



Plenty of space in the attics of Palais Strozzi. Help us to grow complexity science in Austria with a donation to grow the Hub. (c) Verena Ahne

Complexity science—more important than ever

In July, a report in *Science* hit the headlines worldwide. Researchers had provided calculations for combating the unfolding climate catastrophe by large-scale tree planting. 900 million hectares of land, the ecologists claimed, would be suitable for reforestation without affecting agriculture or cities—an area almost the size of the United States. In 30 to 60 years, they wrote, these newly planted forests could sequester as much as 205 GT of carbon, corresponding to two-thirds of all human emissions since the beginning of industrialization. Hurray, cried the media. This is the magic bullet!

Somehow this sounded too good to be true. And indeed, another group of ecologists has harshly replied (also in *Science*). It seems as if the initial report not only used flawed figures and calculations, thus overestimating the sequestration effect by almost five times. It also ignored known ecological interrelations—we would call it the complexity of ecosystems. In high latitudes or elevations, for instance, trees could contribute to, instead of reduce global warming. Why that? Because dark surfaces decrease the albedo effect, the surface reflection of solar energy. In areas covered with “dark” forests, more heat is stored than, say, in open grasslands. Even worse, the critics continue, all grasslands and savannas were equally labeled as “degraded areas,” including jewels of nature like the Yellowstone Park or the Cerrado in Brazil,

a rich and rare tropical savanna. The “overambitious and grandiose” proposal to plant trees just about everywhere undermines a good idea (of planting trees), the comment concludes, and is a threat to important ecosystems with their very own value and function (and beauty, I would add).

The case shows once again, that, and why, humans, sciences, and politicians alike have to deal with problems in a new way. The world is complex, interrelated and organized in entangled networks. “One size fits all” solutions must inevitably fail. If we don’t learn to deal with this complexity, we won’t ever manage to tackle the grand challenges humanity faces.

Such an understanding is at the core of our mission, and we are getting better at it every day. We will be even better in the future, as the Hub is growing fast. Which poses its own challenge ... As a matter of fact, the Hub is bursting at the seams. Yet, we haven’t got the means to finance the planned extension of our office space in Palais Strozzi. Is there perhaps a philanthropist out there who would like to support us? We would be happy to show you around and convince you that expanding the Hub is a benefit not only for science in Austria, but for society as a whole.

Verena Ahne, Head of Knowledge Transfer

Contagious suicides in popular TV show

Study raises concerns about the Netflix teenage drama "13 Reasons Why."

Knowing that young people are especially susceptible to suicide contagion, youth psychiatrists were highly alarmed when "13 Reasons Why" aired in April 2017. The series follows high school student Hannah Baker and shows why, and how, she sets an end to her life.

Looking for suicide reasons in Big Data

Thomas Niederkrotenthaler from MedUni Vienna was an early critic of the drama. He asked CSH's → *David Garcia* to pursue a data analysis to check a possible association between the release of the show and teenage suicides. "Netflix does not share viewership data, so we did an extensive social media search," says David. "References to the show on Twitter and Instagram are a good proxy to the amount of attention the show received," he adds. The team found more than

1.4 million tweets by more than 870,000 users for the period of April 1 to June 30, 2017. Instagram produced more than 26,000 posts by 7,875 influencers. The referrals peaked in April. "There was no more social media attention for the drama after June. Therefore we defined the exposure window as April to June," says David.

22 % more fatal cases in girls

When the scientists matched official suicide numbers with this peak exposure, they found an increase in suicides in the age group of 10 to 19 years—the target group of the show. There was no rise in other age groups. In boys, the raise was 12 %, in females, almost 22 %—no surprise, as the main character of the show is a young woman. Of course, the researchers cannot know for sure if it was the drama that caused the increase. But as they know that an explicit showing of suicides in mass media provokes copycat suicides, that adolescents are highly susceptible to their peers and that the show is exceptionally popular in teenagers, and given that the drama does not offer other solutions to Hannah's experience of bullying and sexual

harassment than suicide, it does not seem far-fetched to connect the show with the suicide spike. Consequently, the researchers called for the entertainment industry to be much more cautious with this difficult subject.

→ "Association of Increased Youth Suicides in the United States with Release of 13 Reasons Why" (*JAMA Psychiatry*)

Teenagers are especially susceptible to their peers. This can lead to suicide contagion. © Shutterstock



Statins could increase osteoporosis risk

Austrian health data reveal dose-response relationship between cholesterol-lowering drugs and the diagnosis of osteoporosis.

Statins are among the most prescribed drugs worldwide. They inhibit the synthesis of cholesterol from the liver. Effects are decreases in blood cholesterol and cardiovascular risks. However, cholesterol is crucial for many processes in the body. Couldn't an aggressive statin therapy also have undesirable side effects? A team of scientists from the Medical University of Vienna and the Hub went in search of clues.

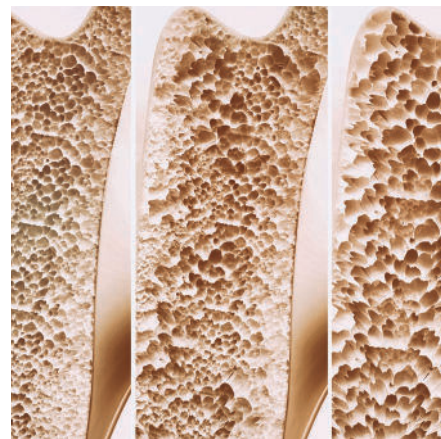
"Cholesterol is a basic building block for the production of sex hormones such as estradiol and testosterone," Alexandra Kautzky-Willer from MedUni Wien points out. "We know that low concentrations of sex hormones—especially the drop in estrogen levels during menopause—are the main cause for the increase of osteoporosis in women. There is a similar relationship between bone density and testosterone," adds the expert in gender medicine. The

scientists were interested in whether the inhibition of cholesterol production by statins could have an effect on bone formation and whether there could be a dose-response relationship.

Higher dosage, stronger effect

For their investigation, the research team, as in earlier studies, used health data of more than 7.9 million Austrians from 2006 and 2007. → *Caspar Matzhold*, one of our young researchers, carried out the processing and statistical analysis of the data as part of his master thesis. "We filtered those out who regularly took statins for at least one year," states Caspar. He also calculated the daily dosage of statins and formed different dosage groups. In a further step, he looked for osteoporosis diagnoses.

The data show a clear correlation between the dosage of statins and the frequency of osteoporosis. Up to 10 milligrams—the lower dose groups—, there were fewer osteoporosis cases than expected. With doses of 20 milligrams and more, however, the tide seems to turn: The higher the dosage of statins, the stronger the effect is. This correlation was seen in both sexes.



High-dose statins could contribute to bone loss, new study by MedUni Vienna and the CSH reveals. © Shutterstock

Big insights through Big Data

"This study again shows how helpful large data sets can be to examine open medical questions," says CSH's → *Peter Klimek*, a co-author of the publication. "The combination of medical expertise with our knowledge in Big Data analysis makes completely new insights possible."

→ "Diagnosis of osteoporosis in statin-treated patients is dose-dependent" (*Annals of the Rheumatic Diseases*)



Optimizing creative teams

A novel experiment singles out key determinants of efficient teams.

Today, many creative processes, from Wikipedia to coding computer games, are the product of a crowd. A scientific

The right balance between strong and weak ties makes teams more successful. © Shutterstock



team including CSH's → *Vittorio Loreto* wanted to know under which conditions such creative communities are most productive. They designed an open-ended experiment, consisting of three Lego brick stations at an exhibition in Rome, to identify key components of successful working groups.

Monitoring live interactions

Visitors to the exhibition could freely contribute to the collective development of one, two, or all stations, by either building, destroying, or modifying parts of it. People were equipped with special sensors that monitored the time and pattern of the individual's interactions as well as their contributions to a station (20-second resolution). The evolution and the volume of the three Lego constructions were monitored by infrared depth sensors, providing real-time 3D reconstructions. "The constant monitoring shows us the dynamics of social bonds between people," Vittorio explains. That is, how social bonds form and break away, continually restructuring the working teams.

Commitment and social influence

"Larger teams with committed people—those focusing primarily on one station—build more successfully," says Vittorio. The higher the commitment and the bigger the team, the higher the growth rates. The artwork also grew faster when several influential people gathered at a time. These "influencers" were defined as information spreaders, analogue to virus spreaders during an epidemic.

New people bring in new ideas

On the other hand, it seems to be of help if a certain number of uncommitted people stop by. "Some experts argue, that such 'weak ties' in a network are the most critical drivers of collective creativity," says Vittorio, as they contribute to a constant inflow of new information. Yet, too many weak ties could prevent an efficient communication. "We saw that an optimal fraction of weak ties exists in a working team that maximizes the building efficiency," concludes Vittorio.

→ "Efficient team structures in an open-ended cooperative creativity experiment" (PNAS)



New people at the Hub: *Peter Turchin, Jiaying Chen, Christian Diem, Erwin Flores Tames, Marcia Ferreira, William Schueller*

New people & new subjects at the Hub

A lot of new people started working with us. What are they all (well, some of them...) doing?

→ *Peter Turchin* will establish a new research group on Social Complexity and Collapse at the Hub. Peter will study the processes that led to the emergence of complex societies in history and the resilience of complex societies to internal and external shocks. He will develop mechanism-based models of the rise of complex societies and their periodic col-

lapses, and test the model predictions against historical and archaeological data.

→ *Jiaying Chen* will examine associations between common mental disorders and socio-economic status among young refugees (aged 16 to 25) in Sweden.

→ *Christian Diem* will model the spreading of stress in financial systems, for example after the breakdown of a bank.

→ *Erwin Flores Tames* will study interactions of an entire economy, based on supply chain data. The aim is to discover weak points in the economy.

→ *Marcia Ferreira* will focus on how people, teams, and places create new ideas. Are there underlying conditions for creativity and innovation? Could we identify important discoveries at an early stage, or do we have to wait patiently and let time decide which breakthroughs have a major socio-economic impact?

→ *William Schueller* will look for a fairer credit attribution scheme for collaborative projects. "Sometimes it is a small contribution that turns out to be the most valuable," William explains. "It would be great if we could trace such ideas in big databases and find a way to adequately reward them," he adds.

UPCOMING

Every day, researchers from the Hub and scientists visiting the Hub develop new ideas for talks, workshops and other events.

Please check out our webpage for updates and more information:
→ www.csh.ac.at/events

CSH Workshop
→ *"Higher-order connectivity and correlations in complex systems"*
Nov 25–26, 2019

The emergence of new features in evolving complex systems highly correlates with their cooperative response to driving forces, which in turn leave characteristic patterns in time-varying data. Collective dynamics can arise from non-trivial connections that go beyond standard pairwise interactions in the network. This higher-order architecture can be described with simplexes of different types—triangles, tetrahedrons, and others—and quantified by using advanced algebraic topology methods.

The goal of this workshop, organized by Bosiljka Tadic and Álvaro Corral, both → *CSH External Faculty*, is to discuss the simplicial complexes representation of various complex systems on the one hand, and their dynamical complexity on the other.

By addressing mathematical and theoretical concepts and empirical data

analysis, the workshop will look for new answers to open problems, specifically, to reveal the implications of higher-order interactions for the dynamics; to find the relevant information through the topological data analysis; and to make these topological approaches to complexity more recognizable.

CSH Workshop
→ *"Using Mobile Telephony Data for Societal Insight"*
Dec 10–11, 2019

Smartphone data can deliver unprecedented insights, for health science, social science, disaster management or mobility. However, the use of this data elicits extreme skepticism on the part of the companies owning the data, as well as of the end users. This usually leads to less-than-optimal data usage in countries with strict privacy regulations.

How can data from mobile telephony be used to obtain deep insights into the functioning of society, while being gathered in such a way that its use is acceptable or even welcomed by members of society?

The workshop, organized by CSH's → *Allan Hanbury*, will identify key application areas, technical measures to guarantee privacy and security, as well as measures to increase the acceptance of the use of data to both society and policy makers.

PUBLICATIONS

This is a selection of publications affiliated to the Hub. Find more at
→ www.csh.ac.at/publications

J. Korbelt, J. P. Aguilar, Y. Luchko
→ *Applications of the fractional diffusion equation to option pricing and risk calculations*, Mathematics 7 (2019) 796

M. Leutner, C. Matzhold, L. Bellach, C. Deischinger, J. Harreiter, S. Thurner, P. Klimek, A. Kautzky-Willer
→ *Diagnosis of osteoporosis in statin-treated patients is dose-dependent*, Annals of the Rheumatic Diseases, Epub ahead of print (30 Sept 2019)

M. R. Kamdar, J. D. Fernández, A. Polleres, T. Tudorache, M. A. Musen
→ *Enabling Web-scale data integration in biomedicine through Linked Open Data*, npj Digital Medicine, Vol 2, 90 (2019)

A. Goldenberg, D. Garcia, J. Gross et al.
→ *Beyond emotional similarity: The role of situation-specific motives*, Journal of Experimental Psychology: General (2019)

M. Ibáñez-Berganza, A. Amico, V. Loreto
→ *Subjectivity and complexity of facial attractiveness*, Scientific Reports 9, Article number: 8364 (2019)

M. Perc, M. Ozer, J. Hojnik
→ *Social and juristic challenges of artificial intelligence*, Palgrave Communications 5, 61 (2019)

O. Williams, L. Lacasa, V. Latora
→ *Quantifying and predicting success in show business*, Nature Communications 10, 2256 (2019) 1–8

V. Loreto, B. Monechi, P. Gravino
→ *Towards novelty-driven recommender systems*, Comptes Rendus Physique, 20 (4), (2019) 371–379

T. Niederkrotenthaler, S. Stack, B. Till, M. Sinyor, J. Pirkis, D. Garcia, I. Rockett, U. Tran
→ *Association of Increased Youth Suicides in the United States With Release of 13 Reasons Why*, JAMA Psychiatry, May 29 (2019)

S. Thurner
→ *Big Data und die Folgen: Sind wir noch zu retten?* Wiener Vorlesungen Band 194, Picus Verlag (2019)

Art at the Hub

In our current exhibition within the → *Art at the Hub* program we show oil paintings of the Austrian artist **Karin Czermak**. In her series "Resolving Landscapes", Karin takes us on a journey around the world. We see the mountains of Pakistan, for instance, where she has lived and worked in disaster relief and hazard mapping.

Karin Czermak studied at the University of Applied Arts in Vienna at the master class for painting, as well as at the University of Rovaniemi, Finland.

In the process of painting, she resolves, splits, and rearranges scenic elements, thus composing fragile works of art.

→ *Our next vernissage will present the work of Maria Hanl.*



Karin Czermak: *loca amoena azur*. Oil on canvas, 100 x 100 cm

If you would like to see the exhibition, just give us a short notice and come by.