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Focus: Animal Navigation

How animals find their way – and what we can learn from them



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Dear reader,

Nowhere else in Europe will you see as many migrating bats as in Pape in Latvia. In the months of August and September, tens of thousands of these small mammals, as well as huge flocks of migratory birds, fly southwards along the Baltic coast at night. It's a truly unique spectacle. But scientists are still very much in the dark about where the animals come from, where they are headed and where they stop along the way. And even less is known about how climate change impacts migratory behaviour.

The gaps in our knowledge about bats extend to many other migratory species – which is one of the reasons why migratory animals are particularly endangered. According to a 2024 United Nations survey, almost half of all migratory populations are in decline and 22 percent are threatened with extinction. In addition to climate change, hunting, fishing, pesticides and habitat loss are all impacting their chances of survival.

This means that if we want to protect these species, we need to learn more about their migratory behaviour – how they prepare for the journey, which individuals survive and return, how migration routes change over time and, last but not least, how the animals navigate. All these topics are the subject of intense research at our university and also the focus of this year's issue of EINBLICKE. We look at a range of different species, taking you to the Latvian Baltic coast to watch the bats migrate, to Greece to observe the learning walks of desert ants, to Norderney, where young wheatears are preparing for their journey, and to Germany's most closely monitored common tern colony at Lake Bant near Wilhelmshaven.

Oldenburg's animal navigation researchers have set their sights beyond studies of sensory perception and animal behaviour, however. Biologist Henrik Mouritsen and ornithologist Miriam Liedvogel explain in an interview how studies on animal orientation and

navigation not only help preserve migratory populations, but can also inspire technological innovation in a variety of fields, from quantum computers to autonomous vehicles.

In this issue, we also introduce you to three impressive researchers at our university who are pursuing new insights that could make a real difference in music, social sciences and economics: Mario Dunkel is investigating the social impact of music, Gundula Zoch is analysing vast amounts of data to glean new knowledge about social inequalities, and Johannes Lorenz is using mathematical models to explore ways to improve tax morale. We also look at how a new type of emergency care service could ease the burden on ambulance services, and introduce you to Germany's oldest photovoltaic system still in operation.

We wish you an inspiring read!

The EINBLICKE editorial team



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Focus: Animal Navigation

Mysterious and inspiring

Migratory species need special protection. At the same time their fascinating abilities provide inspiration for technological advances.

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IN NUMBERS

10,4

watts is the average nominal output of 18 historic solar modules that generated electricity on the roof of the Oldenburg Energy Lab from 1983 to 2022, according to recent measurements. Manufactured as prototypes more than four decades ago, the modules have proven astonishingly durable. Despite looking decidedly weathered after more than 40 years of exposure to the elements, they still deliver almost as much energy as when they were first installed, as a team headed by physicist Dr Martin Knipper reported in a recent study. The original

manufacturer's data sheet promised a slightly lower nominal output. They preferred to err on the side of caution because the modules were among the first to be manufactured for use on Earth rather than in space, so there was very little empirical data to go on.

The 336 photovoltaic modules of the Oldenburg Energy Lab were first put into operation in 1979. They were exhibited during a conference as part of a demonstration system outside the International Congress Centre Berlin. After that they completed a one-year field test on the Telefunk-

en skyscraper in Berlin, where they generated electricity for a transmitter. In 1983 they were permanently installed on the roof of the newly built Oldenburg Energy Lab, one of the first buildings worldwide designed to supply its own energy (a goal that was never fully achieved, however).

Most of the modules are still in use today. The electricity they generate has been fed into the grid since 2007. This is probably the oldest system of this size in all Germany that is still in working order.

0,3

millimetres is the thickness of the monocrystalline silicon cells inside the solar modules. Rows of 36 connected cells are sandwiched between two sheets of glass set in an aluminium frame.

3,46

kilowatts was the nominal output of the entire Oldenburg system. This means that in a sunny year it would deliver a yield of around 3,000 kilowatt hours – enough to supply a two-person household with electricity for a year or to drive 15,000 kilometres in an electric car.

100

dollars was the price of one watt of nominal output in the mid-1970s, so at that time the market value of the Oldenburg system would have been more than 100,000 US dollars. Today, wholesale prices have fallen by a factor of almost a thousand to between 10 and 20 cents per watt.



“Nothing is more important than education”

What opportunities does our society offer, which factors exacerbate inequality and how are people's attitudes and views affected by crises? Driven by a passion for numbers, social scientist Gundula Zoch analyses thousands of people's data to create a tangible picture of the complexities of our social reality.

By Deike Stolz

She wanted to do “something different”. But what? Twenty years ago, just graduating from school, she didn't have much of an idea. “Something different” meant: not electrical engineering like her father; not natural sciences like her mother; and not civil engineering like her older brother. But what? Gundula Zoch printed out long lists of degree courses. “My parents often used to say: ‘Education is the most important thing we can give you’,” she recalls. She found plenty of subjects worthy of consideration, but ultimately settled on sociology, “and I was overjoyed during my studies to find out just how fascinating it is.” Today, Gundula Zoch is a junior professor of Sociology of Social Inequalities at the University of Oldenburg, researching, among other things, precisely the central role of education in determining the trajectories of peoples' lives.

Her work revolves around the causes and consequences of social inequalities. Aside from the fact that we are all individually different: what opportunities does society offer us to participate in education (whether in childcare, school, vocational training, university or job-related training), maintain social contacts, earn a decent income, be politically active and live as healthily as possible? What factors promote inequalities – related to social background, gender, migration background, age or place of residence? And how do crises and transformations impact our career trajectories and political views, for example? These are the kind of questions that Zoch pursues, often in projects with researchers from other research institutions – such as the Leibniz Institute for Educational Trajectories (LIfBi), with which she has maintained ties as a research fellow since moving on to Oldenburg in 2021.

For her research, Gundula Zoch draws on enormous data sets. “In Germany we have incredible resources in this area,” she explains. One example is the LIfBi's National Educational Panel Study (NEPS), the largest longitudi-

nal study on educational inequalities. Since 2009 more than 70,000 people as well as 50,000 people in relevant context such as parents or teachers in schools, have been surveyed and assessed annually on their life situation, school, education, and employment as part of this survey. This allows for the examination of the trajectories of competencies and educational inequalities from birth to old age. The statistical methods Zoch uses to analyse these data sets allow her to detect correlations, identify mechanisms and determine cause and effect.

When commonly held notions and empirical reality diverge

It took some time before Zoch developed her enthusiasm for these quantitative methods – i.e. the standardised investigation into how and why particular combinations of characteristics are distributed statistically. “When starting out, it's pretty tricky to get your head around statistics and these methods”, Zoch says from personal experience during her times as an undergraduate. “Even today, I have the greatest sympathy for my students and make sure always to use plenty of examples to illustrate the particular importance of quantitative research methods”, she adds.

“I just found numbers to be a lot more convincing than verbal arguments: they help to make changes and their causes tangible.” She was so taken by them, in fact, that after earning her diploma in sociology, she completed an additional degree in economics, specialising in applied econometrics. This allowed her to deepen her knowledge of the causal analysis methods that at the time were more commonly used in economics and to be able to apply them to sociological questions.

These methods are still serving Gundula Zoch well today. In the WorkMum project, funded by the German Research Foundation, she and her team

are juggling complex data on more than 2,000 families. On a more or less annual basis, NEPS provides survey data on the parents' living and working situations; the children complete competence tests, for example in reading, maths and science; and researchers even observe the interactions between mothers and babies. Zoch and her team combine all this data with the social security data – accurate to the day – on the women's working hours, earnings and firm characteristics. “Collecting all of this ourselves would be a multi-million-euro project and just not feasible,” Zoch points out.

The most recent finding, published in June by the Federal Institute for Population Research, which is involved in the project, is that if mothers have their child comparatively early, before the average age for first births – currently 30 years – their children exhibit below-average maths and social skills in the first ten years of life, with the lowest skills manifesting in children of particularly young mothers of around 20 or under. These differences, according to Zoch and her team, are largely explained by the fact that younger mothers often have lower educational qualifications and incomes. These factors still have a strong influence on child development in Germany. The conclusion they draw from this data, however, is explicitly not that it is advantageous to start a family later, but rather that decent and reliable formal childcare provision would give particularly young mothers and their children a better chance to catch up.

The topic of formal childcare, and more specifically its expansion for under-threes in Germany, was already the subject of Zoch's multi-award-winning dissertation, for which she conducted research at the University of Bamberg with a scholarship from the Excellence Initiative. She cites it as an example of how common perceptions and empirical reality can diverge: “The perception at the time was that so much money had been invested in this area that all women should have been able to work. But the study showed that



Juggling complex data on more than 2,000 families: Oldenburg social scientists Gundula Zoch (right) and Susanne Schmid (left) at a meeting of the WorkMum project team at the Federal Institute for Population Research.

there were still not enough childcare places, especially in West Germany". Furthermore, the intended impact of boosting employment among mothers was in practice mainly concentrated on families with higher incomes and qualifications, "who obviously know more about how to get their child into a childcare institution in the first place".

In other areas, her research has confirmed common perceptions, such as the fact that mothers tend to back-pedal professionally after the birth of a child. For example, Zoch used NEPS data to show that mothers reduce their participation in job related trainings four times more (by 16 percentage points) than fathers (4 percentage points) after parental leave, and over longer periods of time.

Zoch believes it is important to regularly review prevalent views on society using empirical data. "There are those who might say: 'That's obvious, why do we need a study about it?' But even if the result aligns with general perceptions, it makes a difference if we can quantify trends, highlight social inequalities, and gain a precise understanding of cause and effect." She is regularly asked to give lectures by members of parliament or interest groups, and her findings are incorporated into expert reports for state parliaments or the Bundestag. Although her task is to detect social inequalities

in statistics and averages rather than to assess these, the sociologist notes that her research undoubtedly "puts a finger on the wound" in the public debate.

Every now and then, individual researchers like Zoch are able to use their ideas to help shape and develop data collection in Germany. "Researchers can apply to contribute their own ideas to all large datasets such as the National Educational Panel Study," she says. An application she submitted with a colleague from the University of Leipzig met with success in 2021: In order to analyse the causes of increasing social polarisation and fragmentation in more detail, the NEPS survey now also asks respondents to what extent they agree with conspiracy myths.

Under scrutiny: the consequences of the Covid-19 pandemic

The initial results are surprising, but not in a positive way. Of the nearly 4,000 people surveyed in 2022, 20 per cent or more displayed a conspiracy mentality. In other words, they generally tended to attribute social or political phenomena to the alleged machinations of small, secret, powerful and malevolent groups, supposedly controlling the world's destiny.

According to Zoch, the data shows that such views are not limited to people with a low level of education or in precarious employment. "They also extend across higher education levels, genders, different occupational groups and social backgrounds – in other words, across broad sections of the population."

In other projects, she is analysing the consequences of the Covid-19 pandemic. As part of a project funded by the Federal Ministry of Education and Research, she is looking at shifts in political attitudes, such as the initial upsurge of trust in government and public institutions that later began to erode. A project on other long-term effects of Covid has led to a collaboration with healthcare researcher Prof. Dr Antje Wulff and psychologist Prof. Dr Mandy Roheger from the University of Oldenburg's Medical School: until the end of 2025, the team will be investigating how unequal working and living conditions affect post-Covid syndrome and which factors favour recovery in those suffering from long Covid.

One thing is certain: Gundula Zoch won't run out of research topics anytime soon. "I only have to step out of my office to find endless sources of inspiration. Society is always changing, and there are always new influences that reproduce social inequalities or give rise to new ones."

How is social media changing political communication?

Outlooks



**Prof. Dr
Marius Sältzer**

Digital Social Science

Social media has ushered in a 'new era' of political communication. For a long time, direct personal communication between politicians and the electorate, for example at rallies, was the norm. Then came mass media like newspapers and television. Today, social media is becoming ever more important. It allows political actors to convey a different, customised narrative to each voter group using targeted language and advertising. Of course, rallies and traditional mass media still exist, but through social media political communication is becoming increasingly individualised.

In general, it is difficult to demonstrate either empirically or experimentally how political communication affects voter behaviour. What we do know is that people have always chosen which media to consume according to their political views, and that they like to surround themselves with like-minded people. So they have always lived in an opinion or filter bubble, even before social media existed. There is, however, considerable evidence that social media contributes to a hardening of stances in political debates, because people come together on these platforms who would otherwise not have met and who hold very different views. Unfortunately, it seems likely that this polarisation will only tighten its grip on political culture and society as a whole in the future, with debates becoming more gridlocked, people being less willing to compromise and ultimately the formation of governments becoming increasingly difficult, too.

Researching museum objects using AI

German museums contain hundreds of thousands of objects that came to Europe through war, looting or trade during the colonial era, for example. However, in many cases the documented history of these objects – where they come from, what purpose they served, and who once owned them – is incomplete. This is where an interdisciplinary research team led by historian Prof. Dr Dagmar Freist comes into play. In the project Provenance and Collection Research Digital (ProSaDi), the team is working with researchers from the countries of origin to fill in the gaps for two types of collection items selected as case studies, as well as developing digital techniques to process the data about the collection objects and make it easily and universally accessible. The Lower Saxony Ministry of Science and Culture (MWK)

and the Volkswagen Foundation are providing just under 3 million euros in funding for the project over a four-year period as part of their Wissenschaftsräume (Science Spaces) funding programme.

The ProSaDi project was launched in response to the ongoing debate about the handling of museum artefacts from former colonial territories. Much of the information compiled by museums over the decades has yet to be digitised and often reflects racist and Eurocentric perspectives. The team will develop IT and AI-supported methods that can be used by museums and other institutions to digitally process and display information about their collections. The aim is to compile the data in a user-friendly infrastructure that allows for easy interconnection and retrieval. Together with international partners, the researchers will

also examine the different forms of knowledge production used over time in German museums and in the societies of origin.

In addition, the ProSaDi team will closely interlink research and teaching at the intersection of AI and cultural heritage and develop new concepts for optimising this process. The project team has also enlisted the support of state museums, archives and the Provenance Research Network in Lower Saxony in order to pursue practice-oriented questions. The aim is to ensure that the results of the ProSaDi project are incorporated into everyday practice for museum and archive collections and also applied in the education sector.

The university is a partner in five other projects of the Wissenschaftsräume programme in the fields of physics, environmental sciences, education, sociology and economics.



Left: A headdress made of cowrie shells from Tanzania. The shells of cowrie snails feature in many collections. In the future, an AI will identify individual species.

Right: Jewellery from Oceania. The cowrie shells are woven onto a piece of string.

Below: This belt adorned with cowrie shells comes from the Iramba region in Tanzania.



Utilisation of waste heat from the Data Centre

The university has been recovering waste heat from its Data Centre and using it in its heating system since May of this year. The measure is part of the WärmewendeNordwest research project funded by the Federal Ministry of Education and Research (BMBF), which is headed by energy computer scientist Prof. Dr Sebastian Lehnhoff. The project aims to boost energy efficiency and develop solutions that can be transferred to other universities. The university's heating, cooling, ventilation and power generation systems, which have largely operated independently until now, will be optimised and interlinked in a smart network.

As a first step, the cooling water from the new high-performance computing cluster installed in 2023 will be fed into the university's heating network. The annual heat supply from the heat recovery system is around 500,000 kilowatt hours, which corresponds to the heating requirements of around 30 four-person households and represents a reduction of around 100 tonnes in CO₂ emissions.

Balancing inclusion and academic performance at schools

Measurable academic achievements in the form of grades are a key component of school education. Researchers from the University of Oldenburg and the Free University of Bozen-Bolzano (Italy) are now comparing concepts of academic achievement in primary school education in Germany and Italy and looking at ways to balance achievement, inclusion and educational equality in schools. Prof. Dr Michaela Kaiser is heading the APra project ("Achievement: A social practice in Primary School. An International Comparative Analysis on Germany and Italy"). The German Research Foundation (DFG) and the Province of Bolzano are funding the study over a three-year period with around 800,000 euros.

Properties of crystal surfaces

Prof. Dr Caterina Cocchi and Holger-Dietrich Saßnick from the university's Institute of Physics have developed a new automated method for calculating the physical properties of complex crystalline surfaces using only basic information about the crystal structure. In an article in the journal *npj Computational Materials*, the scientists report that their method can speed up the search for relevant materials for applications in key areas such as the energy sector. The two scientists developed a software programme that requires only the chemical composition of a compound as input in order to calculate the physical properties of the material's surface – for example, the amount of energy required to excite electrons or detach them from the surface. The researchers now plan to combine their method with artificial intelligence and machine learning techniques to further accelerate the process.

Improved battery manufacturing processes

Making European production of lithium-ion batteries more efficient and sustainable is the goal of BATTwin, a recently launched EU project in which the university is involved. Led by an Italian university, the project aims to create a "digital-twin" platform for European battery production plants by 2027. The digital twins in this project are computer models that replicate the processes in a battery cell production plant. A team led by Oldenburg computer scientist Prof. Dr Andreas Rauh is currently developing models that simulate the individual stages of battery cell production. The goal is to reduce scrap rates and minimise energy consumption and emissions during these processes, thus making the entire battery manufacturing process more efficient and environmentally friendly.

Converting carbon dioxide into useful chemicals

Harnessing the power of the sun to convert carbon dioxide into useful chemicals is the goal of a new junior research group at the University of Oldenburg. The international team of researchers led by Oldenburg chemist Dr Lars Mohrhusen is pursuing an ultra-sustainable strategy which involves developing precious metal-free catalysts that chemically activate carbon dioxide, a relatively inert greenhouse gas, using sunlight. The Federal Ministry of Education and Research (BMBF) will provide around 2.6 million euros over the next six years for the SuznCat-CO project.

Mohrhusen and his colleagues will focus on developing catalyst materials based on readily available and inexpensive components such as titanium dioxide and using them for the energy-efficient conversion of carbon dioxide into substances such as methane, methanol or formaldehyde which can then be processed into plastics or synthetic fuels. At present, most catalysts used for this conversion process contain precious metals. Besides requiring large amounts of energy to create the right conditions for the chemical reaction, these materials also have the disadvantage of being expensive and not very durable.

Dedicated to pain prevention

Teaching people in the German-Dutch border region how to prevent chronic pain and provide better treatment to those already affected is the goal of the project “Pain in the Ems-Dollart region: a hidden disease with far-reaching consequences”, a collaboration between the University Medicine

Oldenburg and the University of Groningen (Netherlands). Funded by the EU Interreg VI A Germany-The Netherlands subsidy programme, German and Dutch scientists and doctors from both countries are currently planning several initiatives within the project. Two key components will be coordi-

nated in Oldenburg: a bilingual media campaign focused on educating people via social media channels about how to best deal with pain, and the development of pain management training programmes for healthcare professionals. The project will run until the end of 2027.

Outlooks

When will cancer become less frightening?



Prof. Dr Frank Griesinger
Internal Medicine / Oncology

When a patient is diagnosed with cancer, their world falls apart. In that moment, only one thing matters to them: can it be treated?

In recent years, cancer treatment has advanced dramatically thanks to progress in molecular medicine, which provides insights into which molecular properties facilitate tumour growth – and which drugs can inhibit it. This has taken precision oncology, or personalised cancer treatment, a huge step in the right direction. Another approach that has become established in the past decade and is used to treat many types of cancer are drugs known as immune checkpoint inhibitors, which make cancer cells visible to the immune system.

These and other effective innovations are constantly being refined – and new ways to help patients are being added to the list. The next major breakthrough could come in the form of an mRNA vaccine against cancer. The idea here is to use AI-assisted processes to develop vaccines designed to target the specific characteristics of each tumour based on individual tumour samples and the patient’s individual immune system. The vaccine then functions like a cheat sheet, telling the immune system how to recognise the tumour so that it can fight and destroy it.

Innovations like these show that cancer treatments are becoming increasingly individualised and diverse because every cancer and every patient is different. This may not take the initial shock out of a cancer diagnosis, but it means that in the future we medical professionals will be able to respond more often to the question “Can it be treated?” with a confident “yes”.

Genetic element could be a sensitive biomarker

A genetic element known as a plasmid which is found in the digestive tract of more than 90 percent of people in industrialised nations could be used as a biomarker to detect faecal contamination and other health hazards, an international team led by Prof. Dr Murat Eren from the Helmholtz Institute for Functional Marine Biodiversity has reported in the journal Cell. Plasmids are sequences of DNA that lie outside the chromosomes and are found

in the cells of all living organisms. Identifying these sequences using current biotechnology tools has proven to be a difficult undertaking. The researchers therefore decided to use a new machine learning approach to analyse the genetic information in the human gut in its entirety. Using this approach, the team identified over 68,000 plasmids in the human gut flora and found one plasmid that was particularly prevalent in their dataset. This

plasmid consists of only two genes, one of which is used for self-replication while the other enables transfer to other bacterial cells – no further benefit has been identified to date. Further analyses revealed that this particular plasmid is basically only found in the human gut and in environments influenced by humans. This means that it could potentially serve as a powerful biomarker for identifying health hazards such as contamination of drinking water.

New cause of hidden hearing loss revealed

Hidden hearing loss may have a different cause than previously assumed, a team of researchers from the Cluster of Excellence Hearing4all led by Prof. Dr Georg Klump and Dr Sandra Tolnai from the Department of Medical Physics and Acoustics have discovered. In experiments with gerbils, whose auditory range is similar to that of humans,

the team found evidence that certain neurotransmitter receptors may play a decisive role in how the brain separates different sound sources from one another and enables directional hearing. Directional hearing is an important prerequisite for tuning into the desired sound source and being able to comprehend it in situations where there is

a lot of competing background noise. When it becomes increasingly difficult for a person to hear properly in a noisy environment, this is known as hidden hearing loss. Up to now it had been assumed that damage to the inner ear – caused, for example, by exposure to loud music – was responsible for this form of hearing loss.

Inspired by the animal kingdom

Animal navigation and orientation is a research focus area at the University of Oldenburg. In this interview, biologists Henrik Mouritsen and Miriam Liedvogel explain the importance of this topic for nature conservation – as well as for quantum technologies and autonomous vehicles. An interview with biologists Henrik Mouritsen and Miriam Liedvogel.

Interview: Ute Kehse and Volker Sandmann



Like the famous monarch butterflies, many insects travel long distances every year on their migrations. As pollinators, these little animals play a big part in agriculture. Our food supply depends on them appearing in the right place at the right time.

Billions of animals migrate every year, sometimes travelling extremely long distances. Which navigational feats in the animal kingdom do you find the most exciting?

Liedvogel: That young birds on their first migratory flight find their way to places they have never visited before is truly amazing. These birds hatch from their eggs here in Europe and then fly to Africa. The parents make the journey around two weeks earlier on average. You would think that such young birds would have no clue where Africa is. But they know which direction to fly, when to leave and when they have reached their destination.

Mouritsen: It's incredible that they can reach their destination despite having virtually no points of reference.

Liedvogel: And when they return to their wintering grounds a year later, they seek out exactly the same branch to sleep on after flying thousands of kilometres – which is also very impressive.

How important is the phenomenon of animal migration for ecosystems worldwide?

Mouritsen: I'll give just one example to illustrate the dimensions we're talking about here: each year around two billion birds migrate between Africa and Europe. These are gigantic shifts in biomass, which of course have an enormous global impact.

Liedvogel: But insects also play an important role in ecosystems. Much of the agricultural industry would cease to function without insects as pollinators, and a large proportion of these insects also migrate, as we have only recently learned. Billions of hoverflies fly across the English Channel every year. Butterflies like the admiral cross the Alps. It is crucial for our food supply that all these creatures are in the right place at the right time.

What challenges does climate change pose for migratory species?

Mouritsen: Warmer temperatures cause habitats to shift. This means that animals have to move around more simply because they have to follow their habitats. So understanding how animals deal with space and time and how they move around is becoming

even more important in the context of climate change.

Liedvogel: A problem that affects migratory species in particular is that the changes along the migration route are not interlinked. Those that migrate long distances are the least flexible. If they don't leave their breeding grounds at the right time in autumn, they may not be able to find food en route and thus may not survive the journey.

Mouritsen: In fact, it's the bird populations that migrate to Africa that are experiencing the most dramatic decline. And for them, the problem is not just climate change, but also the ongoing desertification in the Sahel region south of the Sahara, which is also linked to the rapid growth of human populations there. These birds already have to almost double their bodyweight just to have enough energy to fly across the Sahara and the Mediterranean. Their internal organs are partially consumed during the flight. If the desert continues to expand, they will probably no longer be physiologically capable of crossing this enormous barrier.

How can we help migratory species to adapt to the changes?

Mouritsen: This is a topic that we would like to explore in the near future. But first of all, we need to gain a very precise understanding of how animals navigate to a particular location and what cues they use to do this. This will allow us to draw conclusions about the disruptions they face and how they could be encouraged to relocate to a different area or change their migration route, for example.

Can this knowledge be put into practice?

Liedvogel: There are already numerous rewilding projects in which conservationists are trying to halt or even reverse local extinctions. These involve reintroducing parts of a healthy population or animals reared in captivity to a suitable location in the wild. But according to the 2023 UN Biodiversity Conference in Montreal, less than half of these rewilding projects actually succeed. In many cases this is because the animals don't stay in the place where they are released. They sense that this is not 'home'. So we need to understand

how animals define 'home' and we need to understand their navigation mechanisms and sensory perception. One idea for solving the problem is to keep young birds isolated from certain information about their location until they have been brought to the place where they are to be released, so that they accept it as their home. But at this stage we still know too little.

A critical factor in the navigation of migratory birds is their magnetic sense, which is being researched in detail here in Oldenburg together with researchers from Oxford, also in your own Collaborative Research Centre "Magnetoreception and Navigation in Vertebrates". How does this sensory perception work?

Mouritsen: We know that the magnetic sense is light-dependent. We know that birds measure the angle of inclination of the magnetic field lines with respect to the Earth's surface, the so-called magnetic inclination. We know that the magnetic compass is located in the eye and that the information is processed in the part of the brain that deals with visual information. And we

have a hypothesis about the mechanism behind this: there is a protein in their eyes, cryptochrome 4, which detects magnetic fields via a quantum mechanism. We can now produce and analyse this protein molecule using bacterial cultures. Together with our partners in Oxford we have been able to show that the cryptochrome 4 of robins is magnetically sensitive. Although this is not yet proof, it is a clear indication.

Science has long assumed that the energy generated by the Earth's magnetic field was nowhere near strong enough to influence biomolecules.

Mouritsen: Yes, it was said, for example, that the Earth's magnetic field was too weak to split bonds within proteins by a factor of 10 million. In the meantime, we have proven beyond doubt that fields that are about a hundred times as strong as the Earth's magnetic field – in other words, a hundred thousand times weaker than the originally assumed limit – most certainly do have an effect on the magnetically sensitive protein we are investigating. And we believe that this magnetic sensitivity



Professor of Ornithology Miriam Liedvogel investigates the genetic foundations of bird migration. Henrik Mouritsen, Professor of Neurosensory Science, researches magnetoreception in birds. The researchers use devices called Helmholtz coils (in the background) to create artificial magnetic fields.

increases in the molecule's natural environment – in this case, a sensory cell in the eye. To simulate this effect, we produced artificially mutated proteins, which we are currently testing.

Liedvogel: Interestingly, my colleague Corinna Langebrake and I observed in a separate genetic study that the exact same areas of the protein which you are now investigating have changed over the course of bird evolution – the efficiency of the protein for magnetic perception has probably continued to improve over millions of years.

A few years ago, it was also considered unlikely that quantum-mechanical effects could play a role in biology.

Mouritsen: Yes, because quantum phenomena are usually only visible at very low temperatures or on extremely tiny length scales. The conventional wisdom was therefore that quantum effects were far too fragile to play a significant role in the warm, humid and chaotic environment of a cell. But this is clearly not true, and in my view this is the most exciting aspect. It means that this research has a fundamental importance that goes far beyond birds. If someone had told me 20 years ago that people who build quantum computers might be interested in how migratory birds find their way to Africa, I would have thought they were crazy!

So what does magnetoreception in birds have to do with quantum computers?

Mouritsen: Mechanisms very similar to those we hypothesise that birds use for magnetoreception could be used to store information in quantum computers. More specifically, this involves what is known as coupled electron spins. Spin is a quantum-mechanical property of electrons. In magnetoreception, two electrons are presumably coupled with each other for fractions of a second through their spin. You could picture them as mini magnets, and depending on the direction of the two spins, they are influenced by magnetic fields such as the Earth's in different ways. In a quantum computer, electron spins could form the basis for qubits – the basic unit of information in quantum computing. However, most current quantum computer architectures work at temperatures just above absolute zero. Birds, on the other hand, seem to use this mechanism at temperatures of plus 40 degrees Celsius! If the principle could be transferred from biology, it could lead to solutions for quantum computers or quantum sensors that would be much easier to use than today's technologies. Not tomorrow, and not the day after, but perhaps ten or twenty years from now. Our future research will therefore be aimed

at gaining a better understanding of quantum-mechanical effects at room temperature.

Could animal navigation systems serve as a model for new technologies in other ways?

Liedvogel: We want to explore that possibility too. We believe autonomous technical systems could be improved if, like animals, they were to rely on a large number of simple sensors for navigation, rather than just a few highly precise but very complicated sensors.

Mouritsen: Navigating animals are very smart in how they use resources: they have millions or even billions of relatively imprecise sensors – such as cryptochrome proteins – to determine the direction of the magnetic field. Yet taken together, the average value determined by all these sensors is highly accurate. In addition, although these animals have a relatively small 'computer', the high quality of the information that their brains receive from their sensory organs means they can draw on relatively simple decision-making algorithms. So when it comes to difficult decision-making and energy efficiency, they are superior to technical systems. If you combine the solutions from biology with technical, AI-based solutions, you get the best of both worlds.

Is there a future for regional languages?

Outlooks



Prof. Dr Doreen Brandt

Low German literature from a historical and cultural perspective

Even if the number of speakers is in decline and average competence in the language is sinking: Low German (Niederdeutsch) has a future!

But these days, rather than learning Low German from their parents or grandparents, young people are learning it in school instead.

The relevant structures currently being put in place in schools in Lower Saxony, for example, are a result of favourable political frameworks such as the European Charter for Regional or Minority Languages, which came into force in 1999.

In 2019, Lower Saxony issued a decree for the promotion of Low German in schools. Children come into contact with Low German speakers and learn Low German songs in class, and teachers also make a point of drawing their attention to Low German inscriptions on school outings.

The wonderful thing about this is that schoolchildren learn Low German in regions where the language is actually spoken.

Low German itself, which has always been spoken in a variety of dialects, will change of course. Not every local dialect can be taught in schools. More broadly spoken teaching varieties will probably emerge instead. This could have a negative impact on the dialect identification potential, but at the same time make the language easier to learn and comprehend.

Perhaps in the future the language will be spoken less at the marksmen's club, but there will be more opportunities to go to a play performed in Low German. However, Low German will remain a living, dynamic language: it will be spoken, it will be heard, it will be written, it will be read.

Migratory birds on a perilous journey

Migratory species are particularly vulnerable to the effects of climate change, habitat loss and environmental pollution. Several research groups at the university and the Institute of Avian Research are joining forces to gain new insights into the behaviour of migratory birds and improve their protection.

By Tim Schröder



Common terns are long-distance migrants and overwinter in Africa. The Institute of Avian Research has been monitoring a colony on Lake Bant near Wilhelmshaven since the mid-1980s.

W

When the sun sets over Norderney in late summer and the island is gradually swallowed by darkness, a strange spectacle begins. One by one, young northern wheatears fly up from the dunes into the night sky. Some circle gracefully over the island for just a few minutes before landing again; others stay in the air for up to two hours. Some birds even repeat this exercise several times a night. “We don’t yet know exactly why the young birds do this,” says biology professor Heiko Schmaljohann, who researches bird migration. “But we suspect they are memorising Norderney as their home and at the same time training their “magnetic map” so that they can navigate with pinpoint precision when they return from their African wintering grounds the following year.”

Northern wheatears are sparrow-sized songbirds. A fascinating trait of these birds is that, like many other songbird species, they always migrate at night and alone – without parents, siblings or conspecifics, which means that the young birds making the long journey from Norderney to Africa for the first time must find their way to their destination all on their own. “The genetic basis of this behaviour is still relatively unclear – but what we do know is that the birds’ genes essentially ‘tell’ them when, how long and in which direction to fly,” Schmaljohann explains. A particularly exciting aspect for scientists is that many migratory birds have a kind of “magnetic map” which they use to navigate between their breeding and wintering grounds. However, little research has been done on this to date, he adds.

Schmaljohann’s work is part of the University of Oldenburg’s research in the focus area of animal navigation. One objective here is to apply the results more extensively in nature conservation – in measures such as reintroductions of endangered species, for example. But to do this, he and his team must first find out how and when migratory birds learn where

their home is. To track the northern wheatears’ flight routes around Norderney, the scientist attaches a tiny radio transmitter tag to the birds’ backs (see the photo series on page 24). Receiving stations dotted along the North Sea coast then automatically log the birds’ location as they fly past. Using this still relatively new technology, Schmaljohann’s team discovered how the young birds circle over Norderney and even beyond at night.

In a parallel project, his colleague Professor Miriam Liedvogel is investigating the genetics and metabolic mechanisms that control and regulate this fascinating behaviour at the molecular level. Migratory birds are known to develop “migratory restlessness” in late summer, shortly before they set off on their journey. During this phase they flutter their wings frequently and gradually switch from daytime to nocturnal activity. “In the coming years we want to study in greater detail what goes on at the cellular level – which genes are activated, what metabolic processes are triggered in the brain, the eyes and throughout the body,” Liedvogel, a professor of ornithology and Director of the Institute of Avian Research (IAR) in Wilhelmshaven explains.

Instead of migrating south, blackcaps now spend the winter in British gardens

Liedvogel also works in robins and blackcaps, two other songbird species, but together with Heiko Schmaljohann she now plans to also study the northern wheatear in more detail. For this she will use various methods, including virtual displacement experiments, which involve placing the caged birds in an altered magnetic field by means of large magnetic coils. The experiments will simulate a magnetic field corresponding to the field along the birds’ natural migratory route at pre-determined times, and the team

will then analyse how this affects the birds’ migratory restlessness in terms of timing, intensity and activity, as well as how their metabolism correlates.

Miriam Liedvogel is excited to see what the experiments reveal about the underlying genetic and metabolic processes. She is convinced that the genetics of migratory behaviour are far more complex than ornithologists long believed. Her research on blackcaps, a common songbird species in Germany, has already confirmed this. In early summer, its melodious song fills gardens everywhere, but in the colder months the birds migrate as far as Africa. However, in recent decades interesting observations have been made in the UK. Since the 1960s, many blackcaps that spend the summer months on the continent have stopped migrating south in the autumn and are instead heading northwest to winter in British gardens, where they are fed regularly and thrive. This new trend has sparked Miriam Liedvogel’s interest. “We want to understand how this change in migratory behaviour became genetically anchored in a population within such a short time.”

The key questions for Oldenburg’s animal navigation research – how do songbirds find their way to their destination? How do they learn where home is? And how do they find their way back when they fly alone? – also play an important role in nature conservation practice, for example, when reintroducing birds to areas where they have become extinct. “These reintroduction projects only work if the animals actually adopt the new location,” Heiko Schmaljohann explains. One such example is a reintroduction project involving the aquatic warbler, a small moorlands species which has disappeared from Germany entirely as a breeding bird and is now considered the rarest songbird in Europe. In an EU project in 2018, several young birds were brought to a nature reserve in Lithuania from a neighbouring country with a stable population. The following spring, when eleven of the birds which had all been fitted with geolo-



Young wheatears (image: a young bird being ringed) circle over Norderney at night. They are presumed to be imprinting the location of their home on an internal map.

cator tags returned after wintering in Africa, the project was hailed as a success. “In reality, however, at least half of these projects fail because the animals do not recognise the reintroduction site as home. They migrate away from the new site, presumably to return to their birthplace,” the ornithologist reports. This means that reintroduction projects can only succeed if scientists understand when and how young birds imprint and learn their birthplace, as the young northern wheatears on Norderney do.

A fifth of all migratory species are threatened with extinction

A recent United Nations study highlights just how precarious the situation of migratory animal species has become. It shows that across the globe 44 percent of all migratory populations are in significant decline, with a fifth facing extinction. There are many factors that can contribute to this negative trend, including habitat loss. In the case of migratory birds, one additional key factor is light pollution, which can disrupt nocturnal orientation and lead them astray during migration. An-

other is the accumulation of pollutants in the birds’ tissues.

Professor Sandra Bouwhuis, Scientific Director of the IAR and a lecturer at the University of Oldenburg, is investigating this latter phenomenon. In 2017, her team began measuring mercury levels in the blood and feathers of common terns, a species that is “highly endangered” in Germany – not least because wetlands and near-natural river landscapes are becoming ever rarer. The IAR has probably done more research on the common tern than any institution worldwide. Every spring, hundreds of these slender birds breed on a group of empty barges filled with gravel on Lake Bant in Wilhelmshaven, where the institute has its main headquarters. After they hatch, each chick is ringed and then, shortly before fledging, fitted with a transponder no larger than a millimetre in size. Over the years, 44 perching boxes fitted with antennas which register each time a bird lands on one of them have been installed on the barges. In addition, the breeding birds are registered at their nests using mobile antennas, so that parents and offspring can be linked together in family trees. The IAR keeps track of whether and when the birds return each year and how successfully they breed.

Until two years ago, the colony was home to around 750 breeding pairs and 2000 birds in total. Then it was hit by avian influenza. In 2023, Sandra Bouwhuis and her colleagues counted just 350 breeding pairs. “The influenza outbreak was a major blow, especially because common terns are already under pressure due to habitat loss and climate change. On top of that, pollutants, in particular mercury, are accumulating in their bodies.” Bouwhuis’s measurements show that blood levels of this heavy metal increase as the birds age. In the coming years she plans to conduct more detailed studies to determine whether the rising mercury levels affect the terns’ migratory behaviour. Because one thing is clear: migration is extremely stressful for the birds. They burn enormous amounts of energy and lose a lot of weight. Heavy metals may take a further toll on their health. Sandra Bouwhuis now plans to expand her research on neurotoxins, and together with Heiko Schmaljohann and Miriam Liedvogel apply it to songbird species as well. After all, there are lots of pollutants in the environment. Not just mercury, but also pesticides, which can contaminate cereal crops and insects – the main food sources of many songbirds.

How can we make products more sustainable?

Outlooks



Prof. Dr Christian Busse

Sustainability and Supply Chain Management

Currently, a product’s life cycle is generally a linear process: raw materials are extracted, components are manufactured, the product is used, then at some point it ends up on the scrap heap. A circular system in which products are fed directly back into the manufacturing process at the end of their lifespan makes more sense. Unfortunately, this circular economy is not well established and remains little more than a vision.

It would be good to extend the use phase, for example with companies not selling their products but offering services instead. So rather than buying a printer, you lease it and pay for the operating hours while the printer itself remains the property of the manufacturer. This would have the advantage that manufacturers develop a vested interest in producing durable products and remanufacturing them at the end of their lifespan.

Of course, it’s vital that products are designed to cause as little damage as possible throughout their life cycle and across all social and environmental dimensions. I firmly believe that this can only be achieved through government regulation: in the long term, governments must set out a clear, reliable framework – and ensure that it aligns corporate and societal interests.

Tracking birds, bats and bugs

In order to protect migratory animals, we need to know their flight routes. For a long time, however, smaller species such as songbirds were difficult to track. The Migration Ecology research group headed by Professor Heiko Schmaljohann uses tiny radio transmitters and fixed radio receiving stations that are part of a worldwide network to track animals over long distances. In a unique experiment carried out last summer, the researchers used an aeroplane to assess just how precisely migratory routes can be estimated on the basis of radio recordings.



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1 To track the routes of small species such as bats, songbirds and even insects, researchers use radio transmitters that weigh as little as 0.1 to 2.6 grams. These are carefully attached to the birds' backs using elastic bands to avoid impeding their movement. Each transmitter emits a unique radio signal every few seconds that allows the carrier to be identified and tracked individually. After a few weeks, the transmitters generally just fall off.

2 During the experiment conducted by the Migration Ecology research group in July, it was not a bird but an aeroplane that took to the air. It took off from Varrelbusch Airfield in the district of Cloppenburg, near Oldenburg.

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3 The researchers – pictured here: technician Mario de Neidels – attached a total of six radio transmitters to the plane's wings and undercarriage. The aim of the experiment was to calibrate the transmitters by comparing the flight route estimated by the transmitters' signals with the flight route identified by GPS in the aeroplane.

4 The researchers used tear-resistant tape to attach the transmitters. The batteries in the tiny devices have a lifespan of a good four weeks.

5 Before take-off, Dr Thiemo Karwinkel checks whether the transmitters are operational and emitting signals.



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6 For the test flight, the Oldenburg team set up a temporary receiving station at the airfield. Together with around 60 fixed stations along the North Sea coast, it formed part of the Motus Wildlife Tracking System, an international collaborative research network that tracks the migration routes of small moving animals. The receiving stations consist of directional antennas on masts that are up to ten metres high. They can receive radio signals from a radius of five to twenty kilometres.

7 Each receiving station has a tech case containing a robust radio receiver. During the experiment, the researchers tested how the signal changed when the plane flew past and, for example, whether its wings interfered with transmission.

8 Final preparations before take-off: pilot Renke Schütte programmes the flight route. On board with him are doctoral student Georg Rüppel and technician Melanie Willen.

9 During the test flight, the plane flew over a Motus network receiving station located in the Wold woodlands, west of Oldenburg. Wold Lake can be seen in the background.

10 For the experiment, the team spent two days following typical bird migratory routes along the North Sea coast, flying past numerous receiving stations of the Motus network (green dots). The team first flew along the west coast of Schleswig-Holstein, made a stopover on the island of Föhr, then flew to the islands of Sylt and Helgoland and back to Varrelbusch. In its second flight, the plane flew over the Jade Bight and the East Frisian Islands to the seaport of Emden, taking a detour to a light vessel in the North Sea. Doctoral student Georg Rüppel will use the collected data to create a model for estimating the flight paths of the radio-tagged animals more reliably. The researchers want to be able to track, for example, small migratory birds at night and determine whether they are more likely to pass through or avoid wind farms.



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The inner compass

Many animals can perceive the Earth's magnetic field. Scientists suspect that in some species this capacity is based on magnetic iron oxide particles in the animals' bodies, but they haven't yet been able to locate the corresponding sensory cells. Using sophisticated experiments and cutting-edge technology, several research groups at the University of Oldenburg are hot on the trail of this mysterious sense.

By Ute Kehse



trout, and perform behavioural experiments to gain a detailed understanding of how their sensory perception works, while Winklhofer and his research group "Sensory Biology of Animals" are working to establish new laboratory methods and microscopy procedures.

A mysterious sense

The research in this area benefits from the fact that there are organisms called magnetotactic bacteria which are already known to use magnetic particles for orientation. These unicellular organisms synthesise chains of magnetic nanoparticles called magnetosomes, which help the microbes to move up and down along the lines of the Earth's magnetic field in bodies of water. "You can picture magnetosomes as microscopic compass needles," says Winklhofer. He and his team use the bacteria as a "positive control" group to prove that a method for detecting magnetic nanoparticles works.

Their theory is that similar chains or clumps of magnetic iron minerals could be present in the nerve cells of higher organisms. When these mini-magnets reorient they may generate a mechanical stimulus that is then converted into a signal and transmitted by the nerve cell. Winklhofer's team aims to prove the existence of

these magnetic iron particles, which are probably no more than a hundred nanometres (a hundred billionths of a metre) large, and at the same time determine their exact location in the bodies of the studied species. But their endeavour is complicated by the fact that iron is ubiquitous in all living organisms and the environment, which frequently leads to contamination and false results.

Among the various microscopes deployed by the researchers, there is one that uses fluorescence to visualize magnetic fields and thus magnetic particles in tissue. In addition, the scientists now have access to a state-of-the-art scanning electron microscope that provides ultra-high-resolution images of even the most sensitive biological material. This device is also able to pinpoint the exact position of various elements – such as iron – within a sample. The team hopes that this high-tech combination will finally enable them to locate the iron particles within the nerve cells.

The researchers are using rainbow trout as a model organism. "Studies suggest that the trigeminal nerve may be involved in their magnetoreception," says biologist Dr Laura Ziegenbalg, a postdoctoral researcher in Winklhofer's team. In humans, this nerve transmits pain, temperature, and pressure stimuli from the facial skin and teeth to the brain. In animals, however, this nerve is known for its remarkable sensory adaptations, innervating infrared receptors in the

pit organ of snakes and even electroreceptors in the snout of platypus. Mediating such a remarkable range of sensory modalities, the trigeminal nerve has been an obvious candidate for the magnetic sense, too. Indeed, an electrophysiological study on rainbow trout from the year 1997 suggested that the upper branch of this nerve carries magnetic stimuli from the snout region and nasal cavity, where magnetite particles were found too. There is still no clear anatomical evidence where exactly the elusive sensory cells are located, but the new scanning electron microscope will allow Winklhofer's team to perform the complex analyses their research involves much faster than before.

A navigation system for insects

The state-of-the-art equipment also plays an important role in the research of biologist Pauline Fleischmann, who investigates orientation in desert ants. She, too, is on the hunt for sensory cells that can detect magnetic fields. "Our working hypothesis is that the ants' magnetoreception mechanism is located in their antennae," says Fleischmann, a Research Group Fellow associated with the Oldenburg Magnetoreception CRC. The ants' delicate antennae are multifunctional organs which they use among other things to smell and touch.

Desert ants are an interesting model for magnetoreception research because they are established experimen-

vestigating this hypothesis intensively for several years. The researchers have made numerous findings that are gradually providing an overall picture of how the mechanism might function.

The second mechanism proposed for magnetoreception is based on magnetic iron oxide particles. The theory seems obvious enough given that compass needles, which are aligned northwards by the force of the Earth's magnetic field, are also made of magnetic mineral particles. However, the evidence gathered so far is confusing: although behavioural experiments indicate that various animal species use this mechanism, scientists have yet to find proof of any corresponding magnetic structures.

The researchers in Oldenburg are approaching the topic from several angles. Teams led by biologist Dr Pauline Fleischmann, Oliver Lindecke and physics Professor Michael Winklhofer study species that are sensitive to magnetic fields, including ants, bats and

The magnetic sense is still considered to be one of the most mysterious phenomena in biology. "Although magnetoreception has been studied for decades, it is still a highly contentious field," explains Dr Oliver Lindecke, a Research Fellow in the University of Oldenburg's Collaborative Research Centre (CRC) "Magnetoreception and Navigation in Vertebrates" and an expert on bat navigation. One reason for the ongoing controversy, he explains, could be that "animals probably use at least two different methods to perceive the magnetic field."

There is already substantial evidence that small songbirds rely on a quantum effect known as the radical pair mechanism. These findings suggest that the mechanism is located in their eyes and is triggered by light. The Magnetoreception CRC coordinated by Oldenburg biologist Professor Henrik Mouritsen and another project funded by the European Research Council and jointly run by the Universities of Oldenburg and Oxford have been in-

What do desert ants, Nathusius' pipistrelle bats and rainbow trout have in common? At first glance, not much: ants crawl, bats fly, trout swim. And there are many other differences: ants are insects, weigh just a few thousandths of a gram and live in colonies. Bats are mammals, weigh several grams each and have a complex social life. Trout, a popular food fish, can each weigh several kilos and lead a solitary life in the wild.

But as different as these three species may be, they all possess an amazing yet little-understood ability: they can detect the Earth's weak magnetic field, which is imperceptible to humans. They use this sensory perception to orient themselves and, in some cases, navigate over long distances – which is why the university's scientists are studying them as experimental model organisms that can help to advance our understanding of this mysterious sense known as magnetoreception.



1 Physicist Michael Winklhofer uses state-of-the-art microscopy to detect magnetic nanoparticles within cells.

2 Desert ants have an excellent sense of direction. Biologist Pauline Fleischmann is researching the insects' magnetic sense in Greece and elsewhere. In field experiments, she observes how the ants are affected by artificial magnetic fields created using Helmholtz coils.

3 The ants, which are about one centimetre long, don't bite or sting. Pauline Fleischmann brought two colonies from Greece to Oldenburg for her research.

tal models for insect navigation with excellent navigation skills and a tiny brain well-suited for neurobiological analyses "Their navigational performance is very impressive," stresses the researcher. They inhabit the barren salt pans of the North African Sahara or the pine forests of Greece. When foraging, they sometimes move hundreds of metres away from their nest, but once they have found something to eat they return to the nest in a straight line.

These ants have long been known to use a "celestial compass" system, taking the position of the sun, for example, for orientation. During her PhD project, Fleischmann and colleagues made the exciting discovery that desert ants also possess a magnetic sense. Their findings show that when the ants leave their nest for the first time and perform what is known as learning walks in preparation for foraging, they orientate themselves to the Earth's magnetic field in order to memorise the location of the nest entrance. These insects open up an interesting perspective on magnetoreception, says Fleischmann: "It is often assumed that magnetoreception is above all useful for migratory species that travel over long distances, but the desert ants are a living counterexample."

In addition to the proposed sensory organ, Fleischmann is also investigating the ants' behaviour in their natural and lab environments, as well as how their brains process magnetic stimuli. Her experiments have shown that the learning walks leave measurable traces in the insects' brains. In an article recently published in the scientific journal PNAS, the biologist and two colleagues from the University of Würzburg reported that when desert ants are exposed to an altered magnetic field the first time they leave the nest, two areas of their brain which play a key role in orientation remain noticeably smaller and less interconnected. Their findings suggest that the magnetic compass helps to calibrate the ants' visual compass and train their spatial memory. Further investigations

will now aim to clarify how the lack of magnetic stimuli during the learning phase affects the ants later on when they become foragers.

The bats' journey

Some mammals can also detect the Earth's magnetic field, but as with insects, only a few studies to date have focused on their magnetic sense. "Research on mammals' orientation and navigation is at least 50 years behind that on birds," says Oliver Lindecke. The biologist specialises in bats, which he describes as good models for investigating these phenomena in mammals. "They're friendly animals that are easy to work with," he explains.

Lindecke's main objective is to find out how the magnetic compass mechanism helps bats to orient themselves. He and his colleagues are conducting experiments near the University of Latvia's Ornithological Research Centre in Pape. "Tens of thousands of bats migrate southwards along the Baltic coast in the months of August and September. It's a fantastic spectacle, unique worldwide, and truly stunning," says the researcher, who has done a lot of groundwork in recent

years towards understanding the bats' behaviour and establishing appropriate experimental set-ups.

He has already achieved impressive results: first he demonstrated that when caught during migration and then released elsewhere, the bats continue their journey in the same direction. "That was the first key point to be proven in order to establish a model for mammal navigation," he explains. He then designed an ingenious experiment for determining the direction in which the bats want to fly. He uses a circular arena with a tight-fitting cover and places the bats at the centre of the plate. This means that a bat has to crawl to the edge of the plate before it can fly off. However, it cannot see the sky and can only use echolocation to a limited extent to orientate. As Lindecke demonstrated, the point at the edge of the arena from which the animals take off can be used to determine their intended direction of flight.

In addition, he discovered that Soprano pipistrelle bats calibrate their magnetic compass at sunset; they note the point at which the sun sets in order to determine their flight trajectory for later that night. In a study published at the end of 2023, Lindecke reports

that during this process the bats can sense two different components of the Earth's magnetic field: the horizontal direction and the angle between the magnetic field lines and the Earth's surface, also known as the magnetic inclination.

Based on his research to date, Lindecke considers it more likely that the bats use the particle-based form of magnetoreception. The first place where he and Winklhofer now want to look for the nanoparticles is the cornea of the eye – a tissue densely innervated by the trigeminal nerve. In behavioural experiments, the researcher has already found evidence that the cornea could be involved in magnetic perception.

Lindecke is confident that the mystery surrounding particle-based magnetoreception will be solved within the next few years. He sees Oldenburg, where several research teams with wide-ranging expertise in the field of magnetoreception have congregated, well-positioned to make significant advances in this field. "If you want to be in the right place to discover where magnetoreception is located in the body, then you need to be here," he says.

Quantum effect or magnetic particles?

The two proposed mechanisms for magnetoreception are based on different principles of physics, which means that behavioural experiments can be designed to distinguish between them. The radical pair mechanism, for example, which is based on quantum mechanics, is light-dependent and therefore cannot function in absolute darkness. It is also disrupted by electrosmog, i.e. radiofrequency magnetic fields in the range of 100 kilohertz to 100 megahertz.

Magnetoreception based on magnetic

particles, on the other hand, should not be affected by darkness or electromagnetic radiation, but is likely to be disrupted by a strong but brief magnetic pulse. Such pulses can reverse the direction of the magnetic field in magnetic minerals or even mix up their arrangement in magnetic sensory cells. As a result, a disturbed sensory cell can no longer reliably detect an external magnetic field until it is recalibrated or repaired.

Experiments with songbirds have shown that they need light to use their magnetic sense, and that electrosmog

disturbs their orientation. These, as well as many other findings, support the theory that their magnetoreception is based on the radical pair mechanism. By contrast, experiments with pigeons, young sea turtles and bats showed that their orientation was disrupted by magnetic pulses, which is why scientists suspect that the magnetoreception in these species is particle-based. It cannot be ruled out that in some animal species both mechanisms are present and are used for different aspects of navigation.



What if tax declarations were made public?

Would people be more honest about paying their taxes if they had to publish their income? Johannes Lorenz, an economist at the University of Oldenburg, and two colleagues decided to investigate. One key finding of their research was that maximum transparency doesn't necessarily translate into maximum tax revenues.

By Henning Kulbarsch

To many people in Germany, the idea of their tax data being made public

may seem unusual. But for Johannes Lorenz, Junior Professor in Business Taxation at the Department of Business Administration, Economics and Law, it raises interesting research questions, for example: "Could such a level of transparency actually encourage taxpayers to illegally evade or legally avoid their taxes?" His reasoning here is that if someone sees that their acquaintances are not being honest in their tax returns, the behaviour might rub off on them.

Tax evasion is a major problem for both state and society. In 2019, a report by the University of London estimated that in Germany alone, tax revenue losses amount to more than 125 billion euros per year. This then creates a hole in the state budget when it comes to financing projects in key areas such as education, research and infrastructure. Lorenz now plans to examine the phenomenon in greater detail. In previous studies he looked at how social narratives affect tax avoidance behaviour and the "race" between tax legislation and tax avoidance. Lorenz is a Research Fellow in the Collaborative Research Centre Accounting for Transparency, which is coordinated by the University of Paderborn and investigates the effects of tax and transparency regulations on the economy and society. "I'm interested in how taxation affects entrepreneurial decisions and, in particular, how income tax transparency influences tax compliance and tax revenues," says Lorenz.

To explore these questions in greater depth, Lorenz and two colleagues from the University of Passau used what is known as a "small world" network model in which people are represented as nodes that influence each other. These computer-based models are used

in economics to uncover structural relationships through simulation games based on a relatively limited number of premises.

The model designed by the three researchers simulates a fictitious neighbourhood with a population of 1,000 individuals who observe each other's behaviour over a period of 40 years. The simulation is based on three premises: first, that neighbours can determine the real income of an individual based on factors such as the size of their house or the make of their car. Second, there is a five percent chance that the tax authority will audit a taxpayer in any given year. If someone is caught faking donations or cheating on their commuter allowance, for example, they have to pay a fine and are forced to be honest for the next four years. Finally, taxpayers are free to optimise their tax burden through legal means, which gives them the same financial advantage as tax evasion but is more complicated.

Does income tax transparency influence tax morale?

The researchers tested three scenarios: in the first, which resembles today's situation in Germany, no one has to publicly disclose their tax data. In the second, taxable income is made public by the tax authority. This is similar to the legal situation in Norway and Sweden. In the third, there is maximum transparency: gross income, tax returns and taxable income data are all disclosed. The scientists assume that taxpayers, as rational subjects, not only want to pay as little tax as possible, but also want to gain some "social advantage". Here the scientists are referring to people's tendency to behave similarly to those around them.

"Let's say I see that my self-employed neighbour can afford a big house even though he has a low income according to the disclosed data. I don't want to be the fool who pays more, so I try to minimise my tax payments too," Lorenz explains. This hypothesis is based on empirical studies that show that group pressure is a strong factor in tax evasion.

The key finding of the simulation is that partial rather than full transparency generates the highest tax revenues. In the first scenario, the people have no idea how their neighbours are behaving; tax fraud is a popular strategy here because evasion often goes undetected. In the second scenario, taxpayers can tell if their neighbours are paying less tax than might be expected, but not whether they are evading or optimising taxes. Consequently, neither strategy is encouraged by herd behaviour, and people tend to pay their taxes honestly. In the third scenario, which entails maximum transparency, it's clear who is evading, who is optimising, and who is doing neither. Here, most people choose to optimise their tax payments using legal means. Tax evasion, on the other hand, is made unattractive by the deterrent effect of fraudsters getting caught.

"The study suggests that from the state's point of view, partial disclosure is preferable, since this results in the lowest tax losses," Lorenz summarises. However, he admits that the results vary depending on the size of the network, the likelihood of being audited and the tax rates. He therefore plans to refine the model in future studies in order to make the impact of different degrees of tax transparency more measurable. The results of the simulations are then to serve as an initial hypothesis for empirical studies. "In this way, our research can help to combat society's problem of tax evasion."

Not all emergencies are equal

If you dial 112 for the emergency medical services in the Oldenburg area, the dispatchers of the Oldenburger Land or Vechta Rescue Control Centre won't always send an ambulance. Since the pilot project Gemeindenotfallsanitäter (Community Paramedics) was launched five years ago, they may decide to send a specially trained paramedic instead. Insa Seeger, a health services researcher at the University of Oldenburg, is investigating the impact of this new medical service on healthcare in the region. Her expertise is in growing demand among policymakers.

By Sonja Niemann



Dozens of times every day, emergency medical dispatchers make crucial decisions based on the calls they receive. Are the symptoms of the person on the line serious enough to warrant an ambulance? Or is it perhaps a less urgent case that would be better served by a general practitioner? If so, sending an ambulance would not only be unnecessary but would also mean that this important resource would be temporarily unavailable for a real emergency.

Since 2019, employees at the Rescue Control Centres involved in the Gemeindenotfallsanitäter project have had an additional option: they can deploy Community Paramedics who drive minivans fitted with medical equipment and are trained to provide on-site medical assistance independently. The goal is to ease the pressure on emergency departments and ambulance crews.

Health services researcher Dr Insa Seeger probably knows better than anyone else whether the concept is working. Although she is not present when the paramedics respond to a call, together with other researchers she has analysed thousands of deployment protocols over the last few years. Seeger (46) is a research associate at the Department of Health Services Research and spokesperson for the Oldenburg Research Network for Emergency and Intensive Care Medicine. She has provided scientific support for the project from the outset. "Our task is to analyse the impact of the community paramedics objectively and from an external perspective," says the researcher, who studied Business Administration in Healthcare Facilities after training as a medical assistant and completed a doctorate on outpatient emergency care in Germany in 2019. The Community Paramedic pilot project was launched in that same year as the only one of its kind in Germany at the time. Other participants in the project aside from the municipal authorities and Rescue Control Centres are the Malteser aid agency, the

German Red Cross Cloppenburg, the City of Oldenburg's fire brigade, the Ministry of the Interior of Lower Saxony, the statutory health insurance companies and the University Medicine Oldenburg. Just over a year after its launch, Seeger was already able to provide an analysis of the community paramedics' deployments, which have changed only minimally in the intervening years. In most cases (more than 60 percent) the paramedics conclude that the patient "is not in urgent need of medical assistance". This means that neither rapid medical intervention nor a hospital examination are necessary. Instead, the paramedics offer medical guidance, administer medication or provide support with self-medication, and check vital signs such as blood pressure and blood oxygen. "All these calls would otherwise involve the deployment of an entire ambulance team which is then no longer available for a real emergency situation," Seeger explains. In around one in three cases the paramedics recommend that patients go to the emergency room. Only rarely does the situation turn out to be more serious than the dispatcher had assessed it to be, in which case the community paramedic immediately begins emergency treatment, calls for telemedicine guidance from Oldenburg Hospital if necessary, or summons backup via the Rescue Control Centre. Seeger's first study already showed that more than half of the patients were older than 65, so this group became the main focus of the researchers' attention in following studies. "The Community Paramedics are able to provide the necessary assistance to more than half of the patients on site. This is a big advantage for older people in particular," explains Seeger. After all, the often long wait times for treatment at an emergency department or inpatient admission can be very stressful, especially for the elderly.

Another key finding is that emergency calls are often made to emergency medical services which are not qualified or equipped to deal with the situation in question. Roughly one in

seven of the elderly people to whom the community paramedics are deployed are in a nursing home – and with conspicuous frequency the reason for the call is a problem with a indwelling urinary catheter. Unlike regular paramedics, the community paramedics can provide immediate assistance in such cases. They learn how to handle catheters as part of their specialist training. By contrast, ambulance services tend to take such patients straight to hospital for further treatment.

Between outpatient care and standard emergency medical services

"Nationwide, we can see that Rescue Control Centres are receiving more and more calls that are not actual emergencies," says Seeger. Her own research has shown that only a very small proportion of those who call the emergency services and to whom the community paramedics are then dispatched tried to contact their own doctor or the medical on-call service beforehand. Instead, they immediately dialled 112, thus putting themselves on the radar of the emergency services.

Precisely because the new service closes the gap between outpatient care and traditional emergency medical services, it cannot be clearly assigned to either of these two separate care sectors. According to Seeger, this is one of the main reasons why the project has not yet become a standard care service. Among other things, this classification process would determine how the cross-sector service is legally regulated and ultimately also how it is financed.

Consequently, the project is a recurrent topic of political debate. This has not gone unnoticed by Seeger, whose scientific expertise on the subject is increasingly sought after – by municipal authorities that are interested in the project and in some cases have already adapted it for their purposes. But also by politicians. She was recently invited by the Committee for Internal Affairs



Around 30 community paramedics are currently operating in the region.

and Sport of the Lower Saxony state parliament to give an expert opinion on a draft law amending the Emergency Services Act. Seeger also regularly reports on the experiences with community paramedics at conferences for the emergency services sector.

Building on the results of her research so far, the study "Deployment, Services and Effects of the Community Paramedic" has also focused attention on the impact of this new emergency resource on the healthcare system in recent years. A team of researchers from

various departments at the University of Oldenburg and other universities worked together to evaluate not only the paramedics' protocols, but also data from rescue control rooms, ambulance services and emergency departments. The objective was to analyse how the services provided by the community paramedics impact other medical emergency service providers. General practitioners and patients were also given the opportunity to describe their experiences with the paramedics. At the time of going to press, the results of the

three-and-a-half-year study had not yet been published. "However, we can already say that the patients included in the survey were very satisfied with the care provided by community paramedics," Insa Seeger emphasises.

This feedback reaffirms Seeger's opinion that it makes sense to continue the pilot project: "The goal is to ensure that everyone seeking medical assistance receives appropriate care without wasting resources – and community paramedics can certainly contribute to this."

Community paramedics

Community paramedics are qualified paramedics with at least five years of professional experience who have completed a three-month auxiliary training course. Unlike ambulance crews they work alone and drive a specially equipped emergency vehicle. Community paramedics provide medical assistance, advice and support to patients on site and if necessary

contact their GP, a hospital, a nursing home or the care services to coordinate or arrange further measures. They are part of the regular ambulance service and are deployed whenever the rescue control centre does not consider a situation life-threatening and the patient is unlikely to need hospitalisation. The pilot project was launched in 2019 in the districts of Cloppenburg, Vechta and

Ammerland and in the city of Oldenburg. There are currently around 30 community paramedics in action. By adding the community paramedic service to their range of emergency medical resources, the municipalities are responding to the growing number of emergency calls being made in situations that are not life-threatening.

How can education become more equitable in the digital world?

Outlooks



Prof. Dr Felicitas Macgilchrist

Digitale Education and Schooling

German schools vary greatly in terms of the digital learning resources on offer. This must change. However, ensuring greater equality of access is not enough to ensure equal opportunities.

The US philosopher Nancy Fraser named three factors that are prerequisites for equal opportunities: the redistribution of resources, (cultural) recognition and (political) representation. Digital technologies in school lessons could do much more to promote this than they have done so far. Why not use the tablet computers in schools to encourage participation in decision-making and gather everyone's vote when it comes to designing the school garden or planning where to go on the next school trip? Why not make a film – but this time with guidance that ensures that the collaboration doesn't simply reinforce existing hierarchies within a group or class, but becomes an inclusive learning experience for everyone?

Rather than following a market logic, tools should be designed and used to promote collaborative learning and democratic education. Even at school young people should be given the feeling that their voices are heard and they can have a say.

If school can be designed in such a way that pupils get a first-hand experience of democracy, this could make a real difference. I am convinced that even the most banal learning apps used in schools are in some way political. These apps shouldn't always just tell pupils what to do. Pupils need to be able to participate in the decision-making process at the school level, at the class level – and at the individual learning level.

An open attitude to music

Musicologist Mario Dunkel loves both jazz and punk, is a champion of equality in music education and studies the instrumentalisation of popular music. He recently investigated how right-wing populist content is disseminated through music.

By Constanze Böttcher



Mario Dunkel appreciates the fact that different music genres enjoy equal status at the University of Oldenburg's Institute of Music. The music professor is a jazz pianist, but he used to be in bands that were inspired by metal, rock and punk.

already had a connection to this university long before I actually moved to Oldenburg," says Mario Dunkel on a June evening in the packed auditorium on Haarentor Campus. The guests have come to listen to a concert that is part of the University of Oldenburg's 50th anniversary celebrations.

But before the music starts, Dunkel, a professor of music education and director of the university's Institute of Music, holds a short speech reflecting on one of his predecessors, Egon Kraus. Kraus was head of the music department at the Oldenburg School of Education in the 1960s, before the university was founded. It was pure coincidence, Dunkel recalls, that he came across the name while doing his

doctorate at TU Dortmund University more than a decade ago.

At that time Dunkel was researching the historiography of jazz and was also interested in the role jazz played in the foreign cultural policy of the US State Department in the 1950s. Curious about what had been going on in Germany during that same period, he began researching West German foreign cultural policy, and that's when he encountered Kraus.

As the official head of the liaison office for intergovernmental relations of the German Music Council, Kraus advised the West German Foreign Office and wrote short recommendations on which music groups should perform abroad. But that evening in the auditorium it soon became clear

that Kraus was certainly no role model in Dunkel's eyes: for one thing, the former cultural consultant and elitist music teacher didn't care for jazz and popular music. For another, as Dunkel explained in his speech, there were dark spots in Kraus's past: he had been a cadre unit leader in the Hitler Youth, and as director of the Rhineland branch of the Musicians' Guild he had been responsible for regional music policy under the Nazis.

"Egon Kraus's history has yet to be fully reappraised," Dunkel remarks a fortnight later in his office, which happens to be located in the old School of Education building where Kraus worked. However, as Dunkel points out, the sweeping political changes of the early 1970's – in the course of

which the University of Oldenburg was founded as a reform university – formed the background to Kraus' work. The training of music teachers in Oldenburg changed fundamentally during this period.

"In Oldenburg there was the Kraus group on one side and a group led by his colleague Ullrich Günther on the other," Dunkel explains. Günther was a professor, music educator and one of the university's founding fathers – and he had very different ideas to Kraus about music education: "He was interested in all types of sound", and fundamentally questioned the hierarchies between classical and popular music, for example. For Dunkel, the fact that the Institute of Music still stands for this progressive view of music today is

a key feature of the University of Oldenburg with which he strongly identifies.

After all, according to Dunkel's way of thinking, music educators should come into contact with as many musical genres as possible. It was thanks to his childhood piano teacher that he himself rehearsed a broad repertoire of musical styles, including Schlager music, from an early age. As a teenager, he played guitar, keyboard and drums in various band projects that drew inspiration from a variety of sources: from metal bands like Blind Guardian and progressive rock or punk bands like Yes and Die Ärzte.

The fact that Kraus features as a side note in Dunkel's academic career serves to underscore something that he considers very important: namely,

to look at music in connection with other social phenomena. For example, in the project "Popular Music and the Rise of Populism in Europe", funded by the Volkswagen Foundation from 2019 to 2023, he and other researchers from around Europe examined how right-wing populist parties in particular use music as a tool. They also analysed how much explicitly populist content is found in popular music.

The results show that discourses of crisis play an important role in popular music in all the European countries studied. In response to crises, this music presents, for example, nostalgia, that is the image of a supposedly better past, or the longing for heroism. The social exclusion of minorities is also offered as a solution. With catchy

melodies and lyrics and rousing performances, popular music makes right-wing populist discourse socially acceptable and accessible to broad audiences, the study shows.

The team's work also added an important cultural dimension to the question of why populist parties and groups are gaining ground in Europe. Popular music is a field where society plays out its conflicts, Dunkel says. His research has given him expertise that is socially relevant and in demand. When hundreds of incidents involving revellers singing far-right slogans to the Eurodance hit "L'amour toujours" made headlines last spring, a number of regional and national media outlets such as *Die Zeit*, *Deutschlandfunk*, *ARD*, *ZDF* and *NDR* asked him to analyse and comment on the scandal.

A lifelong passion for music and academic research

For Dunkel, the topicality of his work is both a warning and an incentive. In his view, his discipline has so far failed to develop adequate approaches and materials to deal with right-wing populist music. "We need to up our game here," he says, making a quick shift from theory to practice: "In a democracy it is crucial that we are literate vis-à-vis this complex media world, including the audio world in which children and teenagers spend their time." Music lessons in schools could contribute here, he adds.

There was little in Dunkel's early life to suggest that his passion for making music would later combine with academic ambition. He turned down a trainee position at the local Sparkasse bank in Cochem an der Mosel, his

hometown, because he wanted "to do something with music". For his teacher training at TU Dortmund University, he chose English as his second subject alongside music – a choice that would have a lasting impact.

At first, he felt alienated by the cultural mindset of some of the instructors at the Dortmund Institute of Music. But studying English opened up new worlds for him: African American Studies, Gender Studies and Queer Theory appealed to his intellect. He felt at home at the Institute for English and American Studies, also because most of the other students "spoke English just as poorly as I did", he quips. His first study trip abroad, to Atlanta, Georgia, kindled his interest in literature – and academic writing. And when he returned to the US to teach German at Hamilton College in Clinton (New York State), he discovered how much he enjoyed teaching.

At that point it still hadn't occurred to him to embark on an academic career, let alone become a professor. The 42-year-old describes the fact that he ended up back at the Institute of Music and Musicology at TU Dortmund University after doing his PhD on a cultural topic in American Studies – on a scholarship from the German National Academic Foundation – as a happy chance.

It was also happy chance that the University of Oldenburg advertised the position of Junior Professor in Music Education with a Focus on Transcultural Music in such a way that Dunkel's rather unusual qualifications fitted the bill. Dunkel got the job and five years later, in 2023, he was made full professor. One of the things he likes most about Oldenburg is the strong focus on teacher training, because through his work with teacher trainees and students who are doing their master's in musicology or media studies he can

also make a contribution to society, he explains.

His main focus when it comes to music and music lessons is "reflecting on culture and our everyday activities". One example of this is a joint project on digital music production and teaching financed by the Federal Ministry of Education and Research (BMBF), which he is currently leading. "Music production has become very accessible. Nowadays you can record music to a decent standard at home with a mobile phone," Dunkel points out. Yet this is barely acknowledged in music lessons, he adds. At the same time music production is associated with certain stereotypes that can make female pupils in particular feel excluded. "Ultimately, we want to anchor aspects of social equality and justice in digital music education using a science-based approach."

How to make music education more equitable

Dunkel has many plans for the future – including projects with his "fantastic colleagues" at the university. He is still very preoccupied with the topic of right-wing extremism, digital culture and music, for example. He also supervises doctoral students who share his interest in matters of diversity and justice and are researching questions such as what it is like for "Women Music Students of Colour" to study at German music colleges, or the extent to which antisemitism plays a role in music lessons. And he continues to pursue his passion at the interface of American Studies, where he is working together with a colleague from Vienna, Magdalena Fürnkranz, on a handbook to contemporary jazz research.

Social inequalities, ocean models and medieval chivalric romances

Every year, the Universitätsgesellschaft Oldenburg e.V. (UGO) gives an Award for Outstanding Doctoral Thesis in memory of Gerhard Wachsmann, as well as an Award for Excellent Research. The sociologist Gundula Zoch is the recipient of this year's research award in the humanities, social sciences and cultural studies category, which comes with 5,000 euros in prize money. Geoecologist Sinikka Lennartz received the same award in the natural sciences, mathematics and medicine category. The outstanding doctoral thesis award, which is endowed with 2,000 euros, went to German Studies scholar Martin Sebastian Hammer.



Award for Excellent Research

Prof. Dr. Gundula Zoch has been serving as Junior Professor of Sociology with a focus on Social Inequalities at the Institute of Social Sciences since 2021. Her research centres on social inequalities in work, family, and education, with an emphasis on analysing inequalities over the life course. She employs empirical methods to study large-scale longitudinal survey data, such as the National Education Panel Study (NEPS). Zoch receives the UGO research award in recognition of the social relevance of her research, addressing issues like the effects of the Covid pandemic and disparities between East and West Germany. Zoch studied in Leipzig and London and earned her doctorate in Bamberg. Prior to joining the University of Oldenburg, she conducted research at the German Institute for Economic Research (DIW Berlin), the University of Bamberg, the Leibniz Institute for Educational Research (LifBi) and the University of Oxford.



Award for Excellent Research

Prof. Dr. Sinikka Lennartz has been serving as Junior Professor of Biogeochemical Ocean Modelling at the Institute for Chemistry and Biology of the Marine Environment since 2022. Her work focuses on analysing the global carbon cycle, in particular on organic substances dissolved in seawater and their role in carbon sequestration. She translates chemical and biological processes into mathematical equations that are incorporated into global biogeochemical ocean models. Lennartz receives the prize in recognition of her innovative research, which has challenged decades-old assumptions about the organic carbon dissolved in the ocean and provided evidence that this natural carbon reservoir reacts more sensitively to environmental changes than previously thought. Lennartz studied in Tübingen and Braunschweig, completed her doctorate at the GEOMAR – Helmholtz Centre for Ocean Research Kiel and continued her research in Oldenburg and at the Massachusetts Institute of Technology.



Award for Outstanding Doctoral Thesis

In his thesis in German medieval studies, Dr. Martin Sebastian Hammer examined metalepsis in courtly romance. He analysed the chivalric epics Erec, Parzival and Wilhelm von Österreich, texts that originated around 800 years ago in medieval royal courts and which in many ways "function" differently to modern novels. He receives the UGO award for his application of modern narratological concepts to earlier literary epochs, which paved the way for a new understanding of the term metalepsis. A metalepsis is the combination of two otherwise separate narrative levels – for example, when the "fourth wall" is broken in a film and the narrator addresses the main character directly. Hammer studied at the Friedrich-Alexander-Universität Erlangen-Nuremberg and conducted research at the Universities of Oldenburg, Wuppertal and Braunschweig. He is currently a research associate at the Technische Universität Braunschweig.



Thorsten Balke

Vegetation Ecology and Conservation

Dr Thorsten Balke has been appointed Professor of "Vegetation Ecology and Conservation" at the Institute of Biology and Environmental Sciences. He studied geography at the Leibniz University Hannover and earned his PhD at Radboud University (Netherlands) in 2013 with a thesis on coastal ecology and geomorphology. While studying for his PhD from 2009 to 2013, Balke was a junior researcher at the Deltares research institute in Delft (Netherlands), and also spent a year as a visiting researcher at the National University of Singapore. From 2013 to 2014, after completing his PhD, Balke worked as a researcher at the Deltares institute and the NIOZ Royal Netherlands Institute for Sea Research in Yerseke (Netherlands). He then took up a position at the University of Oldenburg, before moving to the University of Glasgow (UK), where he was a researcher and lecturer at the School of Geographical and Earth Sciences from 2016 to 2023. Balke's research focuses on coastal vegetation in temperate and tropical climate regions and its interactions with the environment. He also develops concepts and monitoring methods that are primarily used in the design of nature-based solutions to climate change and in the restoration and management of mangroves and salt marshes.



Kristian Berg

Grammar of the German Language

Prof. Dr Kristian Berg has been appointed Professor of "Grammar of the German Language" at the Institute for German Studies. Berg studied German, English and Musicology at the University of Cologne and earned his PhD at the University of Oldenburg in 2012 with a thesis on the morphosyntax of nominal units in Low German. From 2008 to 2019, during and after the completion of his PhD, Berg worked as a research associate at the University of Oldenburg. From 2017 to 2018 he was also an Associate Junior Fellow at the Hanse-Wissenschaftskolleg. In 2019 he was appointed Professor of German Linguistics at the University of Bonn, having already held the professorship on an interim basis for several months. Berg's main research topics are written language and word formation. He investigates how written German has changed over time, particularly at the level of spelling and punctuation, as well as how new words are formed and under what conditions they are accepted by a language community.



Kathrin Boerner

Prevention and Rehabilitation Research

Prof. Dr Kathrin Boerner has been appointed as Professor of "Prevention and Rehabilitation Research" at the Department of Health Services Research. She was previously Professor of Gerontology at the University of Massachusetts Boston (US). Boerner studied psychology in Kiel and Trier. As part of her PhD at the Freie Universität Berlin, she conducted research at Harvard Medical School in Boston. From 2000 on, Boerner held various senior research scientist positions at eldercare facilities in the US, including Lighthouse International, a rehabilitation agency for adults with visual impairment, and Jewish Home Lifecare, a health care system for older adults offering all levels of care. Aging research was her main focus at all stages. Since 2014 she conducted research and taught at the University of Massachusetts Boston. Boerner investigates the management of age-related chronic diseases in mid- to late life, as well as unique challenges in the care of very old adults. Of particular interest in this context are social isolation and loneliness in late life, as well as ways to optimize care teams in the care of older people.



Mark-Oliver Carl

Didactics of German Literature including Media Didactics

Dr Mark-Oliver Carl has been appointed Professor of "Didactics of German Literature including Media Didactics" at the Institute for German Studies. Before joining the University of Oldenburg, he was a research associate at the University of Cologne's Institute for German Language and Literature II. Carl studied German and English language and literature at the Universities of Kassel and Manchester (UK). He earned his doctorate in Kassel in 2007 with a dissertation on intertextuality in the works of GDR author Ulrich Plenzdorf. In 2009, he qualified as a secondary school (Gymnasium) teacher for schools in Berlin after completing the second state examination. He then taught literature didactics in various posts at the Universities of Potsdam, Frankfurt am Main and Cologne, as well as at the University of Education Weingarten. He completed his habilitation in Cologne in 2022 and qualified to teach German literature and its didactics at university level. In his research, Carl uses empirical methods to investigate how school pupils interpret literature, acquire cultural knowledge and learn to access the deeper meaning of literary texts. He is particularly interested in the didactics of serial and dystopian narratives.



Jan Erhorn

Sport Science with a Focus on Sport Education and Sport Didactics

Prof. Dr Jan Erhorn has been appointed Professor of "Sport Science with a Focus on Sport Education and Sport Didactics" at the Institute of Sport Science. He previously held a professorship of the same name at Osnabrück University. Erhorn did a teaching degree in education science, sport and history at the Universität Hamburg, where he also earned his PhD in 2010 and then worked as a post-doctoral researcher. In 2013 he was appointed Junior Professor of Sport Education and Sports Didactics at Europa-Universität Flensburg and remained there until 2017, when he took up the professorship at Osnabrück University. His research focuses on empirical teaching research, teacher professionalisation, movement, games and sport in early childhood, and the professionalisation of early childhood educators, as well as inclusion and approaches to heterogeneity. Erhorn is a reviewer for numerous scientific journals and was Chairman of the Board of the Lower Saxony Institute for Early Childhood Education and Development (nifbe) from 2018 to 2023.



Verena Klös

Embedded Hardware-/Software-Systems

Prof. Dr Verena Klös has been appointed to the Chair of "Embedded Hardware-/Software-Systems" at the Department of Computing Science. She studied computer science at the Technische Universität Berlin, completed her master's in 2012 and received her PhD in 2020. After working as a research associate at the Technische Universität Berlin, she became junior professor in computer science with a focus on tactile computing at the Technische Universität Dresden in 2023. Klös's main area of research is Self-Adaptive and Cyber-Physical Systems (CPS) as well as formal methods for guaranteeing the safety of software systems. Another critical aspect of future CPS is their direct interaction with humans. To improve this, she is researching how the systems can use explanations to ensure that the people interacting with them understand what behaviour to expect in any given situation. Here she is also interested in the extent to which the systems have to adapt to their human users and vice versa.



Andreas Martens

Cardiac Surgery

Prof. Dr Andreas Martens has been appointed Professor of "Cardiac Surgery" at the University of Oldenburg's Department for Human Medicine. He is also the new Director of the Department of Cardiac Surgery at Klinikum Oldenburg. Before joining the University of Oldenburg, he was head of Aortic Surgery and Senior Consultant at the Clinic for Cardiac, Thoracic, Transplant and Vascular Surgery at Hannover Medical School (MHH), where he also completed his medical degree, his doctorate and his training as a specialist in cardiac surgery and vascular surgery and then qualified as a professor in 2017. He was appointed adjunct professor in 2020. Martens specialises in surgery on the thoracic aorta, minimally invasive heart valve procedures and coronary vessel surgery. He also conducts research into improving these techniques. He is a member of the Aortic Surgery Commission and the Commission for promotion of young talents of the Deutsche Gesellschaft für Thorax-, Herz- und Gefäßchirurgie (German Society for Thoracic, Cardiac and Vascular Surgery) and member of the Aortic Dissection Task Force of the European Association for Cardiothoracic Surgery, among other medical associations. Martens is part of the Editorial Board of the Zeitschrift für Herz-, Thorax und Gefäßchirurgie and a reviewer for numerous medical journals.



Christoph Matheja

Theory of Correct Systems

Prof. Dr Christoph Matheja has been appointed to the professorship for "Theory of Correct Systems" at the Department of Computing Science. He studied computer science at RWTH Aachen University, where he earned his master's degree in 2014 and his PhD in 2020. He was a post-doctoral researcher at ETH Zurich (Switzerland) from 2020 to 2021, and then moved to the Technical University of Denmark in Lyngby, where he was an assistant professor from 2021 to 2023 and associate professor from 2023 to 2024. Matheja's main area of research is the development of formal methods and tools for software verification that give correctness guarantees in the form of mathematical and, ideally, machine-checked proofs. To this end, he develops verification tools that can rule out programming errors at an early stage. A particular focus is the analysis of probabilistic programs, which can make decisions based on random experiments. Matheja develops methods for quantifying the correctness and robustness of such programs.



Rebecca Palm

Nursing Science

Prof. Dr Rebecca Palm has been appointed Professor of "Nursing Science" at the Department of Health Services Research. She will also lead the new master's degree programme Advanced Nursing Practice, which has been launched in the current winter semester. Before joining Oldenburg, she was a professor at Witten/Herdecke University. After training as a nurse at the German Heart Centre Berlin (DHZB) she studied nursing science at Osnabrück University of Applied Sciences and at Witten/Herdecke University, where she also completed her doctorate in 2016. Professor Palm's research activities focus on the care of older adults with a dementia illness and gerontopsychiatric care needs. She is particularly interested in investigating the structural conditions that care facilities should provide to meet the care needs of people with dementia. She is currently also researching the topic of delirium in geriatric care facilities. Palm is a strong proponent of the academisation of nursing education.



Ayça Polat

Social Pedagogy in the Migration Society

Prof. Dr Ayça Polat has been appointed Professor of "Social Pedagogy in the Migration Society" at the University's Institute of Educational Sciences. Polat studied intercultural education and social sciences at the University of Oldenburg, where she also completed her PhD. After a period as a Fellow at the Centre for Ethnic, Immigration and Pluralism Studies at the University of Toronto (Canada), she worked as a lecturer for special tasks at the University of Oldenburg. From 2008 to 2015, she was Integration Officer for the City of Oldenburg. She then took the post of Professor of Interculturality and Migration in Social Work at Kiel University of Applied Sciences. In 2022, she was appointed to the professorship of Social Work in the Context of Social Diversity at Osnabrück University of Applied Sciences. In the same year, Polat completed her habilitation with a thesis on the foundations of reflection on social and educational work in the migration society. Polat's main research interests include theories and approaches to criticising racism and increasing diversity awareness, as well as migration education and critical migration research. More recently she has focused on the phenomenon of everyday racism and the question of what role diversity and discrimination play at universities.



Wolfram Rollett

School Education with a Focus on School Development

Prof. Dr Wolfram Rollett has been appointed Professor of "School Education with a Focus on School Development" at the Institute of Educational Sciences. He was previously Professor of Empirical Education Research with a Focus on School Development at the Freiburg University of Education. Rollett studied psychology at the University of Vienna (Austria) and RWTH Aachen University, and completed his doctorate at TU Braunschweig in 2007. From 2007 to 2012 he headed a research group at TU Dortmund University which focused on the development of all-day schools (Ganztagsschule) in Germany. After earning his habilitation in 2012 he took up the professorship position in Freiburg, where he was also Dean of the Faculty of Educational Science from 2021 to 2024. In his research, Rollett uses empirical methods to investigate learning and development processes. His key focus areas are adaptive and inclusive learning environments, the learning and organisational culture at all-day schools, the effectiveness of various learning formats and the impact of class composition on the development of pupils.



Ulrike Sallandt

Protestant Theology with a Focus on Systematic Theology and Ecumenism

Dr Ulrike Sallandt has been appointed Professor of "Protestant Theology with a Focus on Systematic Theology and Ecumenism" at the Institute of Theology. Before coming to Oldenburg, she was a research fellow at the Heidelberg University of Education and a lecturer at Ruhr University Bochum. Sallandt studied Protestant Theology in Bielefeld, Tübingen and Leipzig and passed her First Theological Examination in 2002. She went to Peru on a research visit while doing her PhD at Ruhr University Bochum. Sallandt completed her PhD in 2006, then took her second Theological Examination a year later and was ordained by the Evangelical Lutheran Church in Peru. From 2007 to 2014 she worked in Lima as a teacher, deputy head teacher and parish priest. In 2015, she moved back to Germany and took up a post as a research associate at the University of Bonn, where she worked until she switched to the Heidelberg University of Education and completed a master's degree in philosophy in 2016. Her research focuses on theology and philosophy, ecumenism and interreligious dialogue, transcultural theology, Pentecostalism in Latin America and postcolonial theory.



Christoph Sextroh

Accounting and Corporate Governance

Prof. Dr Christoph Sextroh has been appointed Professor of "Accounting and Corporate Governance" at the Department of Business Administration, Economics, and Law. He studied Business Administration at the University of Duisburg-Essen and the NHH Norwegian School of Economics in Bergen (Norway) and completed his PhD in 2014 at the University of Mannheim's Graduate School of Economic and Social Sciences. During his doctoral studies from 2009 to 2014 he was a research assistant at the University of Mannheim. In 2016 he took up the post of Assistant Professor of Accounting at Tilburg University (Netherlands) and then became tenured Associate Professor in 2021. He was a visiting researcher at the University of Washington in Seattle (USA), the Bocconi University in Milan (Italy), the University of Michigan in Ann Arbor (USA) and London Business School (UK). Sextroh's research focuses on questions relating to corporate transparency and capital market communication, the dissemination and processing of financial and non-financial information by the various stakeholders and the impact of financial technologies and social media.



Timm Wilke

Didactics of Chemistry

Prof. Dr Timm Wilke has been appointed to the professorship of "Didactics of Chemistry" at the Institute of Chemistry. He is a Lower Saxony profile professorship, which receives extra funding from the Lower Saxony Ministry of Science and Culture. He studied chemistry and French at the University of Göttingen, where he earned a Master of Education degree and went on to complete his PhD at the department of Didactics of Chemistry. From 2016 to 2020, Wilke was junior professor of teaching and learning research at the Technische Universität Braunschweig's Chemistry School Lab. He also worked as a part-time teacher at various schools for eight years. From 2019 to 2020 he held a visiting professorship at the University of Graz (Austria), and then from 2020 to 2023 he was Professor of the Didactics of Chemistry at the Friedrich Schiller University Jena. Research visits have taken him to the Centre National de la Recherche Scientifique in Toulouse (France), the Florida Institute of Technology in Melbourne (US), and the Leibniz Institute for Science and Mathematics Education in Kiel. Wilke's research interests include adapting current research topics such as nanotechnology, green chemistry and functional materials for school lessons, developing digital teaching-learning tools for lessons, teaching and research, and the use of AI in chemistry lessons.



Antje Wulff

Big Data in Medicine

Dr Antje Wulff has been appointed Professor of "Big Data in Medicine" at the university's Department of Health Services Research. She had previously been a junior professor at the university since 2022. Wulff studied Business Information Systems at the Baden-Württemberg Cooperative State University in Stuttgart and Business Information Systems - Medicine and Health at the Technische Universität Braunschweig. She then took up a post at the Peter L. Reichertz Institute for Medical Informatics, which is jointly run by the TU Braunschweig and the Hannover Medical School. Wulff's main research interests include computer systems that support medical staff in decision-making by providing diagnostic and predictive models for diseases based on health data. She also conducts research on medical data modelling and methods to facilitate standardized data flow between systems and institutions.



Jan Patrick Zeller

Slavic Linguistics

Prof. Dr Jan Patrick Zeller has been appointed to Professor of "Slavic Linguistics" at the Institute of Slavic Studies. He was previously Professor of Slavic Linguistics at the University of Greifswald. Zeller studied Slavic Philology and German Studies in Oldenburg, St. Petersburg (Russian Federation) and Krakow (Poland). From 2011 to 2012 he completed a research trip to Belarusian State University in Minsk (Belarus) on a DAAD doctoral scholarship. In 2014 he received his PhD at the University of Oldenburg, where he stayed on as a research associate at the Institute of Slavic Studies until 2017. He then took up an assistant professorship in Slavic sociolinguistics at the University of Bern, before moving to Universität Hamburg as a junior professor. In 2021 he became a full professor at the University of Greifswald. Zeller's research focuses on Poland, Belarus, Ukraine and Russia as linguistic regions. He studies the connections between language and society as well as language and cognition, with a special focus on language contact, multilingualism and linguistic variation.