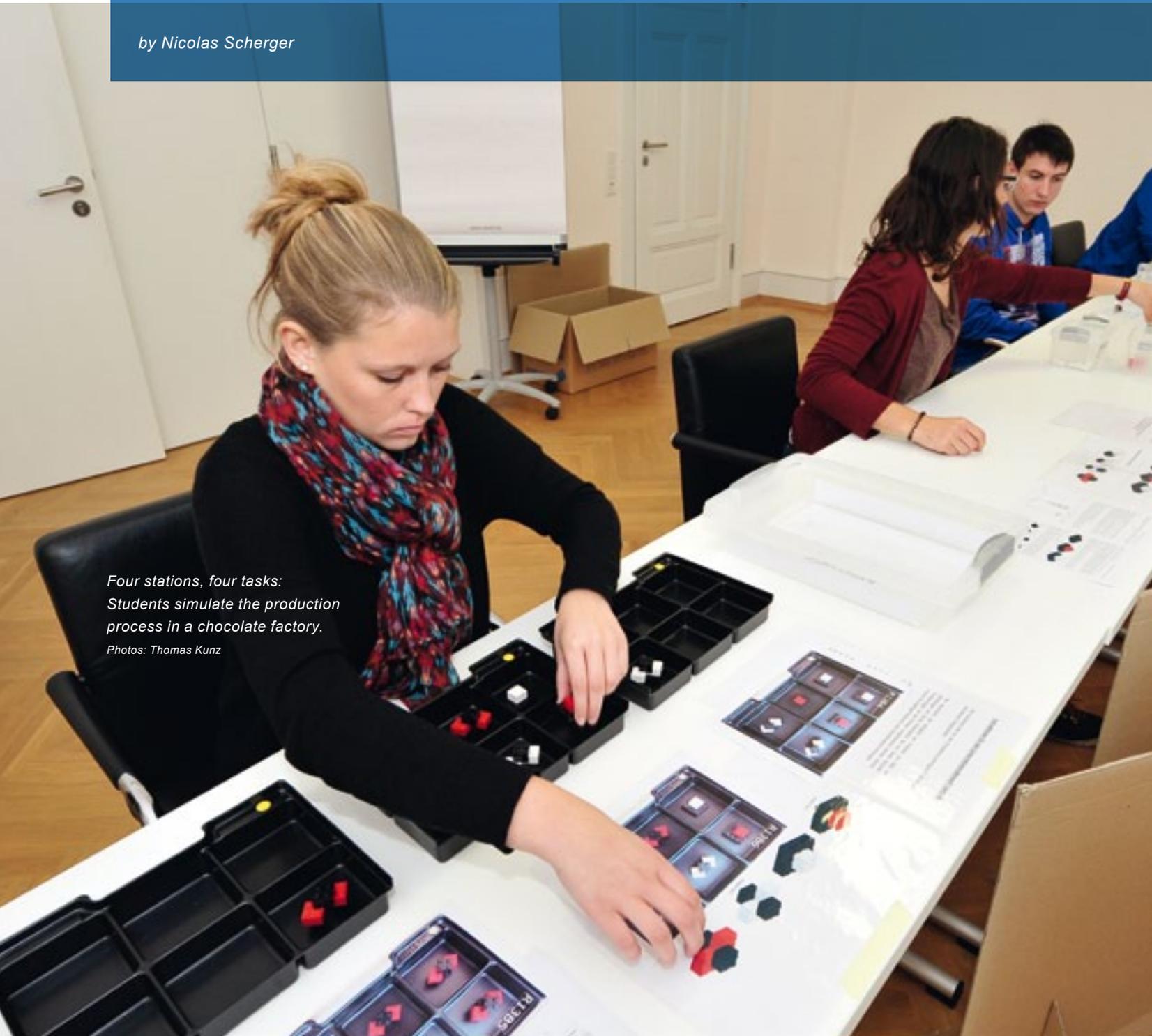
A twelve-minute simulation, divided into three rounds of equal length, each followed by a brief analysis – that's all the time Prof. Dr. Stephan Lengsfeld and his team need to illustrate to students the effects of so-called departmental egoism. This is a term economists use to describe the behavior of employees who follow their own interests and goals or those of their department, if necessary at the expense of other departments or the entire company. The example the economist uses to demonstrate this term is that of a chocolate factory. It needs chocolate, cream, and cherries to make various kinds of chocolates, represented in the simulation by black, white, and red Lego bricks. The factory has work stations, each of which is responsible for a special task in the value chain. Before the first round begins, the students receive instructions on the relevant tasks and targets for

"The basic questions come from the business world."

their work station. The "purchasing" station is responsible for purchasing raw materials at the lowest possible unit prices, the "warehouse" station tries to minimize refrigeration costs, the "production" station makes as many chocolates of various kinds as possible, and the "distribution" station handles incoming orders by arranging the chocolates according to the customers' wishes, packing them in boxes, and sending them off.

Overcoming Departmental Egoism

In the first round the stations are separated by cardboard walls to prevent the students from seeing what's going on at the other stations, because the departments at companies are also often separated from one another in a spatial or organizational sense, resulting in a lack of com-

munication. The factory has already suffered a loss after the first four minutes – even though all four stations are acting in accordance with their individual tasks and targets. Lengsfeld has encountered this pattern in many companies: "Everyone thinks everything's running fine in their own department, but the overall result is poor, because they lose sight of the big picture." In the second round the cardboard walls are gone, and the students can see which raw materials the factory is running out of and which kinds of chocolates the distribution department needs. Now they recognize that there can be a discrepancy – possibly caused by the system of targets and incentives set up by the company itself – between fulfilling their own targets and achieving the best possible result for the company as a whole. When they are ready to focus less on their own targets, the individual stations can cooperate better. The purchasing station doesn't just buy the cheapest raw materials available, and the production station doesn't just try to make as many chocolates as possible but pays more attention to demand. The students make a profit in this round, and the task in the last four minutes is to increase it: Now the students can discuss their tasks and roles with one another and consider together how to further improve the production process.

From confusion to a coherent structure: A simulation shows what makes up a lean office. Photos: Thomas Kunz

"Departmental egoism" is just one of many topics Lengsfeld simulates for students with his concept "EconRealPlay." "The basic questions come from the business world," stresses the economist, whose research partners include companies and local trade associations. "We take these questions as a basis for developing simulations that achieve a learning effect in the students and at the same time allow us to analyze behavior patterns." What are the effects of incentive systems that reward or penalize certain behavior? What information do employees need to carry out their tasks? At which points in the process is communication necessary? What part does the general organizational set-up play? These are the kinds of questions Lengsfeld is looking to answer. His methodology

"All ideas are welcome."

involves changing a single organizational element each round – in the chocolate factory it is first the walls and then the communication barriers that disappear. "This reveals which innovation leads to which effect." In some simulations he divides the participants up into two groups and has them play through the same scenario under different conditions and observes how the effects differ. Besides simulations in which teams of students reconstruct a process with Lego bricks or other materials, Lengsfeld and his team also conduct computer experiments. Some of them focus on both individual and group decisions. Others involve participants competing against one another without

knowing what the others are doing, allowing the researchers to study competitive situations.

From Experience to Analysis

All of the simulations are based on a multistage concept that combines experimental economics research with problem-based interactive teaching, while at the same time encouraging the students to develop their own research projects. The students begin by running through a simulation themselves without knowing what it is about. Then they are taught theoretical and methodological concepts that enable them to study their own behaviors and motives. This forms the basis for a move from the level of experience to that of analysis: Since the students have taken note of the steps and results of their work at all stations during the individual rounds of the simulation, they now have data to analyze. In the next step, the students provide their input to improve the simulations or develop new ones. And finally, some of the scenarios are used to conduct social science experiments. One such study is currently being made into a publication on time autonomy: What are the consequences for product and process innovation when employees either can choose their own working hours or need to spend a fixed amount of time on planning and production?

Other publications in preparation include studies on the interaction between incentive systems, process flows, and employee motivation. "The approach offers an unbelievable amount of pos-

sibilities," says Lengsfeld. How can organizational conditions and individual communication and incentive systems promote or inhibit particular behaviors and the innovation of new products and processes? How do particular systems interact? "Research on these questions is still in its infancy," says the economist, who has received the University of Freiburg's University Teaching Award and Instructional Development Award for his concept.

Lengsfeld's approach is not limited to the manufacturing industry. The service and administrative sectors also stand to benefit, as shown by his simulation of an automobile insurance provider: The four stations are "department head," "damage report administrator," "contract administrator," and "office assistant." The goal of the ten-minute rounds is to process as many incoming requests as possible. The simulation begins with four students sitting at four different tables arranged around filing shelves. White and blue files are placed in no apparent order on the shelves, and various forms are strewn across the tables. As a consequence, the participants spend the first round putting things in order on their own. Not much gets done, and time gets wasted. This improves in time, because the students are allowed to implement more and more "lean office" principles each round, including sorting out unnecessary things, cleaning up the workspace, arranging things in a practical way, standardizing processes, and continually improving standards. In the last round the tables are rearranged to

minimize the distance between the stations. The forms are now sorted, superfluous files thrown out, and work materials available and in easy reach. Moreover, now the tasks have been allocated differently among the two administrators. The processes run much better and faster than in the beginning – and yet the participants still have a lot of ideas for improving the processes even further.

Cooperating with Businesses

The simulations on departmental egoism and the lean office are not yet finished products. With input from his team and students, Lengsfeld wants to continue refining the processes simulated in both scenarios and enable the participants – whether students or employees of companies and organizations – to learn as much as possible from them. He sees it as a process of trial and error: "All ideas are welcome, and failure is a part of the process – like in large corporations, in which an average of nine in ten research projects fail to achieve the desired result," the economist reports. "But the one flash of inspiration among them might just make all the difference." The team aims to establish regular business partnerships, first of all so they can offer simulations as in-service training courses at companies and organizations. "Our goal is to impart a consciousness for mismanagement to participants and encourage them to scrutinize and improve their own processes and work flows." In addition, Lengsfeld and his team want to develop new simulations treating further problems, challenges, and best-practice behaviors from business to promote knowledge transfer between the university and private enterprise at the interface to research.

www.finrech.uni-freiburg.de/copy_of_econrealplay

Files, forms, envelopes, stickers – the simulation reveals which materials are useful for various tasks.

Prof. Dr. Stephan Lengsfeld studied business administration at the University of Saarbrücken and completed core studies in mathematics at the University of Cologne. He earned his PhD in economics at the latter institution in 1998. In 2004 he completed his habilitation thesis at the University of Tübingen. Following stints at the Technical University of Munich and the University of Hannover, he accepted a professorship in finance, accountancy, and controlling at the University of Freiburg in 2010. His research focuses on human resources and organizational economics, coordination and incentive systems for product and process innovations, experimental economics, internal corporate accounting, success factors for small and mid-sized companies, and new methodologies for university teaching and learning.

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Students studying at the University Library:
Independent knowledge acquisition is an
important part of learning.
Photo: Sandra Meyndt

Don't Get Distracted

Students can observe their own learning process and
avoid procrastination

by Tanja Kapp

"The fear of failure is both the starting point and the product of procrastination."

The organization of bachelor's degree programs into modules demands that students show a lot of initiative. They have to prepare for courses and do follow-up work after completing them, and the amount of work hours required is determined via a point system. This structure has given degree programs a concrete temporal framework, four-fifths of which consists of independent study in some subjects. The university has no means of monitoring this independent study – it's a black box, says Matthias Nückles, an educational science professor at the University of Freiburg who is studying how independent study works. He has conducted several projects to test mechanisms designed to encourage students to engage in thoughtful independent study. Two of them have received the University of Freiburg's Instructional Development Award.

Facts Rather than Feelings

Students aren't the only ones to allow themselves to be distracted by all manner of things when they are actually supposed to be concentrating. Some clean the apartment, others surf the Internet, and still others go shopping rather than studying for an upcoming exam. The aim of such procrastination is to escape fears of failure – by simply not engaging with the material to be learned. "The fear of failure is both the starting point and the product of procrastination," says Nückles. Before they know it, the students are caught up in a vicious circle of procrastination: The greater their fear of a performance situation, the more they try to avoid it. Nückles and his team have developed a method to describe this dynamic: the learning journal.

"Students have a tendency to put off studying because they don't have enough control over themselves," says Nückles. The project group's approach was to confront the students with their own behavior and enable them to achieve a more objective perspective on it. "Studying is no different from many things we occupy ourselves with. When we go on a diet, for instance, we keep a list of what we eat so that we can rely on facts rather than feelings later on." In cooperation with the Faculty of Environment and Natural Resources, the researchers set up an online portal on which students of forest and environmental sciences can document their learning process.

Each Sunday for 19 weeks, the 150 participants recorded in a personal profile how they perceived their learning behavior in the past week and what learning goals they had for the coming week. By comparing their entry with those from previous weeks, they were able to see which goals they had reached and which they had not. In other words, they were able to review their own learning process. "Simply taking ten minutes time, planning one's own learning, and reflecting on it makes learning more effective, thus improving one's chance of success in a subsequent examination," stresses Nückles. The study showed that people who allow themselves to be distracted less achieve results that are 1.24 grade points higher than those who tend to procrastinate.

The Vicious Circle of Procrastination

The cycle of self-directed learning describes the learner's progress through various phases. Learners begin by setting goals and planning an approach. During the learning process itself they apply various strategies to understand and remember the material, and they monitor the process. As Nückles has determined, students prefer revision strategies in preparing for exams, such as reading over their notes from lectures again and again. On the other hand, they are evidently a lot less likely to apply elaboration strategies – such as thinking up examples of abstract concepts or explaining material to one another. Yet these strategies are also important for succeeding in an examination: "They help the learner link the learning material with prior knowledge, enabling a deep understanding and long-term retention." Finally, the learners assess whether they have

achieved their goals and how efficiently they have worked. If possible, they add further learning intervals. As the phases of the learning cycle influence each other, Nückles aimed to show that procrastination goes hand in hand with a lower use of learning strategies.

"Assessment mechanisms like learning exercises or small tests are important."

The educational scientist differentiates between the "vicious circle" of procrastination and the "virtuous circle" of self-efficacy, both of which are self-reinforcing: Students caught up in the vicious circle of procrastination are driven ever further into the blockade, are stressed out, and achieve poorer learning results. Those in the virtuous circle, on the other hand, steadily increase their self-efficacy. These learners believe in their own abilities, set clearly defined goals, and are willing to make an effort to achieve them by applying learning strategies that foster deep understanding, such as elaboration – and this leads ultimately to better grades.

Visual Feedback

Nückles uses behavioral therapy to help students out of the vicious circle of procrastination: He forces them to confront their fears of the performance situation. The educational scientist conducted a study on a group of medical students preparing for an exam to determine whether a visual representation of their own tendency to procrastinate would motivate them to learn more efficiently. Some of the participants received a
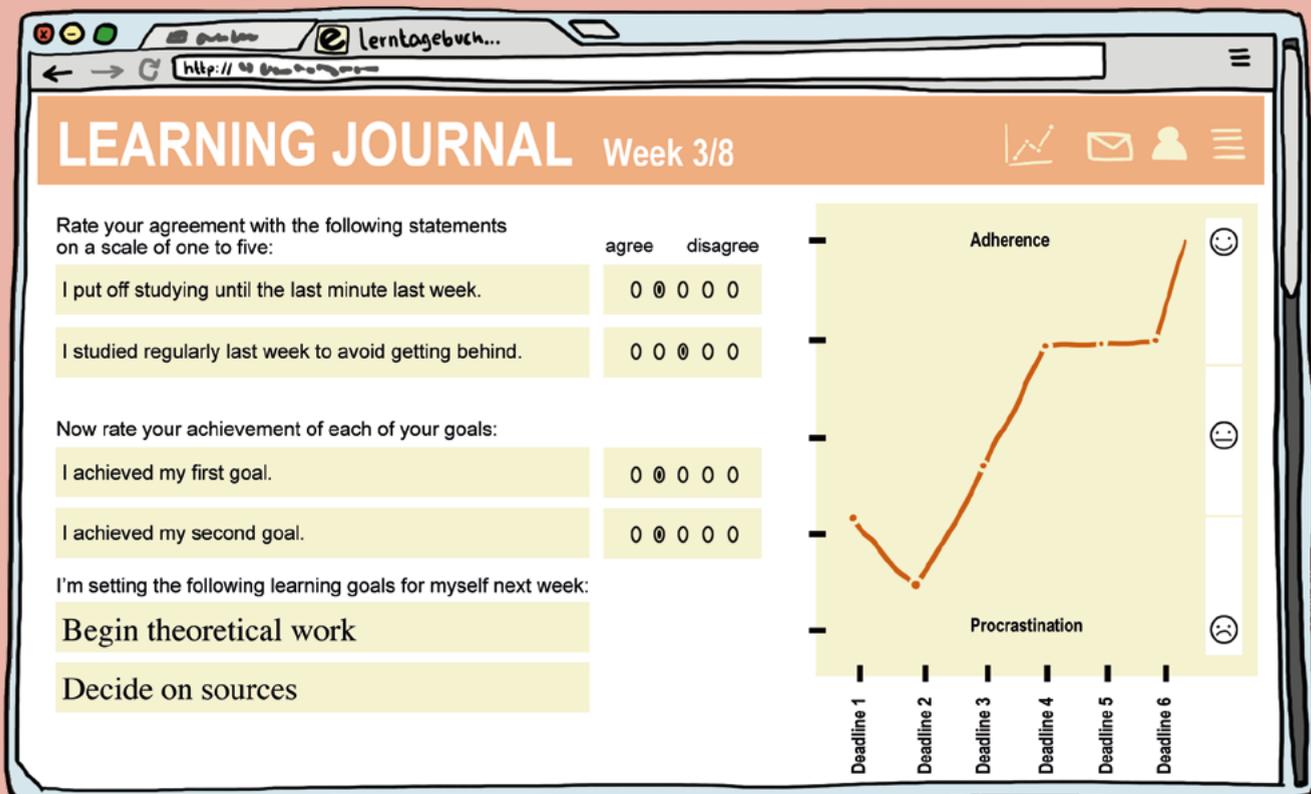
Students record how they perceive their learning behavior over the past week and set goals for the coming week in an electronic learning journal. Illustration: Svenja Kirsch

Cleaning, surfing the Internet, shopping: Many students distract themselves when they should be studying.
Photos: Konstantin Yuganov, Africa Studio, Minerva Studio (all Fotolia)

graph with a system of coordinates reflecting the procrastination they had documented in their learning journal, while the others studied for the upcoming exam without this visual feedback.

"We found out that students whose self-reported learning behavior we had shown in the form of a graph procrastinated less than their classmates," reports Nückles. Students who are confronted directly with their procrastination reflect on their work habits and have an easier time getting into a "virtuous circle," because they are able to adjust their goals accordingly. These students monitored their learning process more closely in the study and set more concrete learning goals. Instead of just telling themselves they would study physiology next week, for example, they aimed to explain key concepts of physiology of the senses in their own words.

In his own lectures, Nückles tries to find the right balance between control and freedom. "You can't chase after the students all day," he says.

"It's important to make it clear to them what relevance and potential uses the learning material has so that they're motivated to learn. But at the same time, they should also receive good guidance from their teachers." Nückles doesn't consider attendance lists to be a particularly useful way to motivate students to attend large lecture courses. Instead, he gives the students regular learning exercises. "Assessment mechanisms like learning exercises or small tests are important, because they give the students feedback and let them know what they've learned so far and what they still need to work on."

Even more importantly, however, the students should learn to monitor their own progress. The educational researcher is currently developing a web-based learning journal that can be integrated into the university's existing online ILIAS portal. This web platform has been used up to now primarily as a means of providing students with course materials. "But some degree programs are already implementing e-portfolios in which students can review and reflect on the learning material," Nücklas explains. Like electronic portfolios, learning journals help students to monitor their learning process and thus counteract their tendency to procrastinate. Such tools allow students to review and optimize their own strategies and make it easier for them to cope with daily life as a student – and all it takes is a little self-monitoring.

http://blog.lehrentwicklung.uni-freiburg.de/author/nueckles

Prof. Dr. Matthias Nückles studied psychology, sociology, philosophy, and cognitive science in Freiburg and Kent, Great Britain, and has served as professor of educational science at the University of Freiburg since 2009. After completing his habilitation thesis in psychology, he worked from 2006 to 2009 at the University of Göttingen as professor of educational psychology. Nückles deals with issues concerning how to design teaching and learning processes in learning situations at school, university, and in informal contexts. His current research interests are self-regulated learning by writing, the analysis and promotion of effective explanations in mathematics, and support for trainee teachers in diagnosing their students' learning processes.
Photo: private

Further Reading

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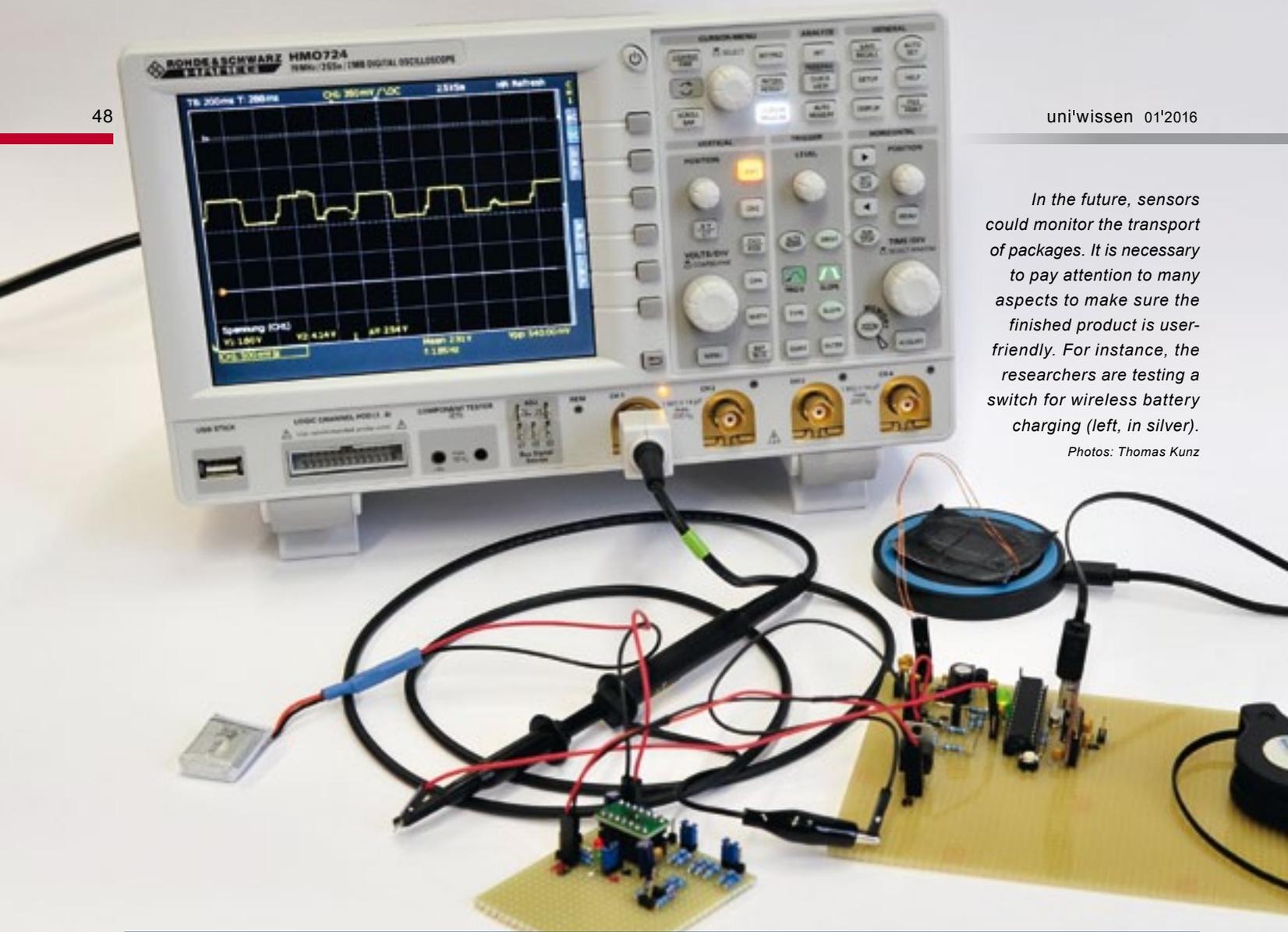
In the future, sensors could monitor the transport of packages. It is necessary to pay attention to many aspects to make sure the finished product is user-friendly. For instance, the researchers are testing a switch for wireless battery charging (left, in silver).

Photos: Thomas Kunz

Tinkerers and Entrepreneurs

The training program Smart-X helps students find out whether they have the stuff to launch their own business

by Stephanie Streif

A year ago Marc Pfeifer sold a speaker on an online auction website. Everything was as usual. After the auction closed he wrapped up the item and sent it to the highest bidder via parcel post. The buyer received the package, unwrapped the speaker, plugged it in, and – nothing happened. The speaker was broken, and Pfeifer was not amused. After all, the speaker had been in working order when he dropped it off at the post office. Tough luck – or not? Pfeifer, a student in the master's program in embedded systems engineering (ESE) at the University of Freiburg, is now developing a sensor that measures whether a package has been dropped somewhere on the way to its destination.

A good idea. The question is only whether the student can develop it into a business idea. A startup business isn't the sort of thing you can just pull out of a hat. That's where "Exist Bootcamp"

Students sketched out their ideas for an imaginary company in a workshop.

comes in. Offered as part of the training program Smart-X, this workshop gives people like Pfeifer a chance to determine whether they have the necessary skills to run their own business. The workshop helps students learn to think like entrepreneurs even before they have completed their degree. The training program Smart-X, winner of the University of Freiburg's Instructional Development Award (IDA) in 2015, was offered for students of the bachelor's program in ESE starting in 2014. "Smart" stands for intelligent technologies that feel, think, or act in the place of humans. The "X" represents a technology of any kind – for example a thermostat that turns on the radiator as soon as someone enters the room or a coffee machine that fetches cups on its own before making coffee. These are the kinds of inventions the ESE students are tinkering with.

Learning to Be an Entrepreneur

Since some of the students are not satisfied just tinkering with their innovations on their own, the program has now been expanded to include the Exist Bootcamp and opened to students of all fields. The fact that half of the participants are students from the humanities testifies to the success of the newly expanded program. But what can students discover about themselves and their inclination to establish a business in the space of a two-day workshop? "A whole lot," says Sabrina Reinshagen, who helped develop the concept for the workshop as marketing and communication officer of the Faculty of Engineering's continuing education program in intelligent embedded microsystems (IEMS). The boot camp gives students the chance to find out what qualifications entrepreneurs need, whether they would make good entrepreneurs at all in light of their strengths and weaknesses, and how to identify whether a business idea is promising.

"The trade-off, developing the innovation into a finished product, is a very time-consuming process."

To discover the potential they have in themselves for becoming entrepreneurs, the students engaged in activities like visualizing a business idea in a group and using the so-called business model canvas to identify customer groups and distribution channels. Another important element of the boot camp was lectures by real-life entrepreneurs.

They told the students how much effort they had to put in before they could finally make money with their business and what part failure played in the process. The seminar did not make all of the participants want to found their own business, says Dr. Tobias Schubert, lecturer and researcher at the Department of Computer Science and director of the IEMS continuing education program. But that's not the point, he finds: "You can't learn if you don't try something out" – and Smart-X and Bootcamp give students the opportunity to do so. Most importantly, however, Smart-X provides an education in entrepreneurship that is even open to students of bachelor's programs. "Entrepreneurship and self-employment are still topics that receive far too little attention at the university," Schubert finds. Yet it is important to promote knowledge transfer between the university and private enterprise and to build up a culture of experimentation.

Weighing Costs and Benefits

So how is Marc Pfeifer's business project coming along? At the moment, he's spending a lot of time in a lab at the Faculty of Engineering and improving his sensor to make it ready for the market. "The trade-off, developing the innovation into a finished product, is a very time-consuming process," he says. Schubert adds that "for a normal master's thesis, it would be enough to develop a working prototype. But if you want to start a business, you need to think beyond this point, make your device user-friendly, and of course also weigh the costs." For example, Pfeifer's sensor needs to be small, inexpensive, and practical, while still fulfilling its function – namely to measure temperature and distinguish between heavy and light impacts. Pfeifer served as a tutor for Smart-X and participated in Bootcamp himself. Now he knows

Smart-X helps students to develop intelligent technologies – like a coffee machine that fetches cups on its own. Photo: Thomas Kunz

he doesn't want to just develop innovations but also market them. He says the training program and the workshop helped him to reach his decision. One thing's for certain: There is not yet a sensor for transport monitoring like Pfeifer's available on the market.

"You can't learn if you don't try something out."

Smart-X is now being adapted to address the needs of companies more directly. In the future, the students will spend more time weighing the benefits of the products they are developing. This is another important step in becoming an entrepreneur, says Schubert: "Away from the technical aspects and toward more usability." Schubert and his team plan to open up Bootcamp to even more disciplines than before and make it into a center for entrepreneurship education at the university. They also want to get students interested in entrepreneurship from the beginning of their studies on. Then they would have several chances to think about the topic while completing their studies – in seminars and training programs and at courses and advising sessions offered by the university's Entrepreneurial Office. And suddenly a good business idea is much more than just a opportunity: With the right know-how, it becomes doable. Even for students.

www.pr.uni-freiburg.de/go/exist-bootcamp

Marc Pfeifer
is studying embedded systems engineering at the University of Freiburg. He works as a student assistant for computer architecture at the Department of Computer Science, where his duties include serving as a tutor for the Smart-X training program. For his master's thesis, he is developing a sensor for transport monitoring. He aims to pursue a doctoral degree and start a business to market his business idea.
Photo: Thomas Kunz

Dr. Tobias Schubert
is a research group leader in computer architecture at the University of Freiburg's Department of Computer Science and director of the continuing education program in intelligent embedded Microsystems. He studied at the University of Freiburg, majoring in computer science and minoring in microsystems engineering, and earned his PhD in 2008. Besides conducting research on the verification and testing of integrated circuits, his main professional interest is advocating application-oriented teaching and knowledge transfer between the university and private businesses. His instructional project "Training Innovators Using Smart-X: Micro Business and Exist Bootcamp" aims to increase awareness among students for self-employment as a career option.
Photos: Sandra Meyndt

Sabrina Reinshagen
studied German linguistics and literature and sociology in Freiburg and German literature in Berlin. She is responsible for marketing and communication in the continuing education program in intelligent embedded microsystems at the University of Freiburg's Faculty of Engineering. In April 2015 she assumed duties as coordinator of the project "Training Innovators Using Smart-X: Micro Business and Exist Bootcamp," winner of the University of Freiburg's Instructional Development Award.

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