

2022 — ISSUE 1

# MAGAZINE

of Heinrich Heine University Düsseldorf

Smoking cannabis  
relaxes the system  
Advantages and disadvantages of  
legalising cannabis

MATHEMATICS

It's all about the  
correct folding

LAW

Can AI replace  
lawyers?

GERMAN STUDIES

The body in  
Goethe's work

hhu.

1 — 2022

## Campus

- 05 “Science cannot back down!” – interview with President Professor Dr Anja Steinbeck



PHOTO KAY HERSCHELMANN

“Science provides a foundation for decision-making,” says Professor Dr Anja Steinbeck in an interview.



PHOTO CITLALI GUTIERREZ

The government could receive revenue of 4.7 billion euros if it approved cannabis. What are the advantages and disadvantages of this proposal?

## Title

- 16 **Smoking cannabis relaxes the system**  
Advantages and disadvantages of legalising cannabis

# Faculties

## FACULTY OF MATHEMATICS AND NATURAL SCIENCES

07 It's all about the correct folding

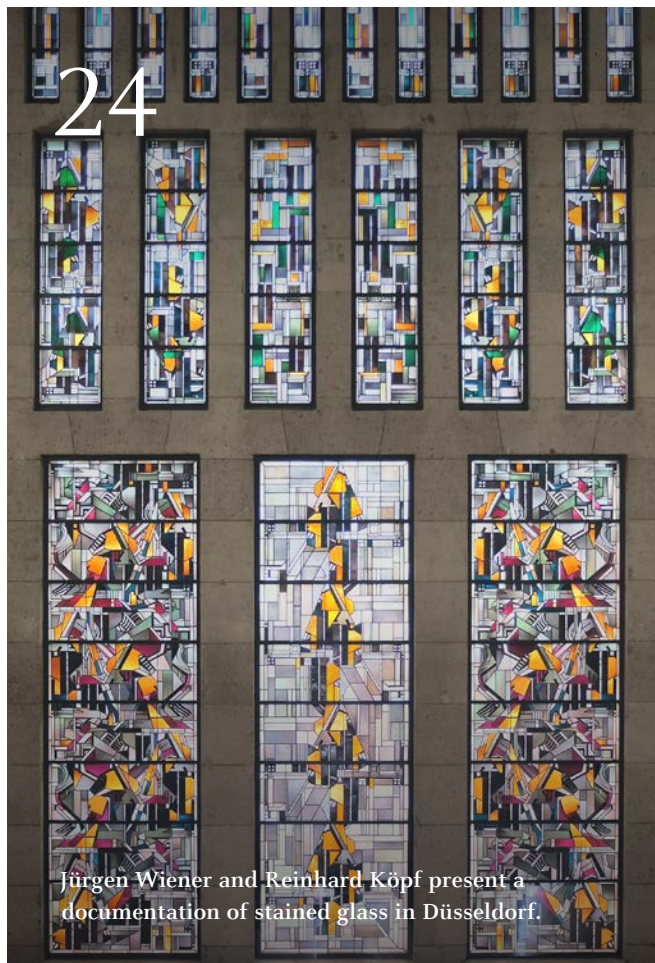
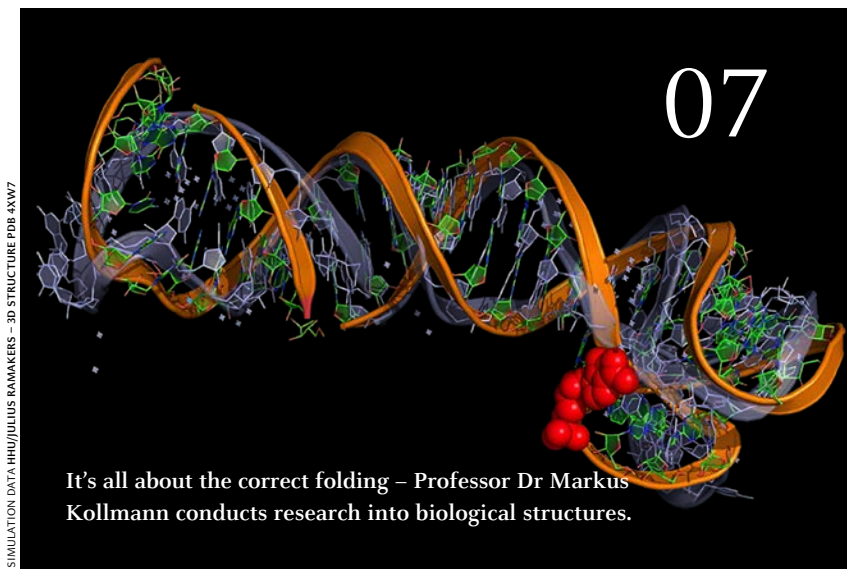
## FACULTY OF LAW

12 Can AI replace lawyers?

## FACULTY OF ARTS AND HUMANITIES

24 Painting with sunlight – a documentation of stained glass in Düsseldorf

30 A matter close to Goethe's heart



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# Editorial



Dear Reader,

Science comes into its own when considering controversial topics and proposals. One such topic is the question of whether cannabis should be legalised and what consequences this would have for individuals and society. To enable a well-informed and evidence-based debate to take place, an assessment from a range of scientific disciplines is needed. It is not enough to consider the issue simply from a health policy perspective. A complete picture must also include economic arguments, among others. The cover story in this issue of “HHU Magazine” aims to provide a broader picture by bringing together the perspectives of different HHU researchers on the topic of legalising cannabis. Many questions ultimately remain unanswered, but that is also typical of a scientific approach.

When science takes a stand on controversial issues, it often steps into a conflict situation and becomes the target of criticism. One such case is the subject of the interview with the President of HHU, which was prompted by a tabloid newspaper report exposing several scientists as purportedly responsible for the coronavirus lockdown. As the President points out, it is the duty of science to make itself heard and provide well-informed contributions to decision-making. However, science itself cannot and should not make binding decisions or assume political responsibility. Yet it would be a fatal error if science were to withdraw completely from the role of political advisor and retreat into its ivory tower, as those who wish to force through their own interests and who do not care about the future of others would then be able to exert a strong influence on decisions.

Particularly in these times of crisis and war, as people of science and as members of a university, we must take a stand: in particular for peaceful and cooperative collaboration across borders – to ensure that the world becomes a better place again.

I wish you an enjoyable read! Kind regards,

Professor Dr Stefan Marschall

Vice President for International Relations and Science Communication



PHOTO: KAY HERSCHELMANN

Interview with President Professor Dr Anja Steinbeck

## “Science cannot back down!”

In December, the German tabloid newspaper *“Bild”* printed the headline *“The lockdown makers”* together with photos of three scientists – as though indicating that they were personally responsible for strict coronavirus measures in Germany. This clearly overstepped the mark for the President of the Helmholtz Association and President Professor Dr Anja Steinbeck also criticised this headline in her role as spokesperson of the Universities Members’ Group of the German Rectors’ Conference (HRK).

In January, *Bild* editor-in-chief Johannes Boie then discussed the relationship and self-image of science and journalism in the pandemic with representatives from various scientific organisations. Boie did not go as far as to apologise for the headline, but he did admit that it was “extremely unfortunate” and promised to change how the paper reports on scientific matters. This represents a good opportunity for the MAGAZINE to talk to Professor Dr Anja Steinbeck about the boundaries between science and politics, and differing responsibilities.

**MAGAZINE** Where does the boundary between science and politics lie? And, in your opinion, do all those involved make sure this boundary is made properly clear?

**Steinbeck** Politicians have to make decisions and they need a solid foundation on which to base those decisions. This foundation includes their own knowledge, their values and convictions and naturally also what experts tell them. And science is one of a number of “players” here. Science provides a foundation for decision-making, just like business, culture or even lobby groups. I don’t really want to talk about science supplying “facts” here as – particularly during the

pandemic – in the first instance, it is often estimates that are being provided – but these estimates are based on a sound scientific footing. Perhaps we could refer to “current scientific knowledge”. In theory, the boundary between politics as a decision maker and science as a supplier of information to enable decision-making is very clear. But in practice, this boundary can of course become blurred. For example when Federal Minister of Health Karl Lauterbach refers to “his team” and names scientists as members of that team, then the boundary can appear blurred to the public. And when *Bild* prints the headline “The lockdown makers”, it deliberately misleads readers.

**MAGAZINE** Don’t we need to think about the media and their own rationality here? For a tabloid, which ultimately wants to sell as many newspapers as possible, a headline like that is actually brilliant.

**Steinbeck** Absolutely. But we criticise the tabloids in the same way when they vilify artists or sportspeople purely to increase sales. And we must criticise them in exactly that way when they make such comments about scientists and oversimplify the situation to such an extent that it ultimately leads to a false statement. But it is of course right that scientists must be treated in exactly the same way as other public figures when they descend from their ivory tower.

**MAGAZINE** So you are saying that “The lockdown makers” is unfair?

**Steinbeck** It is incorrect. It is quite simply wrong! Scientists did not cause the lockdown. They contributed to a chain of cause and effect that ultimately brought it about. But the decision always lies with the government as only the government has democratic legitimacy. The government always bears ultimate responsibility.

**MAGAZINE** Scientists also aren’t the only ones to advise the government...

On 22 February 2022,  
the Senate of Heinrich  
Heine University  
unanimously passed  
a resolution calling  
for trust in science.

**Steinbeck** Yes, and that’s a very good thing. In the coronavirus pandemic, it makes sense that e.g. social organisations also have a say and that they are heard by the government. They must also present their point of view and the developments that concern them. A lockdown may be the right thing to do from a scientific point of view, but it may not be the best decision from a social point of view. I’m calling on science not to back down.

**MAGAZINE** You have advocated that science should descend from its ivory tower for many years. Do you feel that the way science is perceived in politics has changed significantly?

**Steinbeck** The pandemic has brought science very much to the fore in people’s consciousness. However, I believe that the way science works and its boundaries have not entered people’s consciousness in the same way. If two virologists disagree in a talk show, it doesn’t mean that one of them is talking nonsense. Science thrives on debate and the provisional nature of findings – and that is something that needs to be made clear on a regular basis. I believe that many scientists have also expressed this.

**MAGAZINE** And how far does the responsibility of science extend?

**Steinbeck** Scientists cannot assume political responsibility but they must adhere to the rules of their scientific community, namely the rules of good scientific practice. These rules are extensive. They not only cover data authenticity, replicability and authorship, but also address the need for scientists to consider the consequences of their actions and reflect on the ethics. This impetus is part of the rules and I don’t think you can demand any more of scientists. Unlike the government, scientists do not have the ability to enforce laws.

**MAGAZINE** ...but they have Twitter.

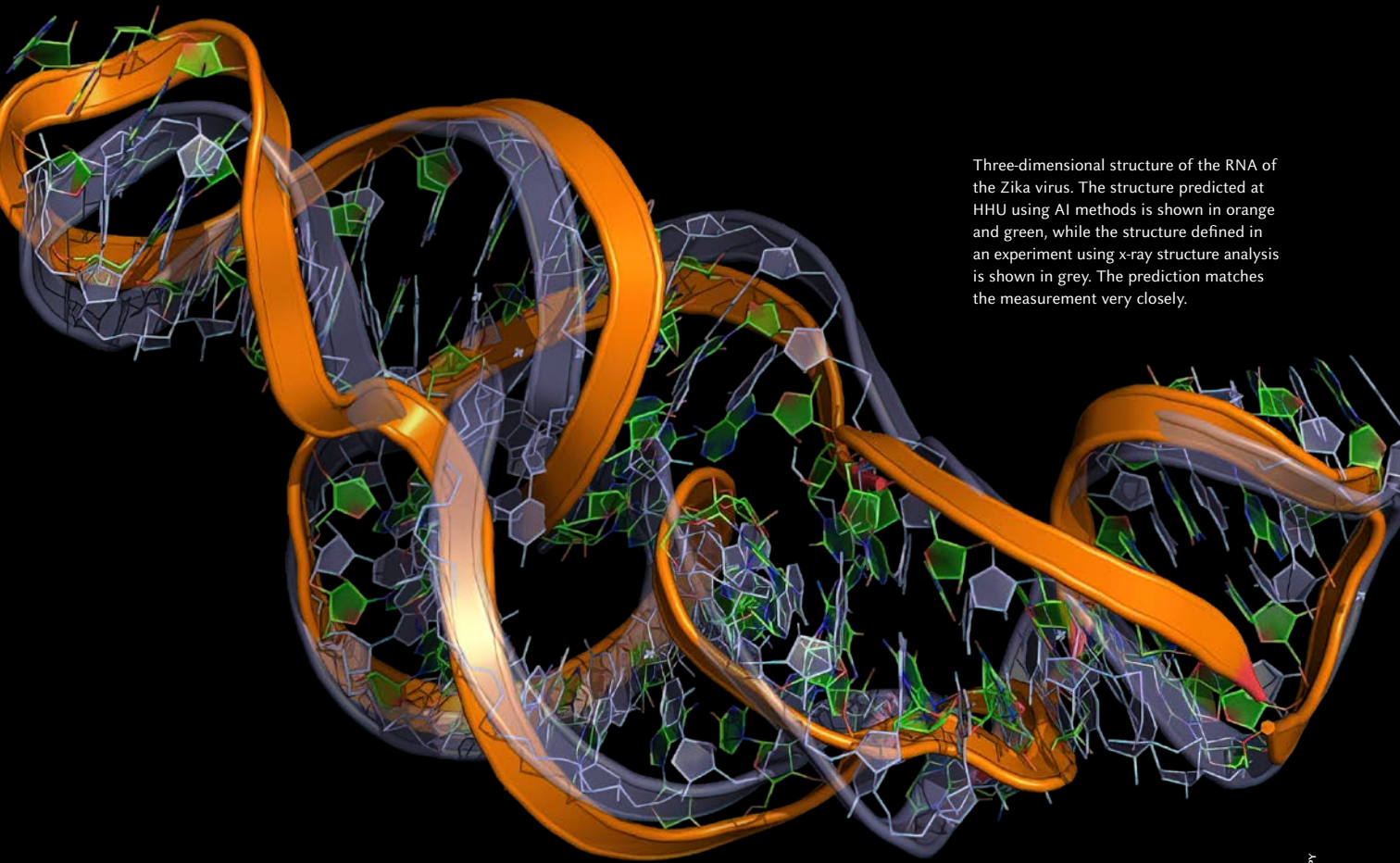
**Steinbeck** That’s right. And I feel that the responsibility of science has increased in that respect. I’m not sure whether it’s right to publish something on Twitter that you wouldn’t be prepared to submit to a scientific journal. I see a greater responsibility there.

**MAGAZINE** And your conclusion?

**Steinbeck** You can of course criticise everything, but you must also ask: What would be a better way of doing it? And I don’t see a better way. Nothing can top science as a basis for decision-making. We have to live with the shortcomings and provisional nature of scientific findings.

*Interview: Victoria Meinschäfer and Achim Zolke*

# It's all about the correct folding



Three-dimensional structure of the RNA of the Zika virus. The structure predicted at HHU using AI methods is shown in orange and green, while the structure defined in an experiment using x-ray structure analysis is shown in grey. The prediction matches the measurement very closely.

Theoretical physicist researches biological structures

BY ARNE CLAUSSEN

Professor Dr Markus Kollmann heads the Institute for the Mathematical Modelling of Biological Systems at Heinrich Heine University. Using artificial intelligence tools, he is researching what the three-dimensional structure of biomolecules looks like and how algorithms can be used for image differentiation in emergency medical care.

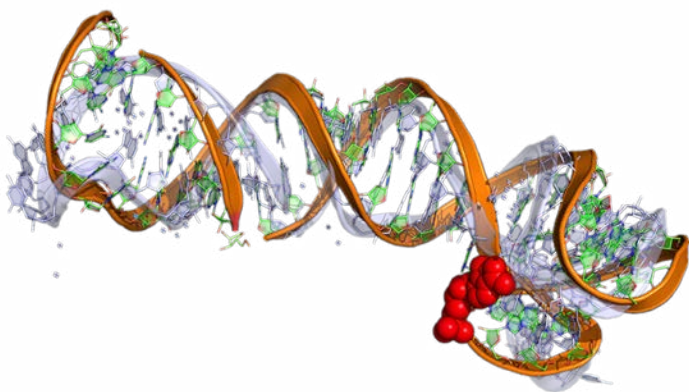
**T**he corridors of the Institute lack the typical objects and facilities you would expect to find in a biology institute: Laboratories, white coats, microscopes or even pot plants. How is research conducted here? “We do biology on the computer!” says Professor Kollmann in response to the surprised question.

Markus Kollmann is a theoretical physicist who moved into biology 17 years ago as he was fascinated by its issues. He established an interdisciplinary team of biologists, computer scientists, mathematicians and physicists who are addressing two questions: How can the folding of RNA molecules be predicted and how can computers identify anomalies in patterns quickly and accurately? Both questions are relevant for medical applications.

Ribonucleic acid, RNA for short, is very similar to the genetic material DNA. It became well-known in the course of the coronavirus pandemic as several of the vaccines against the SARS-CoV-2 virus are based on this molecule. To be precise, the Biontech/Pfizer and Moderna vaccines comprise a copy of a DNA strand, the “messenger RNA” (for short: mRNA), which contains the instructions for producing the “spike protein” on the viral envelope. When this kind of mRNA molecule enters an animal cell, the cell itself produces these spike proteins, which the immune system identifies as alien and produces antibodies to fight them.

## Compact folding for maximum infection protection

However, mRNA molecules cannot simply be injected into your arm as they would be broken down quickly in the body without protection. To deliver mRNA to cells, vaccine manufacturers encapsulate the molecules in tiny lipid nanoparticles. To ensure a strong immune response, it is important that each nanoparticle contains as much mRNA as possible and the mRNA should ideally be folded into a very compact structure. Kollmann: “mRNA is not a straight, stretched molecule. Instead, it folds up in a three-dimensional structure, depending on the base sequence. This folding can be influenced by clever selection of the base sequence.” This is because a protein comprises a chain of 20 different amino acids in total. In both DNA and RNA, three genetic letters – the bases – provide the code for an amino acid. “Many amino acids have several base combinations and this was our starting point for designing the optimum three-dimensional base sequence in the mRNA molecule,” explains Kollmann. From the various alternatives, the three-letter code is selected that promises the most compact 3D structure.



SIMULATION DATA HHHU/JULIUS RAMAKERS – 3D STRUCTURE PDB 4XW7

The structure of a so-called ZMP riboswitch overlays the predicted and measured structure. A small AMZ molecule (red) attaches to the RNA, which changes its form as a result. In the body, this process is used to regulate e.g. metabolic processes by activating or deactivating the function of the RNA. In this case, the body's synthesis of purines is being controlled.



The HHU working group aims to find exactly these constellations on the computer. However, the physicist is not using a simulation based on the relevant physical formulae for this. “There is no computer anywhere in the world that could solve this immense system of linked, stochastic differential equations in a reasonable period of time.” So the team is focusing on the AI method of “Deep Learning” instead. For example, the computers learn known RNA molecules and their base sequences that have produced the concrete 3D structure. From these examples, the computers derive rules, which they should then be able to use to predict unknown structures just from the base sequence. “This already works very well with proteins, where the three-dimensional structure of almost 200,000 molecules is known. But in the case of RNA, there are only around 700 examples,” says Kollmann – too few for a successful learning process.

## Data augmentation creates sample data for AI learning processes

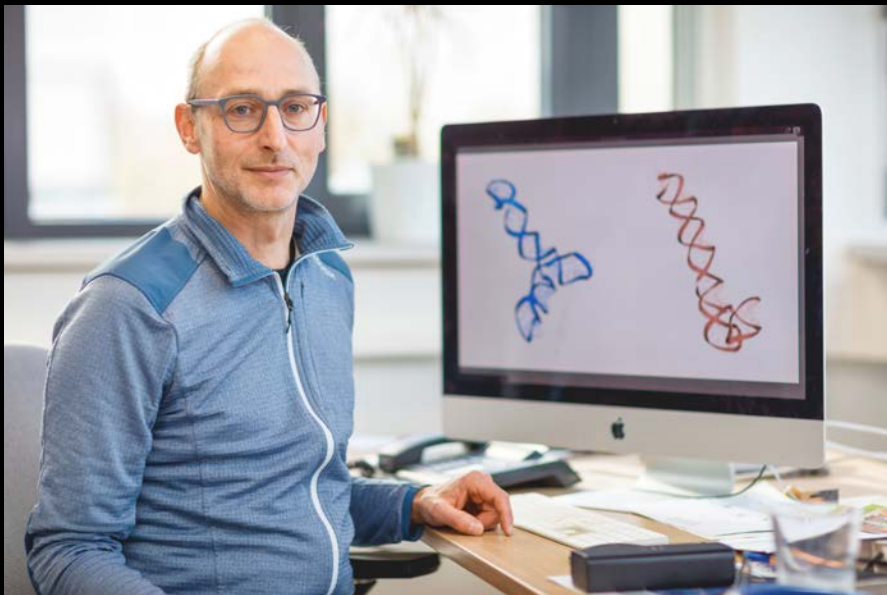
So, like many other AI researchers, the Düsseldorf-based team is also relying on “data augmentation” in which they generate a large number of small subrecords from the known data. “In each case we take just a small section from a large RNA structure. This substructure, the associated base sequence and the boundary conditions – i.e. how this section

is connected to those around it – represents a good learning module. We can obtain several thousand from one large RNA structure.”

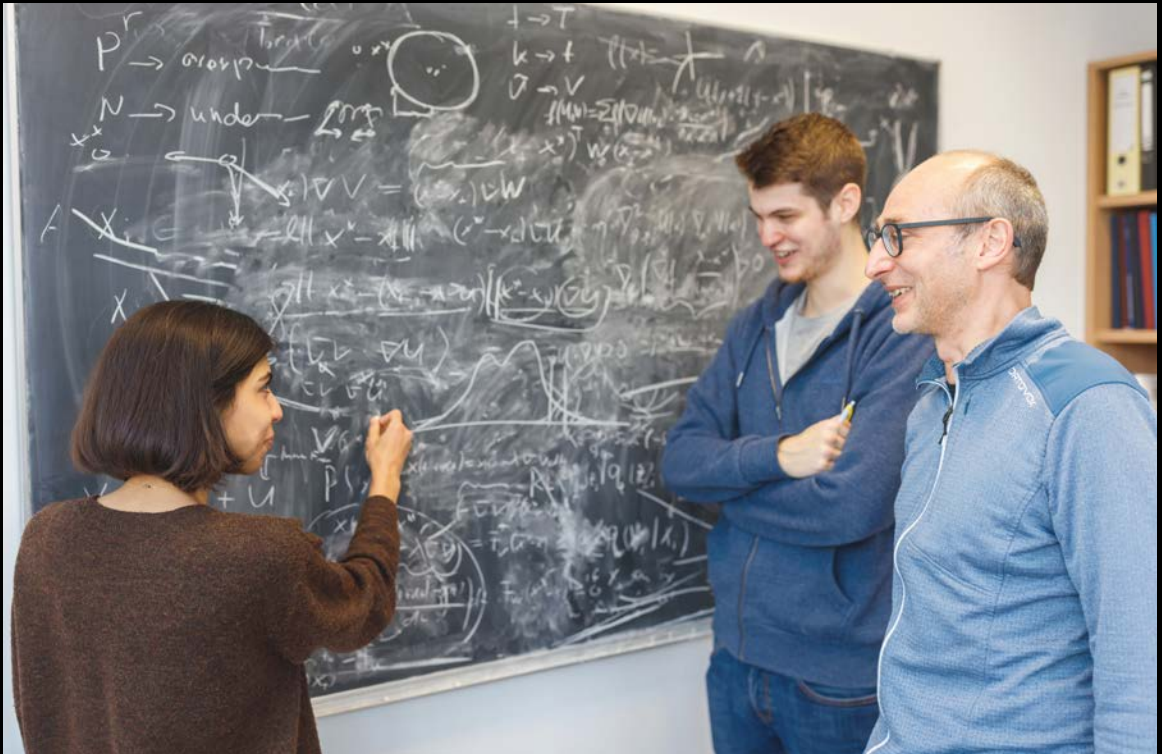
How successful the learning has been is tested using known RNA molecules that have not previously been used for training. Kollmann: “We can reconstruct their structure with an accuracy of four to eight ångström ( $1 \text{ \AA} = 10^{-10} \text{ m}$ ). That’s a value that can for example help in the development of mRNA vaccines.”

“mRNA is not a straight, stretched molecule. Instead, it folds up in a three-dimensional structure, depending on the base sequence.”

Professor Dr Markus Kollmann — physicist



The physicist Professor Dr Markus Kollmann heads the Institute for the Mathematical Modelling of Biological Systems at HHU.



Professor Kollmann discusses the use of Deep Learning methods in the three-dimensional structural reconstruction of RNA molecules and the analysis of medical vital sign data with his doctoral researchers Rahil Gholamipour and Tim Kaiser.

Professor Kollmann states a further field of application for this research: “We have also had inquiries from the area of pharmaceutical research, where the aim is to develop gene therapeutics against rare inherited illnesses.”

“When it comes to anomaly detection, there’s no major difference between whether the algorithm needs to find a dog photo in a mass of cat photos or whether it needs to identify sudden arrhythmia.”

Professor Dr Markus Kollmann — physicist

In these illnesses, a mutation in the DNA code of the sufferer generates a defective protein, the instructions for which have been read from the DNA by an mRNA molecule. The therapeutic agent binds with the mRNA and should correct the defective sequence. “To enable this to succeed, the docking molecule – the “guide RNA” – needs to be a perfect fit and we can simulate various constellations here in Düsseldorf.”

### Identifying significant variances

A second field of work for Kollmann’s group is “anomaly detection”, which involves the identification of significant outliers in series of data, again with a concrete application area: Wristbands with integrated measuring devices, so-called wearables, for the continuous recording of the vital signs of patients who have had e.g. a stem cell transplant. Normally, these people would have to go to their doctor’s practice every few days to be examined for signs of possible rejection. This is very time consuming, both for patients and doctors.

Kollmann explains the research approach: “It would be much easier if a computer system continuously analysed vital signs measured at home such as pulse, oxygen saturation, blood pressure and body temperature and only notified a doctor if the values vary from the personal norm to a concerning degree.” However, all patients are different: The pulse rate of a person who does not do sport regularly is for example significantly higher and much more variable than that of a sporty person; a personal emergency monitoring system must be able to recognise this. So first of all it needs to learn what is normal for that individual. Once the algorithm has determined this normal status, it needs to identify significant anomalies in the continuous flow of data that require medical attention.

“This sounds easier than it is in reality because each and every person has e.g. a very different pulse profile, which is also dependent on their current situation – for example physical exertion, watching TV, sleeping. What may be normal for one person can already be concerning for another. And on top of this every anomaly can look different.”

The HHU researchers are also relying on Deep Learning here. As the vital sign data collected at HHU and by partners at Aachen University of Technology (RWTH) are not publicly accessible and no public vital sign databases exist yet, it is difficult to gauge the prediction accuracy of the algorithms

developed by the group compared with those developed by other working groups. However, publicly accessible datasets containing vast numbers of photos do exist which the AI community is happy to use to train its systems. “When it comes to anomaly detection, there’s no major difference between whether the algorithm needs to find a dog photo in a mass of cat photos or whether it needs to identify sudden arrhythmia,” comments Professor Kollmann.

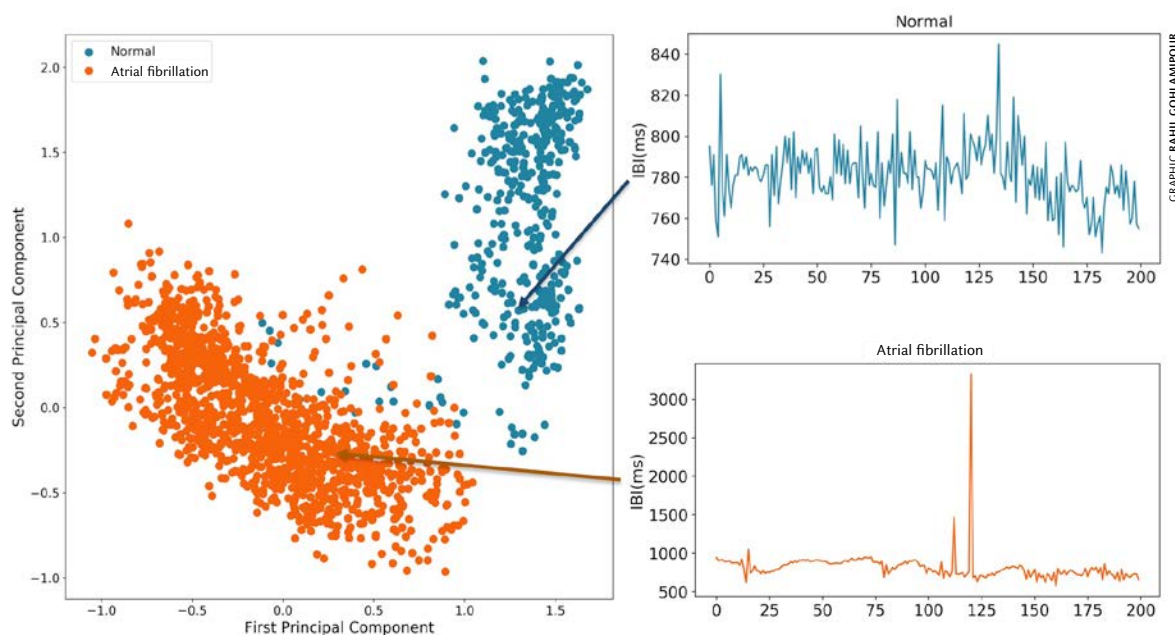
## Cat photos and arrhythmia

It will still be some time before the AI algorithms become part of everyday clinical practice, but the first patients are already expected to test the AI system in 2022. Their feedback will flow into the ongoing development. The conversation with Professor Kollmann shows that biological research is perfectly possible, even without white coats.

### CONTACT

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Applying anomaly detection to medical data. The pulse of a healthy person is shown in blue, while that of a patient suffering from atrial fibrillation is shown in orange. A large number of patient pulse curves are processed in order for each to appear as a single data point. The data points for healthy individuals and patients suffering from arrhythmia differ significantly in a corresponding two-dimensional depiction (left).



# Can AI replace lawyers?

Dr Thomas Wostry's innovative and interactive "Corporate Criminal Law and Legal Tech" course invites participants to get involved.

BY CAROLIN GRAPE

Everyone is talking about Legal Tech – but what exactly is it? The term combines “legal services” and “technology” and refers to the digitisation of legal work – i.e. combining technological applications with legal matters – with the aim of increasing automation in individual work processes and even entire legal services to improve efficiency and quality, and save costs.

**L**egal Tech has steadily become more and more important for the legal profession over the past few years, with tools ranging from “simple” applications (e.g. using Microsoft Excel or complete database systems) through to sophisticated and highly refined IT technology based on artificial intelligence (AI) and machine learning (ML). In certain respects, the latter tools are quicker and less error-prone than people and also increasingly capable of determining and evaluating contexts themselves. This makes them valuable assistants in an area strongly characterised by the resources of human intelligence such as the ability to judge complex issues and empathy. Is it conceivable that Legal Tech systems could make minor court rulings independently in the future?

This is a topic with potential for the future in legal practice, but – apart from a few exceptions – it cannot yet be found in legal training and degree studies.

## The Faculty of Law as a pioneer

The Faculty of Law is taking on a pioneering role and breaking new ground: Lecturer Dr Thomas Wostry is offering a course that is currently unique in Germany as a regular component of the criminal law specialisation. In his “Corporate Criminal Law and Legal Tech” course, advanced criminal law students not only learn the legal fundamentals for using Legal Tech, artificial intelligence and machine learning in (corporate) criminal law cases and in company compliance, but also undertake practical work with cloud applications and even develop Legal Tech tools themselves. “We want to offer our students the opportunity to learn about Legal Tech, understand what it is and how it works. We don’t just look at what regulation is necessary or who bears liability for what, we actually build these systems. We look at the code, we train artificial intelligence and work with chatbots and chat windows on the internet that we create ourselves,” says Wostry, explaining his concept.

The course includes a practical phase where participants are explicitly invited to work together to develop an AI application that initiates or closes investigations, question witnesses using chatbots and design a compliance workshop. Only when the budding lawyers can experience for themselves how AI works in detail, will they be able to see where the opportunities and risks of Legal Tech lie.

Programming skills are not required, but participants should have an interest in figures. “We introduce students to these technical aspects very slowly and steadily, and then go into a great level of detail – but at a very gentle pace,” says Wostry. Students can access extensive cloud-based resources to accompany the course and try out and follow every step of the AI development process themselves.

## “It’s not excessively complicated in technical terms, but the interesting question is: is it allowed?”

Dr Thomas Wostry — postdoctoral researcher at the HHU Faculty of Law

At the interface of IT, data science and corporate criminal law, numerous links are also established with other criminal/police law and technical topic areas. The course is supported by presentations given by experts from the cloud service provider, Amazon Web Services (AWS), on AI, the cloud, chatbots and many other applications, and by experts from e.g. the central contact office for cybercrime (*Zentral- und Ansprechstelle Cybercrime*) (ZAC) in North Rhine-Westphalia at the Cologne public prosecutor’s office, the federal police or specialist lawyers from the renowned law firms Hengeler Mueller and Ratajczak & Partner who are already using Legal Tech tools in practice. The students consider practical applications employing AI and the technology behind them, and create their own versions of small elements of particular legal interest. These include for example an algorithm tool to save time when entering and evaluating the large amounts of data that are usually gathered during investigations in companies to establish whether certain allegations are relevant or not.

### Developing Legal Tech tools for concrete cases

The practical part also includes programming a self-learning AI application (machine learning) which is capable of deciding in an environmental criminal law case e.g. whether the disposal of certain types of radioactive waste in a plant is a punishable offence or not. A programme is implemented that requires significant fine-tuning and where the correct settings have to be learned automati-

cally from data. In the use case, the training data comprise imported certificates that already contain the information “criminal offence” and “not a criminal offence”, which enable the algorithm to learn to recognise typical patterns of behaviour that constitute criminal offences and output corresponding data records. If the initial suspicion is confirmed, the system generates a notification of the initiation of proceedings, creates a file and opens an investigation. “It’s not excessively complicated in technical terms, but the interesting question is: is it allowed? Is the public prosecutor’s office allowed simply to connect a hard drive so that the system can automatically initiate investigations against all sorts of people?” asks Wostry.

This is where the intensive legal part of the course begins – where do basic rights and procedural principles set the boundaries for the opportunities presented by quantitative and empirical methods? Data protection concerns are a clear argument against the automatic initiation of criminal investigations – the ban on automated decision-making that disadvantages an individual applies here, making use of the system unlawful. By contrast, however, the closure of an investigation by such AI tools is fundamentally conceivable from a legal point of view. The tools would filter out the majority of cases that are



PHOTO PRIVATE

#### Dr Thomas Wostry

is writing his postdoctoral thesis on corporate criminal law at the Faculty of Law and conducts research into Legal Tech and AI in (corporate) criminal law at HHU. He has also been studying computer science at the Distance-Learning University of Hagen since 2019. He is an Accredited Instructor for Cloud and Machine Learning Foundations at the AWS Academy.

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Legal Tech 3.0
Die Einträge aus der staatsanwaltschaftlichen Verfügung nutzen wir als Trainingsdaten für ein Legal Tech-Tool 3.0, das in der Lage sein soll, künftig diese und ähnliche Fälle zu erkennen. Hierzu fügen wir den Einträgen aus der Verfügung das label "ermitteln" und den übrigen Einträgen das label "nicht ermitteln" hinzu. Es handelt sich also um eine binäre Klassifikationsaufgabe:

In [ ]:
1 #trainingsdaten labeln und als csv-Datei exportieren
2
3 index2FI = datenauszug.index
4 resultatFI = datenauszug['Vergleich'].str.contains("Nah")
5 treffer_liste_resultatFI = index2FI[resultatFI]
6 datensatzDBfertigFI = datenauszug[treffer_liste_resultatFI]
7 datensatzDBfertigFI = datensatzDBfertigFI.drop(treffer_liste_resultatFI)
8 datensatzDBfertigFI2 = klartext(datensatzDBfertigFI)
9
10 alledaten = datensatzDBfertigW.append(datensatzDBfertigC)
11 fortraining = alledaten.drop(columns=['Unternehmen',
12                                     'cluster',
13                                     'Vergleich']).reset_index(drop=True).drop(0)
14 fortraining['label']='ermitteln'
15
16 alledatenNE = datensatzDBfertigFI2.drop(columns=['Unternehmen',
17                                                'cluster',
18                                                'Vergleich']).reset_index(drop=True).drop(0)
19 alledatenNE['label']='nicht ermitteln'
20
21 fortraining2 = fortraining.append(alledatenNE)
22 fortraining2.to_csv('trainingsdaten7A.csv', ',', index=False)
23 fortraining2.reset_index(drop=True)

In [ ]:
1 #trainingsdaten wieder mit integers verschlüsseln und den Datensatz um den Faktor 10 vergrößern, anschließend splitt
2
3 import mxnet
4 from mxnet import gluon
5
6 def bigdata(dataset):
7     print("Datensatz multiplizieren und Trainings-/Validierungsdaten erstellen...")
8     for i in range(10):
9         copy1 = dataset.copy()
10        dataset = dataset.append(copy1)
11        return dataset.reset_index().drop(columns=['index'])
12
13 def verschluselnME(dataset):
14     noklartext = dataset['label'].replace("nicht ermitteln",0, regex=True)
15     dataset['label']=noklartext

```

GRAPHIC: THOMAS WOSTRY

In the course, students learn how to use so-called Jupyter Notebooks to programme and realise machine learning – a typical screen display is shown here.

not relevant under criminal law in advance – and criminal justice and company compliance would benefit.

“We look at our domestic criminal law, money laundering regulations, corruption law and naturally also at all the associated procedural issues, from the right to question witnesses to gathering evidence in criminal proceedings. In each lecture, our view of the technology is linked with a detailed consideration of legal issues,” says Wostry.

## Witness questioning by chatbot?

And how should we imagine the simulation of witness or employee questioning by chatbot? Chatbot technologies are based on automated systems that have been programmed in such a way that they can enter into dialogue with users and answer questions or offer assistance in the case of certain problems. Just like ALEXA or SIRI, the underlying technology is a speech recognition and messaging system that breaks down spoken or written language components, which are then analysed and interpreted by AI. There are many arguments in favour of their use: Chatbots are programmed to be friendly and create a pleasant atmosphere. The system records very accurately and people would no longer be needed

to keep records. And they can be used and addressed at any time, irrespective of individual working hours. But there are also many obstacles to be overcome: Currently, the big challenge in system programming is ensuring that chatbots can understand and interpret the facts they are told so accurately that they can ask more detailed questions or identify contradictions. Chatbots also typically react to initiatives while, in an interrogation situation, legal representatives or company management actively question the person making a statement – a typical superior/subordinate relationship. The integration of facial recognition to capture the gestures and expressions of witnesses should also be considered as a potential optimisation measure.

By the end of the course, students have developed a grasp of situations where the use of artificial intelligence in the justice system and legal advice is possible and desirable, and experienced a foretaste of the work of lawyers in the digital world. “I am sure that the term Legal Tech will shape many areas of the legal profession and enable efficient work in the future, so I am looking forward to my professional future all the more,” says Berivan Kartal, who took the course as part of their specialisation. Course participants can also gain an AWS Academy Graduate certificate in the category AWS Academy Machine Learning Foundations, a recognised qualification on the job market.

# Smoking cannabis relaxes the system

Advantages and disadvantages  
of legalising cannabis



BY VICTORIA MEINSCHÄFER

It sounds temptingly easy and not only the figures support the idea that Professor Dr Justus Haucap has advocated for years: The government could earn or save around 4.7 billion euros if it approved cannabis. And protect the health of consumers in the process. Significant advantages, yet forensic scientist Professor Dr Stefanie Ritz-Timme also sees downsides.

The consumption of drugs always seems to have been incredibly important to people and a drug-free society would appear to be impossible. Even in some Asian countries, where the penalties for the possession and consumption of drugs are severe, there is a black market and the interest in drugs is so great that people are still prepared to break the law. This is why Justus Haucap has a clear view on the matter: “We won’t be able to eliminate the black market so it’s better to offer quality-checked cannabis.” In addition, a comparison with the legal drugs alcohol and tobacco clearly points in favour of legalisation: “The consumption of alcohol and tobacco among young people has been declining for years, only cannabis consumption continues to increase,” explains Haucap.

## Regulating the cannabis market

Many things on the German market are regulated – from the power grid and telecommunications to the financial market. If it were up to the Düsseldorf-based economist, Professor Dr Justus Haucap, regulating the cannabis market would be a high-priority government



**Professor Dr  
Justus Haucap**  
Düsseldorf Institute for  
Competition Economics (DICE)

task. In his opinion, regulation in itself is not a bad thing: Markets should always be regulated where there is a risk of market failure without regulation and where it is at least reasonably certain that regulation would lead to better results. Regulation makes sense, for example, when people cannot anticipate the consequences of their actions, which applies for instance in the case of cannabis consumption by young people. Regulation is essential here, as is the protection of minors. Another reason for regulation is information asymmetry, i.e. in the case of cannabis where the seller knows something about the substance that customers do not, such as the presence of impurities and other substances added to make the drug go further. The substance is not checked by the public health authority or trade inspectorate because the market is not legal.

Haucap does not wish to downplay the disadvantages of cannabis consumption in any way, but he sees many financial advantages for the government. “Why don’t we pick up the money that’s lying on the street?” he asked a few days before it became public that the new Federal Government was planning to include the legalisation of cannabis in the coalition agreement. The government would not only have the advantage of the tax revenue, the costs currently generated by the drug’s prohibition would also be eliminated. In addition to the VAT revenue that would be generated by the legal sale of cannabis, “above all, taxing the consumption of cannabis in a comparable way to alcohol and tobacco would bring further money into the public coffers,” says Haucap. “In addition, it is expected that the legalisation of the cannabis market would generate new legal jobs, which in turn would bring in further income tax revenue and social security contributions.” The figures are significant, but also based on a large number of assumptions. There are not

“The consumption of alcohol and tobacco among young people has been declining for years, only cannabis consumption continues to increase.”

Professor Dr Justus Haucap — economist

Row upon row of cannabis plants — but for medical use rather than private consumption here.





Professor Dr Justus Haucap is clearly in favour of legalising cannabis, Professor Dr Stefanie Ritz-Timme still has doubts.

even any precise figures on current consumption volume, never mind the question of whether and how it will rise.

## Many people have tried cannabis

So it is difficult to estimate how much cannabis is currently actually being consumed. However, cannabis is found very frequently in the blood samples analysed in the forensic toxicology laboratory of the Institute of Forensic Medicine for the police – namely in approx. 78% of the roughly 15,000 blood samples analysed in the last two years. Haucap and the German Cannabis Association (*Deutscher Hanfverband*), a “civil rights movement of private individuals”, currently put demand at around 400 tonnes per year. The estimate is based on data from the epidemiological addiction survey, which assesses the consumption of various drugs in an international comparison every three years. The 2018 survey of 18 to 64 year olds established that the majority of Germans over the age of 23 have already tried cannabis, while around 3.4% of Germans had consumed cannabis products for the purpose of intoxication within the preceding 30 days and more than 8.3% in the preceding 12 months. However, Haucap points out that not everyone will admit to consumption, even in an anonymous survey, and that the demand for hemp products has been rising for many years. There would also be tourist demand from consumers who would travel to Germany from neighbouring

countries to buy products following legalisation. This would be set against consumption by those who choose not to leave the black market after legalisation. At a conservative estimate, researchers expect demand of 400 tonnes per year. If you were to add a cannabis tax of 4 euros per gramme, which Haucap feels would be realistic, the government would earn 1.6 billion euros through this tax alone. VAT, trade tax and corporate tax would bring in another approx. 730 million euros. These figures do not include the revenue that would be generated as a result of the government licensing all parts of the value chain, from growth and processing through to sale. “Breaches of licensing laws must also be pursued and may result in fines.” The economists suggest that a self-financing system would ultimately be created in which the monitoring costs would be covered by the revenue from license fees.

The Düsseldorf-based economists also believe that 27,000 new jobs would be created: “In Colorado, where the growth, sale and consumption of cannabis have been legal since 2014, it has been calculated that 69 jobs have been created per tonne of cannabis. If we apply the same calculation to Germany, we can expect 27,000 jobs, which would mean at least another 800 million euros for the government from income tax and social security contributions.”

On top of this income, you need to add what the government will save. The cost of “law enforcement”, i.e. costs for police work, courts and imprisonment, is currently estimated at almost 420 million euros. “Naturally, we won’t be selling any police cars or making any judges



PHOTO UNSPLASH – ADD WEED

Weighed by the gramme – but current estimates put demand at around 400 tonnes per year.



**Professor Dr  
Stefanie Ritz-Timme**  
Institute of Forensic Medicine

“Cannabis use definitely has an impact on road safety, making a major awareness campaign essential.”

Professor Dr Stefanie Ritz-Timme — forensic scientist

redundant following the legalisation of cannabis,” says Haucap, “but the police and judiciary can invest their time in other tasks when the need for prosecution is eliminated.”

Professor Dr Stefanie Ritz-Timme is not vehemently against the legalisation of cannabis, but she is quite sceptical and sees significant risks. On the one hand, there is the issue of “cannabis as an entry-level drug”: “When I was young, that was the fear of all parents: children start by smoking cannabis and then automatically and inevitably move on to heroin. That’s nonsense of course!” But: Anyone who consumes cannabis comes into contact with mind-expanding substances and sees how enjoyable such a high can be. “And that arouses their curiosity,” says the professor for Forensic Medicine, “making them

more likely to take up the next offer.” And perhaps willing to try the pills offered by the dealer the next time round – their inhibitions sink. “As such, the legalisation of cannabis and its sale in licensed shops is an advantage as long as people really do buy in these shops and not from the dealer in the school playground.” Haucap agrees: “Dealers are now increasingly trying to sell their customers harder drugs, as they usually have a higher profit margin than cannabis. Cannabis really can therefore be seen as an entry-level drug in that at least some sellers also offer other drugs and consequently have a vested interest in motivating customers to begin long-term consumption of those drugs with the highest margin.”

## Greater risks for young consumers

There is also the question of the extent to which the majority of current consumers will still be able to obtain their cannabis in legal shops following legalisation as they should sell exclusively to adults – which is exactly the right decision of course. “Consumption by young people is problematic in many respects,” says Ritz-Timme. “Young people who frequently consume cannabis are more likely to develop a psychosis than those of the same age who don’t. And that’s not due to impurities in ‘poor-quality grass,’” says the forensic scientist, “it’s due to the substance itself.”

Ritz-Timme sees road safety as a further relevant problem: “Cannabis use definitely has an impact on road safety, making a major awareness campaign essential.” The problem is that, by contrast with alcohol, it is not possible to set a fixed limit as there is no simple correlation between dose and effect. Users frequently do not realise how much their actions are impaired. They do not stagger about, they have no difficulty taking their keys out of their trouser pocket. They are relaxed. “Although this is the desired effect, it can become their downfall when quick reactions are needed while driving. “Engaging the clutch, selecting a gear, driving off, etc. are all automatic actions and no problem even after a joint. But recognising in time that the cyclist ahead is about to swerve to the left to avoid an obstacle and then reacting quickly enough to do the right thing is far more difficult and barely even possible with cannabis in the bloodstream. The price for this laid-back feeling can be a significant reduction in road safety. In particular the poor attention span and reaction speed that cannabis causes are responsible for serious misjudgements of the traffic situation.” In addition: Cannabis increases sensitivity to glare and slows down pupil reaction, which is problematic at least when driving at night. “Studies clearly prove that the risk of accidents increases with cannabis consumption,” says the forensic scientist.

### Tolerated, prohibited, permitted?

Hemp and cannabis products have been prohibited in Germany since the German parliament passed a resolution in 1929. After the Second World War, cannabis was not officially permitted, but it was tolerated until into 1971. It was banned following the student protests at the end of the 60s and the Federal Constitutional Court declared this ban lawful in 1994. The coalition agreement concluded by the current Federal Government states: “We plan to introduce the controlled sale of cannabis to adults for recreational use in licensed shops. This will enable quality control, prevent the distribution of contaminated substances and ensure the protection of minors. We will evaluate the social consequences of the law after four years.”

Ritz-Timme points out a further problem: Hardly anyone consumes cannabis on its own. Around half of the samples in which the forensic toxicology laboratory of the Institute of Forensic Medicine found cannabis also contained other substances such as alcohol, amphetamines, cocaine, heroin or medication that may impair

### Hardly anyone consumes cannabis on its own

driving ability. And the effects of such a cocktail in the bloodstream cannot be predicted. This means that any legalisation of cannabis must be accompanied by an extensive awareness campaign, which will in turn reduce government income. Haucap also points out that new costs will be incurred through the legalisation: “Raising awareness will be key in the early stages – it’s important to ensure people don’t get the impression that consumption is being legalised because cannabis is harmless.”

The economist views two aspects as critical when it comes to the sale of cannabis: Firstly, sales outlets must be widespread because “if the next shop is 30 km away, the black market won’t dry up.” Secondly, the shops should only sell cannabis products and nothing else, “no beer, no crisps and minors should be barred as is the case in amusement arcades.”

Ritz-Timme understands the arguments in favour of legalisation but remains sceptical with a view to the associated risks. “Ultimately it is a political decision – and it is essential to address the risks very carefully.” Haucap is clearly in favour of legalising cannabis. Prohibition and repression have not been able to hinder the constant growth and “the only ones to benefit from the current drug policy are those in organised crime, and that really isn’t in any of our interests.”

→ The study can be found at:

<https://ideas.repec.org/p/zbw/diceop/112.html>

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Martin Domke,  
Düsseldorf-Bilk,  
protestant Church  
of Peace, chancel  
window depicting  
Christ





Walter Benner, Düsseldorf-Heerd, bunker church, concrete and glass window

# Painting with sunlight

Jürgen Wiener and  
Reinhard Köpf present  
a documentation  
of stained glass in  
Düsseldorf

BY VICTORIA MEINSCHÄFER

The production process has remained virtually unchanged for 800 years and the true magic of the results can only really be appreciated when the sun shines. Everyone is aware of them, but many walk past without really seeing them. Stained glass windows are works of art that do not always get noticed. Professor Dr Jürgen Wiener and Dr Reinhard Köpf have now put together a comprehensive documentation in the book *“Moderne Glasmalerei Düsseldorf”* (Modern stained glass in Düsseldorf).

**D**üsseldorf has been a major centre for stained glass for more than 100 years and leading window production workshops can still be found in the surrounding region. “Unfortunately, this is better known in the USA than here in Germany,” notes Professor Dr Jürgen Wiener. The city owes its good reputation for glasswork to the Art Academy, which merged with the School of Arts and Crafts back in 1919, “creating a situation similar to that at the Bauhaus school,” says Wiener. This merger brought the technical knowledge of the city’s glassworks and the School of Arts and Crafts together with artistic aspirations at a time of great demand – thanks to the many construction projects initiated by the Archdiocese of Cologne. “More than half of the churches in North Rhine-Westphalia were built after the Second World War,” explains Wiener, “and that resulted in huge demand for church windows.” After the war, the windows naturally did not look the same their predecessors from the Middle Ages, but the techniques used remained largely unchanged in many works.

### Collaboration between workshop and artist

To create a stained glass window, the design is first transferred onto a cartoon “to create a full size replica of the window, which usually cannot be realised by the artist alone without the help of other experts,” says Köpf. A tracing is then made of this cartoon to enable the creation of templates that are exact copies of the pieces of glass to be cut. The artist must then select the glass and colours in the glassworks as it is the only place where it is possible to view all the different glasses that can be used, hold the pieces up to the light in large windows and define the exact sequence of colours. “Good collaboration between the glassworks and the artist is extremely important,” says Köpf,

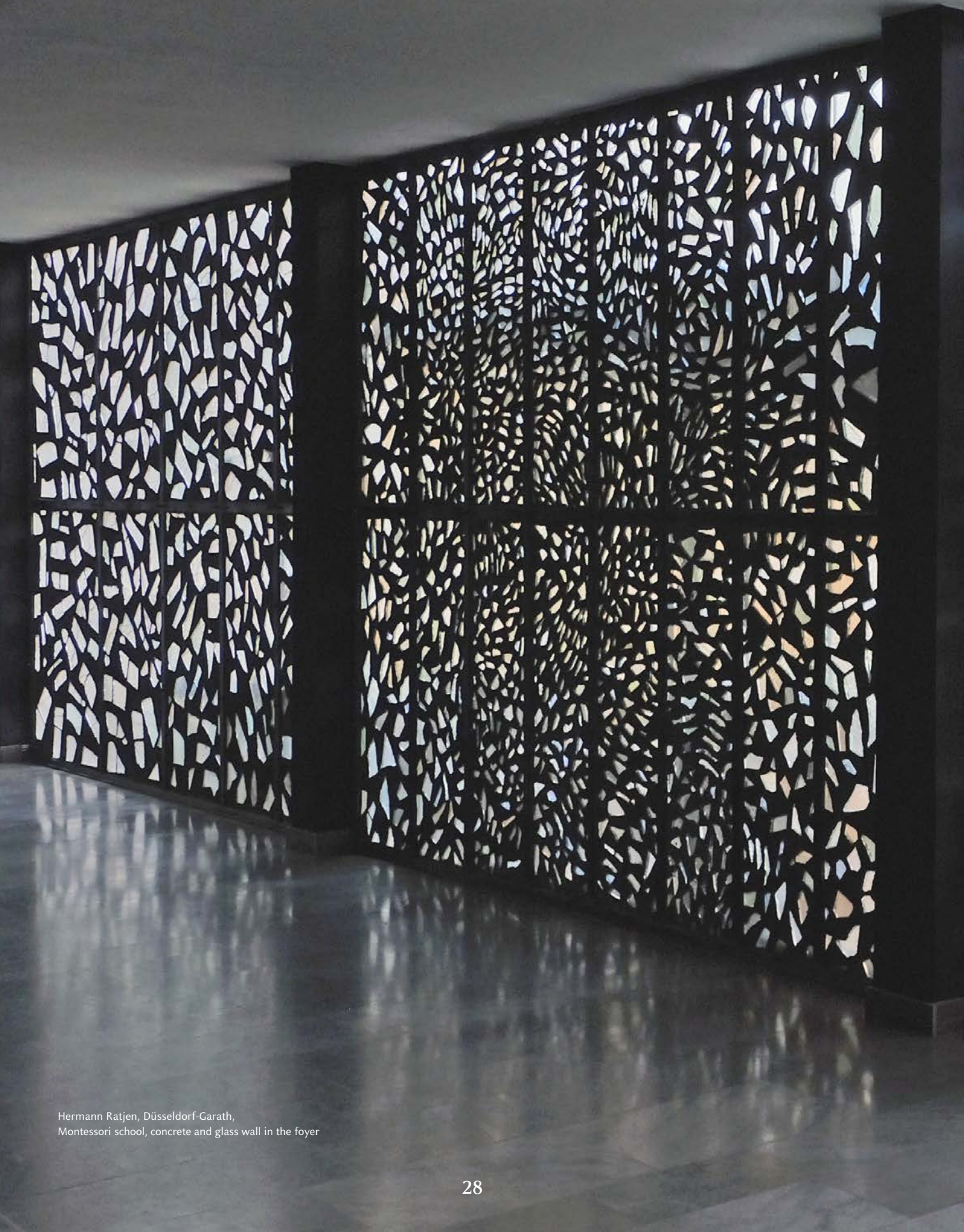
“the craftsmanship and artistic aspects must fit together seamlessly.” Once the individual pieces of glass have been selected, the painting process begins. “Black paint, a mixture of metal oxides in powdered form and readily fusible glass powder, is blended with a binder such as vinegar. The addition of arabic gum ensures adhesion of the colour. A brush is then used to apply this mixture to the glass, which subsequently needs to be fired. In the firing process, at approx. 600 to 630 degrees the overlaid layer of colours melts onto the softened surface of the glass substrate, binding with it,” explains Köpf. Once all the sections have been painted and fired, they are pieced together using lead strips, almost like a jigsaw puzzle.

Even the drafts created by the Dutch painter Johan Thorn Prikker, whose first appointment was in Krefeld and who designed stained glass windows from approx. 1910 onwards, changed the visual perceptions of the time. “He draws on the art nouveau style, but monumentalises the form,” says Wiener. In Düsseldorf, Thorn Prikker – in the meantime professor at the Art Academy – created the windows in the *Kunstpalast* art museum, his biggest and possibly most important piece of work. “Within the work itself you can observe the transition from edgy, jagged cubism to a calmer, more realistic constructivism,” says Wiener about the windows, which were destroyed in the Second World War but which could be faithfully restored thanks to preservation of the cartoon.

Even though the churches built after the Second World War differ significantly from their predecessor structures, only rarely have the colourful windows been dispensed with. In many cases, windows combining fragile glass and solid concrete with their own special charm have been created. Even structures in the brutalist style such as the cathedral in Neviges or the so-called bunker church in Düsseldorf-Heerdt (window designed by Walter Benner, 1957) and in Düsseldorf-Urdenbach (window in the Church

Johan Thorn Prikker, Düsseldorf, *Kunstpalast* art museum, window wall →





Hermann Ratjen, Düsseldorf-Garath,  
Montessori school, concrete and glass wall in the foyer

of the Holy Spirit designed by Joachim Klos, at risk of demolition) are decorated with colourful windows. “Here, the windows no longer tell educational stories about Christianity, but rather utilise the special light to create a reverent atmosphere,” says Jürgen Wiener. Many artists find this special play of light created by stained glass windows highly appealing, while many painters later turn to stained glass and appreciate work in churches, perhaps because it enables them to sacralise their art. “In light of their own mortality, some jump at the chance to contribute to religious buildings and thus legitimise their art as no longer being just for the rich by displaying it in such locations,” says Wiener.

## Not just for religious buildings

“People often encounter modern abstract painting for the first time in churches,” Wiener observes. He points out that it has long been the case that stained glass is not exclusive to religious buildings and that colourful glass windows can also frequently be found in schools, museums or public offices. “It is often a good opportunity to realise art within the framework of construction,” says the art historian. A large wall with a concrete and glass window by Hermann Ratjen can be found in a Montessori school in Düsseldorf, while a glass wall by Ewald Mataré can be found on the upper floor of the former tax authority office in the Düsseldorf district of Pempelfort.

In part together with students, Wiener and Köpf have visited an estimated 95% of the stained glass windows in

“People often encounter modern abstract painting for the first time in churches.”

Professor Dr Jürgen Wiener — art historian

Düsseldorf and nearby cities, documenting and describing the majority of them in their book. This was also extremely important to the two art historians as the creation of stained glass windows is now an endangered art form. “In Düsseldorf, stained glass windows are disappearing as a result of construction measures. The majority of church windows are known, but some windows in schools, public offices or even private houses are listed for the first time here.”

### BOOK

Jürgen Wiener, Reinhard Köpf (editors)  
*Moderne Glasmalerei Düsseldorf*  
*Glasfenster und ihre Künstler*  
 (Modern stained glass in Düsseldorf)  
 Stained glass windows and their artists)  
 B. Kühlen Verlag



Ewald Mataré, Düsseldorf-Pempelfort, former Düsseldorf North tax authority office, glass wall on the upper floor



# A matter close to Goethe's heart

Sonja Klein on Goethe's perception  
of the body, which is still highly  
relevant today

Six weeks before his death in 1832, Goethe wrote a letter to the Berlin privy councillor Peter Christian Wilhelm Beuth about – as he put it – a matter of world affairs. The writer requested that, in future, models should be used to teach students about the human body rather than dissected corpses. What? Goethe, one of the most highly educated minds of his time and someone who attended and even performed dissections himself during his student years, wanted to roll back THE advance of his epoch?

“From his early works to his final days, the body is one of Goethe’s defining themes – a constant aesthetic motif,” says Dr Sonja Klein, German Studies specialist at the Chair held by Volker C. Dörr. She completed her habilitation in German Languages and Literatures with the thesis “God’s Glorious Image. The Body in the Work of Goethe”, for which she also won the GFFU Award. Her hypothesis: Goethe was concerned not only with the body in itself, but also with the relationship between man and nature as a whole. His concept of the body was a matter close to his heart throughout his life and remains relevant to the present day, shaped as it is by ecological issues: “Goethe aimed to bridge the gap that arose around 1800 between man and nature, which had become a scientific object, and warn of the dangers inherent in the loss of respect for nature.”

## Interest in anatomy

Goethe owes his medical knowledge to his early interest in anatomy, which not only took him to medical lectures in Strasbourg, but also led him to participate in dissections. Goethe learned how to dissect corpses from Justus Christian Loder, one of the most famous anatomists of the time. However, the process was subject to strict legal and ethical restrictions: As only the dissection of the corpses of people who had committed suicide and executed murderers was permitted, there was a major shortage of corpses available to those studying medicine. The interest kindled there remained and Goethe described the physical details



Two busts of Goethe: one created in 1790 by Martin Gottlieb Klauer (left), the other created in 1820 by Christian Daniel Rauch.

“From his early works to his final days, the body is one of Goethe’s defining themes.”

Dr Sonja Klein — German Studies

of Werther’s suicide explicitly in “The Sorrows of Young Werther”, which both disgusted and fascinated readers of his time. And whether in “Wilhelm Meister” or “Elective Affinities”, in drama or verse – the body is a frequent topic in his works, for example the embalmed body of Otilie in the glass coffin or the erotically charged bodies in the “Roman Elegies”.

Yet despite (or because of?) the progress of science, Goethe also saw the associated dangers at an early stage. “If they do not wish to destroy the nature they seek to understand, intellectual curiosity and the spirit of research should not be permitted to exceed certain boundaries,” says Klein, explaining Goethe’s position. As a part of nature, man must respect it and ultimately allow nature to keep its secret. “It is not without reason that Faust is blinded at the end of the second part and ultimately stands before the horror vacui of an emptied creation.”

The interest in the body and the warning not to go too far, not to step too far away from man and his “natural sensorium” are evident in both scientific texts and poetry. “While his contemporaries increasingly rely on optical apparatus and technical experiments, Goethe attempts to rehabilitate the human body as the only means and stage of true knowledge,” says Klein.

She sees clear links between Goethe’s perception of science and current times: “Throughout his creative period, Goethe repeatedly referred to the fact that man is a key part of nature. In that moment when man steps away from the rest of nature in order to analyse it purely as an object and thus subject it to his will, he essentially initiates his own destruction.” This does not reject the progress of science, but sets boundaries for it: “Respect for nature should not be sacrificed in the pursuit of science. Goethe emphasized to the end in his works that beauty always lies in living things,” says Klein. V. M.

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## *Haus der Universität*

The *Haus der Universität* is a place of dialogue and exchange between science and society – in the heart of Düsseldorf. After extensive renovations, the van Meeteren Foundation kindly allowed Heinrich Heine University to use the building at Schadowplatz 14 as an event centre and, since 2013, as a venue for scientific conferences and for presenting university research and

teaching as well as academic culture. The *Haus der Universität* takes on a central function for Heinrich Heine University at the interface between science and public. It is part of a higher-level university strategy, the Bürgeruniversität, which actively furthers the exchange between the city of Düsseldorf, its citizens as well as society as a whole.

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