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The musicology of the brain

Using music, the German neuroscientist Stefan Kölsch looks at how we make predictions and how the brain responds if our predictions are wrong.

Not only is Professor Stefan Kölsch a neuroscientist with an international reputation; he is also a skilled violinist.

"The musical environment is one of the reasons I got interested in Bergen," says Kölsch, who is an expert on cognitive neuroscience.

Before arriving in Bergen, Kölsch was a professor of Psychology at Freie Universität in Berlin, with a master's degree in music from the University of Bremen and a PhD in cognitive neuroscience from the Max Planck Institute. He has now joined the Bergen fMRI Group at the University of Bergen (UiB).

At the Bergen fMRI Group, Kölsch is working with a number of leading neuroresearcher, among them Professor Kenneth Hugdahl, who holds an Advanced Grant from the European Research Council (ERC) for the second time.

The sound of music

The German researcher and music therapist has already published his first paper as a UiB-researcher in the journal *Scientific Reports*, a daughter journal of *Nature*.

In the study leading to the publication, Kölsch discovered that when predictions are based on statistical learning, events that do not match a prediction evoke an early

> " Most of the learning humans do is implicit, without intending to learn. |

negativity. The participants were tested by the use of music and brain scanning.

"The participants learned without consciously knowing so. They heard certain combinations of tones, again and again, and some occurred more often than others. Once the brain detects these regularities and begins to learn that certain combinations occur more often than others, we can measure that the brain shows a certain reaction to the unexpected event," Kölsch explains.

Unintended learning

He points out that most of the learning humans do is implicit. That is, without intending to learn, and usually even not being aware that something is learned. Such learning is one of the basics of predictions.

"The phenomenon that we predict certain things is something that happens basically every moment of our life, at least when we are awake. One of my interests is to understand how we make predictions and what happens if our predictions turn out to be incorrect," says Stefan Kölsch. •

FACTS

Stefan Kölsch
- Neuroscientist.
- Supported by the UiB and BFS Toppforsk programme to join the Bergen fMRI Group at the University of Bergen.

Putting algorithms into practice

Professor Michael Fellows is considered the father of multivariate algorithm design.

Among the areas where this branch of algorithm research has played an important role are computational biology and DNA sequencing.

"Speeding up a process by even a small amount can make a big difference to a company," says Professor Michael Fellows, who recently joined the world-leading algorithms research group at the University of Bergen (UiB).

Pioneering research

In particular, he is recognised for his pioneering work on the subject of parameterised complexity, a major new branch of theoretical computer science.

"Europe is leading the way in parameterized, multivariate algorithms, with Bergen as the strongest centre. In this area of research, the UiB Algorithms Group is the strongest research group in the world," says Michael Fellows.

The parameterised complexity branch of computer science is growing, with groups of scientists worldwide exploring this exciting field further.

"The theory has developed mathematically, now is the time to put theory into practice," says Michael Fellows.

An algorithm is a recipe

Almost every modern aspect of industry, commerce, government or innovation needs efficient algorithms, whether for scheduling

> **"** Speeding up a process by even a small amount can make a big difference to a company. **|**

oil production, determining mobile-phone coverage, or coordinating health databases. Algorithms are inherent in all other areas of computer science: from artificial intelligence to networking.

"An algorithm is a recipe. An algorithm for baking a pie would take a cup of flour, do such and so. A good algorithm would make a good pie. Mathematically, a good algorithm is one that uses less resources, runs faster, or uses less memory," the professor explains.

Fellows joins a number of world leading algorithms researchers at UiB, among them several European Research Council (ERC) grant recipients: Professor Fedor Fomin, who held an ERC Advanced Grant 2010–15, and current ERC Starting Grant holders Saket Saurabh and Daniel Lokshtanov. **o**

FACTS

Michael Fellows

• Computer scientist.

• Supported by the UiB and BFS Toppforsk programme to join the Department of Informatics at the University of Bergen.

Creating new treatment for diabetes

Professor Valeriya Lyssenko's main goal is to create new medicine for diabetes patients.

Joining the University of Bergen gives me unique possibilities and access to excellent resources, such as the Norwegian Mother and Child Cohort Study," says Valeriya Lyssenko.

Before joining the University of Bergen (UiB), Professor Lyssenko has participated in world-leading research with a special focus on diabetes, and has several strong publications on her résumé, both as first author and co-author.

Setting big goals for herself

Lyssenko is looking to find flaws in several genes. Early intervention in treatment of diabetes is key to find solutions, as is researching diabetes in a family perspective.

"I want to discover new treatments for diabetes, for patients of all ages. Setting big goals is important," Lyssenko says.

"Lyssenko's approach is one we would like to apply in our research centre," says Pål Rasmus Njølstad, professor at the Department of clinical science and KG Jebsen Centre for Diabetes Research at UiB. "Lyssenko is a perfect fit for the KG Jebsen Centre."

Njølstad is a former holder of an ERC Advanced Grant, which is awarded to established researchers of world class, by the European Research Council.

> ❝ I want to discover new treatments for diabetes, for patients of all ages. ❙

Lyssenko will have an important role in the KG Jebsen Centre, and is currently planning laboratory facilities she will need in her research.

A premier league researcher

Njølstad met Lyssenko through her work Lund University in Sweden, where she has been researching genetic prediction of type 2 diabetes and its complications.

"I think our cooperation with Lund University will be strengthened by Lyssenko joining UiB," says Njølstad, who describes the diabetes research at Lund University as one of the best of its kind in the world.

Lyssenko is currently involved in projects in both Sweden and Denmark, as well as her planned cooperation with the KG Jebsen Centre.

The centre's main goal is to find a cure for diabetes. ⭘

FACTS

Valeriya Lyssenko
- Diabetes researcher.
- Supported by the UiB and BFS Toppforsk programme to join the KG Jebsen Centre for Diabetes Research at the University of Bergen.

Identifying new class inequalities

Professor Don Kalb has been recruited to the University of Bergen to study various aspects of the social relationships of global capitalism.

He plans to establish a research group to study the escalating contradictions of the new global capitalism in China, the global South and Europe.

"The aim is to identify exemplary trends in class relationships, in politics and capitalistic urbanisms in these three diverse world regions, which are thoroughly interconnected," says Don Kalb.

He looks forward to joining the University of Bergen (UiB).

"UiB's Department of Social Anthropology is one of the best in Europe. I have already been involved with Professor Bruce Kapferer and his project on egalitarianism, and this has been very inspiring," says Kalb.

The project he is referring to, has led to Kapferer receiving an Advanced Grant from the European Research Council (ERC), which is awarded to elite researchers.

Using historical methods

Kalb often uses historical evidence in addition to fieldwork. He has been described as "an anthropologist, equally at home with historical methods and debates". His work has addressed numerous topics including globalisation, nationalism, labour history, and class.

The research group he is planning at UiB's Department of Social Anthropology will study various aspects of the social relationships of global capitalism.

> " The aim is to identify exemplary trends in class relationships, in politics and capitalistic urbanisms. |

"When I got the opportunity to lead a great research group of my own for a five year period, it felt great," says Kalb, who hopes his project will also lead to future research grants.

Broad international network

Kalb has enjoyed an international career from the start of his life as an academic and has built an extensive international network. He has published numerous articles in renowned journals and held positions in several countries: Hungary, Italy, Austria, Germany and the US as well as his native Netherlands.

"I think my experience from very different sorts of institutions, and my contacts, is something that would be interesting and a resource for my colleagues at UiB's Department of Social Anthropology," says Don Kalb. ○

FACTS

Don Kalb

- Anthropologist.
- Supported by the UiB and BFS Toppforsk programme to join the Department of Social Anthropology at the University of Bergen.

Philosopher by accident

Coincidence played a major role when Michael Baumgartner chose a career in philosophy. No wonder he created a method called Coincidence Analysis.

There is seldom only one cause, but complex structures with multiple alternative paths that are responsible for typical outcomes in the world we live in," says Professor Michael Baumgartner, whose main focus of research is the philosophy of science and the philosophy of logic, and in particular on causation and logical formalization.

In 2017, he joins the Department of Philosophy at the University of Bergen (UiB).

Minarets and causality
Baumgartner believes that Coincidence Analysis can be applied in many fields, some examples being social and political science, biology and medicine.

"Any field that does not focus solely on net effects, but is interested in the interplay of multiple different causal factors can apply the method," the professor of philosophy says.

One of the examples he uses, is the 2009 referendum when 57.5 per cent of Swiss citizens voted to ban the construction of new minarets in the country. The result of the referendum surprised the politicians, as there were only four minarets in the country in 2009.

Baumgartner detected that an interaction between weak left parties, the traditional economic sector and the share of Muslim population contributed to the acceptance of the minaret ban in Switzerland.

"Most methods used to understand these kinds of political problems are designed to quantify the impact of single causes on scrutinized outcomes. Coincidence Analysis, on the other hand, does not focus on isolated cause-effect pairs, but shows the interactions and alternative aspects that can be causal," Baumgartner explains.

Expanding the scope
Baumgartner looks forward to become part of the philosophy research environment in Bergen.

"I know that the Department of Philosophy is quite large. Due to the *Examen Philosophicum* there are a lot of philosophy teachers at UiB. I applied for research positions in different locations, but Bergen caught my attention," he says.

He plans to expand the scope of his research, and of Coincidence Analysis in particular.

"I need a collaborator from one of the disciplines I want to expand to, for example from biology or medicine," he says, and is excited about the strong emphasis on interdisciplinary research and collaboration at UiB. ○

> **"** My method does not focus on isolated cause-effect pairs, but shows the interactions and alternative aspects that can be causal.

FACTS

Michael Baumgartner
- Philosopher.
- Supported by the UiB and BFS Toppforsk programme to join the Department of Philosophy at the University of Bergen.

BERGEN RESEARCH FOUNDATION

Producing world leading research environments in Norway is one of the most important areas in the Norwegian Government's long-term plan for research and higher education 2015–2024. This is also the ambition of the University of Bergen (UiB) strategy for 2016–2022 – "Ocean, Life, Society".

Bergen Research Foundation (BFS), the Norwegian Government and UiB are funding five international elite researchers to the amount of 137 million NOK (approximately 15 mill EUR) via the UiB and BFS Toppforsk programme.

The idea behind the UiB and BFS Toppforsk programme is to create more world leading research groups at UiB and in Bergen, in line with the government's bold ambitions for future Norwegian research.

The UiB and BFS Toppforsk programme will support the University of Bergen's ability to offer international elite researchers a package deal for a five-year period, which includes positions for members of their own research groups and investment in state of the art infrastructure.

The five researchers UiB has been able to recruit thanks to the UiB and BFS Toppforsk programme are: Stefan Kölsch, Michael Fellows, Valeriya Lyssenko, Michael Baumgartner, and Don Kalb. We welcome these excellent researchers to Bergen. In this mini-magazine, you can read a short presentation of each of them.

Dag Rune Olsen
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