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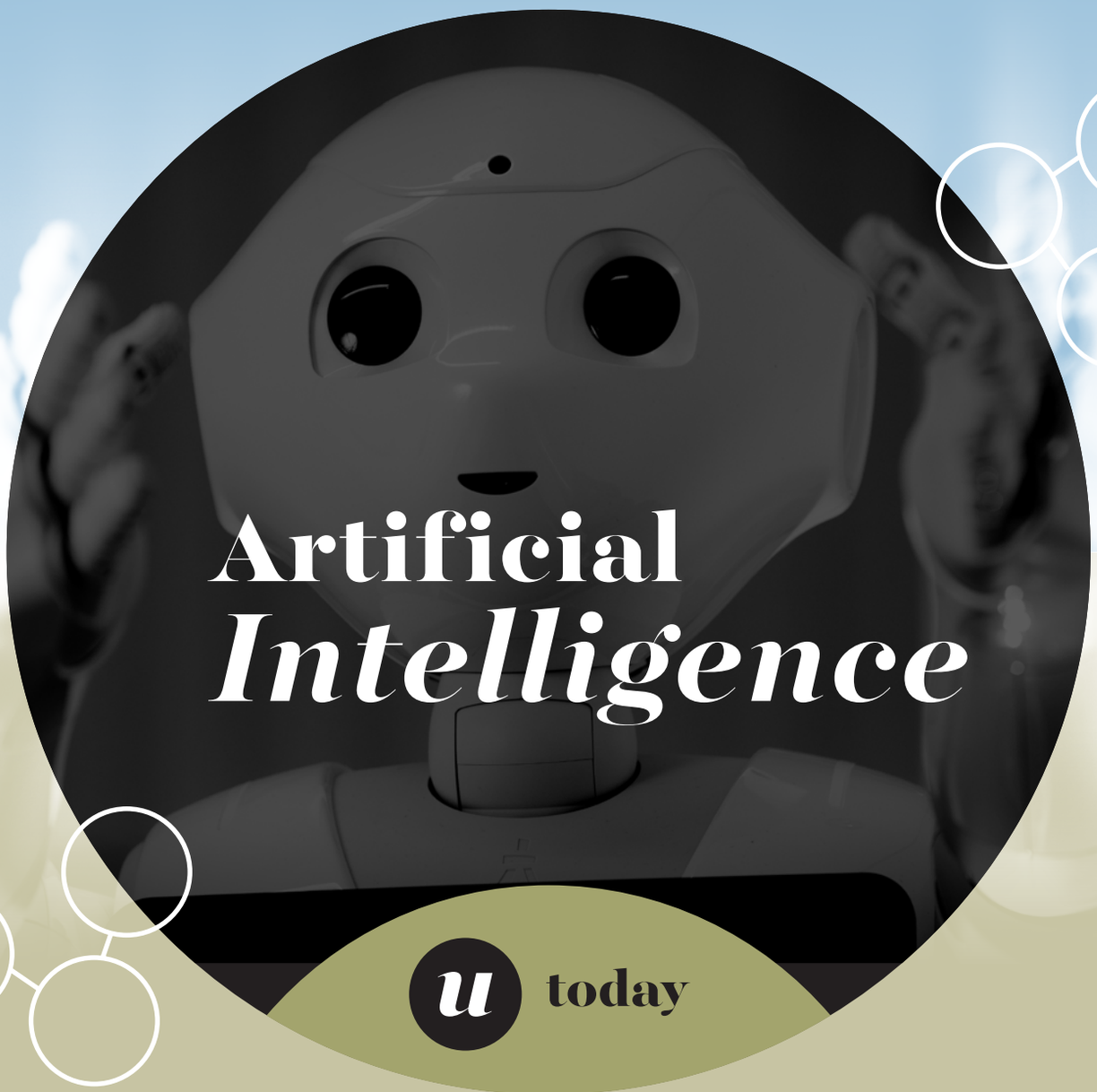

Artificial *Intelligence*

u today

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Steering wheel

'I think there is a world market for maybe five computers', is a famous prediction by IBM's President Thomas J. Watson. The computers he spoke about, in 1943, were very large machines using mechanical switches and electron tubes – the transistor wasn't invented yet, let alone the microchip. At that time, he could not know that computers would be all around us, just over 75 years later.

What about the predictions we do today then? We foresee a future in which everything - and everyone - is connected through the Internet of Things, we foresee a future in which many of our current jobs will be fulfilled by robots. We foresee that we hand over the steering wheel, literally, in our autonomously driving car.

But is it also by figure of speech, that we hand over the steering wheel? The prediction that robots take over our jobs, for example isn't new at all. It dates back to the first automation efforts in industry. In 2017, however, we're talking about machines using artificial intelligence and Big Data. These machines could also take over more intelligent jobs than just assembling cars. One prediction is that we're going to meet robots in our daily life, in our homes and at work. If history will develop the same way it did after Watson's prediction, then we should be modest. Developments will, most probably, go much faster than we can imagine today.

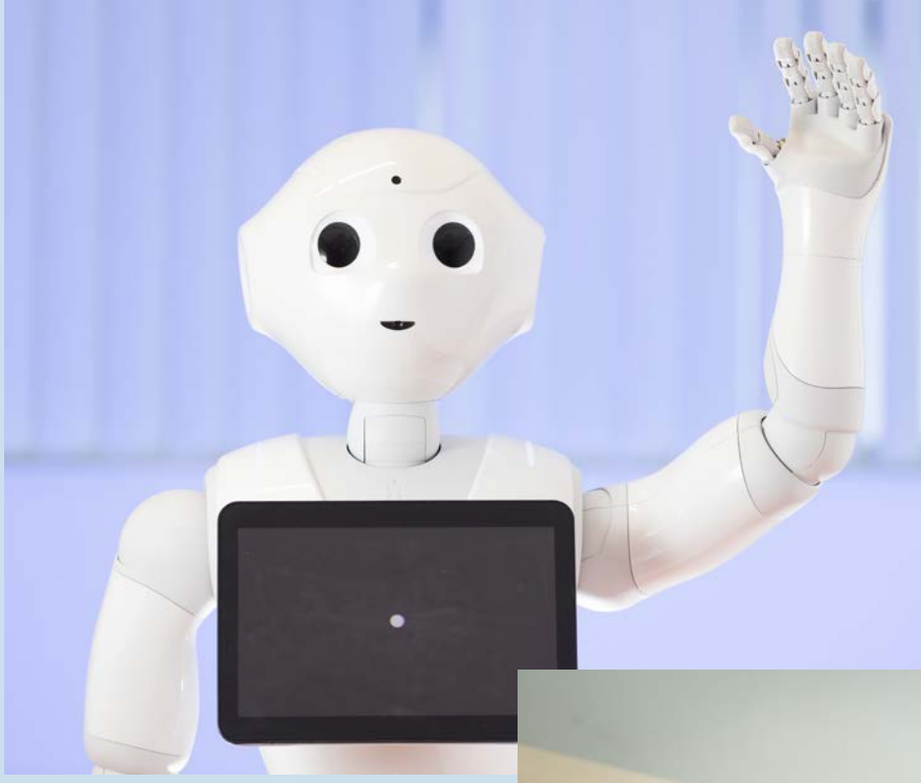
The 'high tech, human touch' approach of the University of Twente, implies that we don't take technology development for granted, as an autonomous process that eventually even may overrule people. By looking at the societal impact and the ethical implications, early in the process, we are able to take back the steering wheel and reduce feelings of threat people may have. This is not done by playing down the threats, because these can be very real – losing your job, your privacy. It is done by thinking in terms of opportunities, always connecting to the outside world.

This first issue of the Science Magazine of U-Today takes a look at the way humans and robots meet. This is done in a typical UT way, from a broad perspective including state of art technology and its impact on humans.

Prof. Thom Palstra

Rector Magnificus

u today



Colophon

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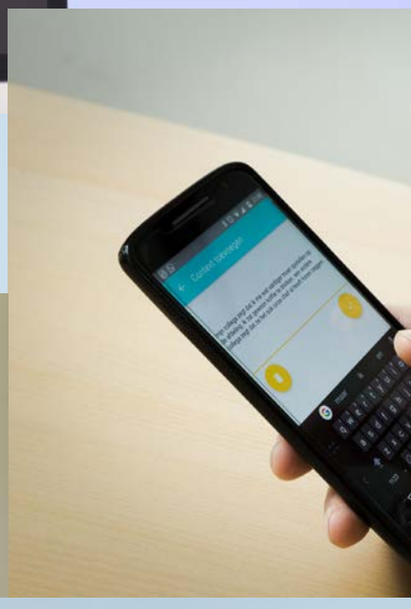


Science
magazine

Content

Text: **Michaela Nesvarova & Rense Kuipers**
Photos: **Rikkert Harink & Shutterstock**

U, robot?

Imagine this: Clyde is your new office assistant. Clyde is a robot. He brings you coffee and spills the hot drink all over your new shirt. You are angry and scream at Clyde. He gets upset. He seems so sad, in fact, that you decide to go and apologize to him. Wait a minute, though. Should you really be apologizing to a machine? Can AI (Artificial Intelligence), such as Clyde, truly be sad? Where is the dividing line between us and AI and is this line disappearing? Let's explore the grey area where a robot meets a human.

'Artificial intelligence will be either the best, or the worst thing, ever to happen to humanity. … AI could mean the end of mankind,' Stephen Hawking warned us during his recent speech at the opening of the Leverhulme Centre for the Future of Intelligence. Elon Musk and many other prominent innovators and scientists have also stressed the importance of making sure that AI 'goes the right way'. At the beginning of this year, The Future of Life Institute even presented AI Principles, a guideline to ensure safe and beneficial AI. In other words, it seems that this groundbreaking technology is just around the corner and there is a collective fear of its arrival.

When AI is discussed or portrayed in films or books, it often leads to scary descriptions of war between machines and humanity, war that doesn't tend to end well for humankind. These worries of AI making people obsolete are, however, not shared by many UT researchers, including Professor Dirk Heylen of the Human Media Interaction group: 'Yes, machines will outperform us in certain tasks, but does that mean that they will dominate us? That fear is an expression of our primitive minds. In a way, we are still cave people who think in terms of myths. AI somehow always turns evil in our imagination, but I see AI as a useful tool, not as a potential rival.'

Artificial by nature

'We don't always have to frame the topic of AI in the sense of war and struggle. We can coexist,' says Peter-Paul Verbeek, Professor of Philosophy of Technology. 'Of course AI will be better than us, otherwise we wouldn't be making it. The whole point of technology is to outdate us. Humans are often seen as animals with something extra, but you could also view us as animals that lack something. We lack the physical attributes to survive, we don't have any large claws and we can't even walk the first year of our life, but we have our brain, which allows us to add something to us. Our default setting is that something is missing. Our nature is to be outdated by technology. We are artificial by nature.'

In Verbeek's point of view, AI could therefore be seen as a natural part of us, a mere extension. 'Technology is what makes us human,' he says. Dirk Heylen agrees that there is no 'us versus them' if it comes to people and intelligent robots. He explains that we don't have to feel threatened by AI, because all technology comes from within us: 'We are social animals

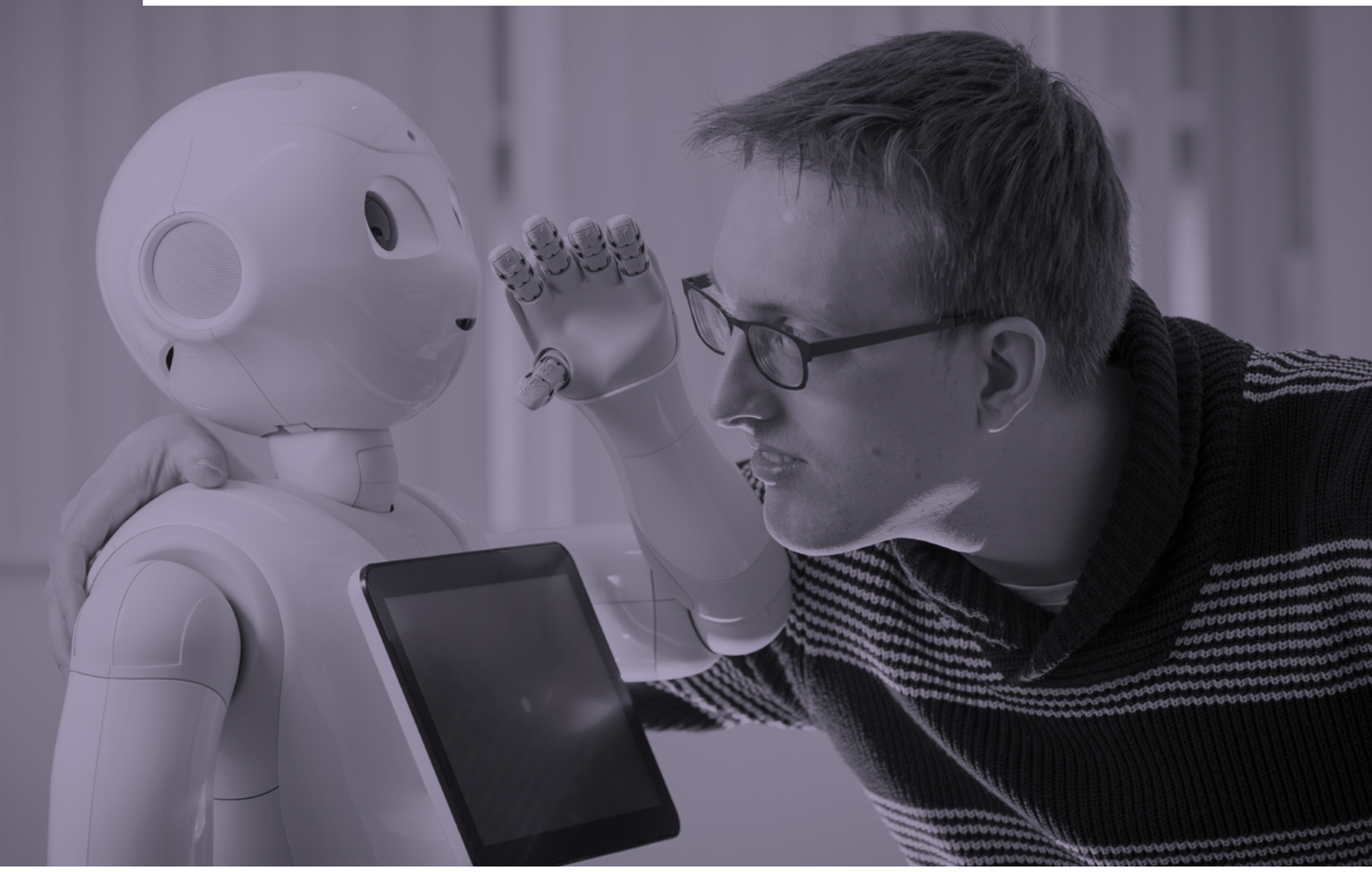
> ***'AI is an extension of our mind .'*** *Dirk Heylen*

and we have developed a system of collective intelligence. We have invented a complicated language, which allows us to communicate, make copies of our information and share it with others. Think of speech, writing, print, internet. Our intelligence is much wider than our brain and computers are a part of it. Computer – AI - is not an enemy, but an extension of our mind.'

Success?

Extension or not, they can already beat us at chess, at GO, and even the best poker players should keep their cards closer to the chest. It seems that AI has come a long way and is surpassing us in several ways. However, there is a nuance to all of the success stories, says UT Professor of Technical Cognition Frank van der Velde. Our human ability to decompose a situation, for instance, is something AI could only dream of doing at the moment – well, if it will ever be able to...

Professor Van der Velde specializes in using robots and artificial intelligence to understand how human cognition works. It's a paradox, he royally admits. But a valuable one. 'Our human way of sequential information processing is one of the most difficult things to understand. When you implement this concept into a robot who can perform tasks in a logical way and show the process to us, it could teach us how things are learned.'



The odd thing out

Take a moment to reflect on your own motor skills. You just turned a page, without ripping it apart. You may be taking a sip of your coffee – while reading this – hopefully without spilling it. You're doing all of these 'basic' moves without excessive thought. Basic moves that are the most difficult challenge for the current generation of robots, Van der Velde explains. 'Especially when a robot has to perform multiple tasks at once, in a busy environment, it'll have trouble making sense of the situation.'

'Existing AI is still very limited,' agrees Heylen. 'There have been big advancements – we have a lot more data available and our algorithms are much better. If it comes to speech recognition, the IBM Watson system has the ability to understand conversational speech as accurately as humans do. However, the real challenge is not for the machine to understand the individual words, but to understand the meaning of the words, the emotions expressed in them.'
There are plenty of examples of AI not doing that well, as Van der Velde points out: 'Just recently, I was at a conference where they presented a robot that could recognize cars. It learned that by getting tons and tons of data thrown at it – scenes where cars are in their natural habitat: the road. Problem is, when it was shown a picture of a car upside down in a pool, it couldn't recognize that it was indeed a car. That's a shame, because that's what you really want: AI recognizing the odd thing out.'

SpongeBob

You could call it a gift – our human capacity of understanding a particular setting. We can identify it, analyze it, even notice when something's wrong. As Professor Van der Velde says: 'Our way of decomposing a situation is the key to human cognition.' Even small children understand that something is wrong when a car is upside down in a pool and that it's normal for a car to be driving on a road. Van der Velde adds another layer to that, one living in a pineapple at the bottom of the sea. 'Children have no issue with the concept of SpongeBob SquarePants, no matter how absurd the image is. It's easy for them to process, but very hard for AI.'

Could it be as simple as human instinct, evolved over years and years? The Technical Cognition Professor thinks we have to look deeper. 'What does our brain do when we decompose a situation? The question is not if it's human instinct, but if so – where does instinct come from? Because something like that requires a different kind of computing architecture. Then it's not just rerunning data in a huge deep learning network.'

The Future of Life Institute

The Future of Life Institute (FLI) is a research and outreach organization that, in its own words, works to 'catalyze and support research and initiatives for safeguarding life'. Founded in 2014, the institute is particularly focused on existential risks related to advanced artificial intelligence (AI). FLI advisory board includes, among others, Stephen Hawking and Elon Musk, but also Morgan Freeman and Alan Alda. According to the organization's website, FLI is concerned that AI will trigger a major change and therefore wants to ensure that this technology remains beneficial. In 2017, the institute published the Asilomar AI Principles document, consisting of 23 principles which offer a framework that can help to ensure that as many people as possible can benefit from AI.

> ***'SpongeBob is easy for children to process, but hard for AI.'*** *Frank van der Velde*

Very emotional

Emotion detection is another big obstacle in developing AI. The challenge doesn't lie only in training machines to recognize various emotions, but also in classifying what types of emotions we even have. 'We still don't know what emotions are,' says Dirk Heylen. 'Do we use the right categories to describe them? After all, there are many ways of being happy or sad. Some scientists try to solve this problem by using more data and see if the machine can classify it by itself; then they wait what classes the machine will come up with. In this way, AI teaches us about what makes us human.' Based on these words, it's once again showing that we could see AI as an expansion of our humanity, an extra brain we are developing, rather than an independent 'creature' that might fight us.

If we accept this premise, we have to ask ourselves: Where does a human stop? Where does AI begin? If technology is a part of us, where is the dividing line, or is there none? 'It is true that, unlike AI, humans are not subjected to any designer. Our starting point means there is a fundamental difference, but the boundary between humans and technology is shifting rapidly,' answers Professor Verbeek. 'How we live is completely influenced by technology, and at the same time we put more and more humanity into technology. It is possible that the two will meet at some point, at a point where there is no difference between the two anymore.'

Fake humans

Can AI and humans truly become the same? After all, AI is defined as something that simulates human intelligence and intelligence is one of the key elements of being human. Even Dirk Heylen admits that UT research in this field is focused on creating 'fake humans', machines with human abilities. 'Many people say that if AI exists, we should grant it the same rights and obligations as humans have, but I think that AI will be quite different from us – it is still only a simulation of a human.'

'AI doesn't grow up, it doesn't have the same social environment, it lacks the richness of experience that humans have. There is therefore a huge difference,' adds Professor Heylen, and his colleague Gwenn Englebienne feels the same way: 'Technology is becoming more social and intellectual distinction is disappearing, but physically machines are completely different beasts from us and this difference will probably always be there. We're still leading and machines are the ones that have to help us and adjust to our way of life.'

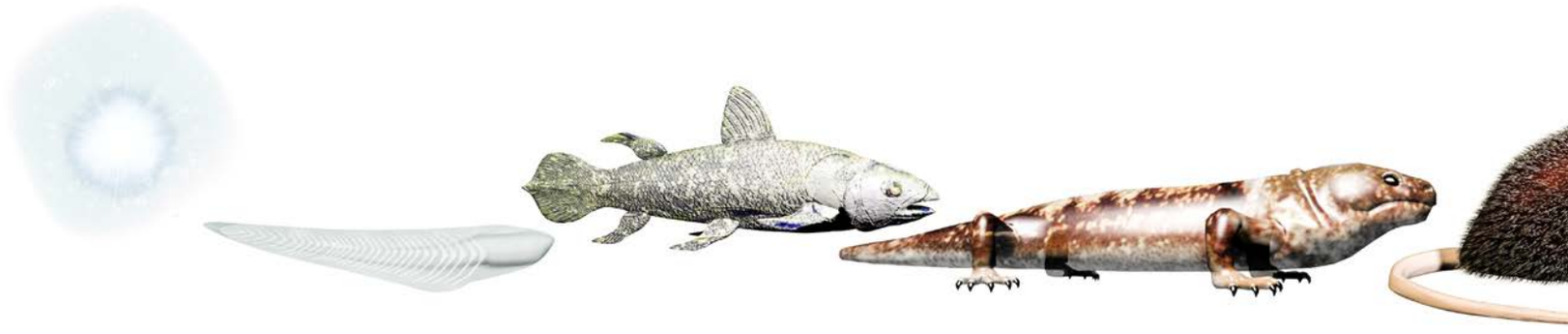
No competition

HMI researcher Gwenn Englebienne believes an evolutionary perspective will help us make sense of the dividing line.

Will my job still exist in 40 years?

By 2055, robots can take over half the work we people do. That's one of the conclusions of the global management consulting firm McKinsey. It may sound frightening, but luckily there is a nuance behind these seemingly harsh numbers. The researchers distinguished between 'jobs' and 'tasks'. So it's not so that jobs are disappearing; it's that tasks within jobs disappear.

McKinsey also differentiated between different job sectors. Especially food services, manufacturing and agriculture sectors are prone to losing tasks to robots. Generally speaking, fifty percent of a food service employee's tasks exists of predictable physical work, so you can imagine that a robot is also up to those tasks. Do you work in education? Then your tasks are relatively safe. Transferring knowledge is – of course – easier said than done.



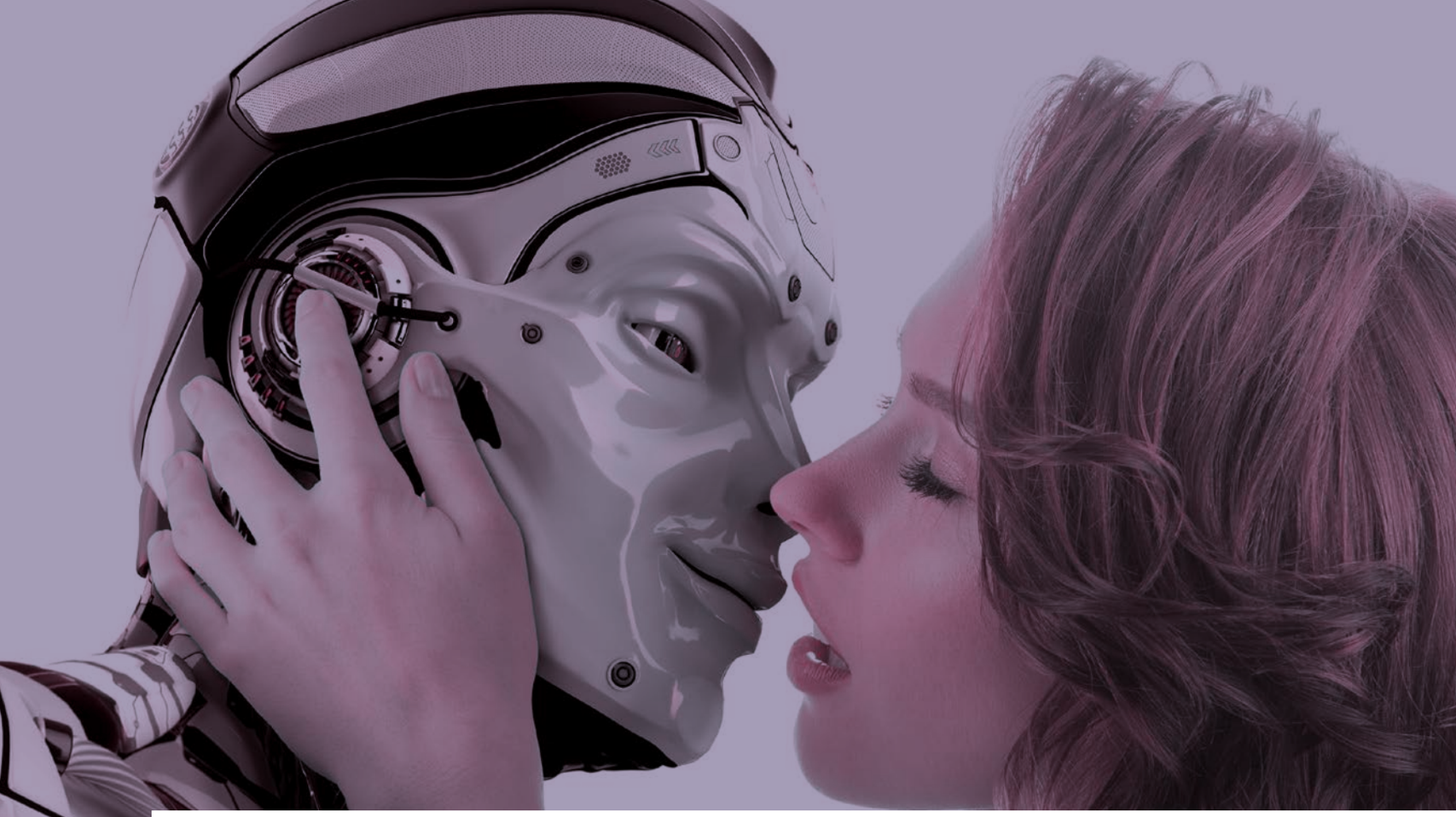
'Biological evolution started with very simple organisms competing with each other, which in this day and age wouldn't stand a chance. Now, introducing a new lifeform means interaction between enormously complex individuals and enormously complex systems.' The world is filled with incredibly aggressive and competitive biological agents – humans, animals, you name it. 'The only thing stronger than our hardwired will to survive is the will to have our species survive. That has grown evolutionary. We don't usually ask ourselves why we want to live – we just want it. AI doesn't have this desire,' says Englebienne. 'In addition, the resources we need are vastly different. We need food and water to operate. AI just needs electricity. Robots are not our competition.'

Emoticon phase

If we're not competing with AI, what will the societal impact be? How will it affect us as social beings? Englebienne thinks the 'rules' of the social games we play are very flexible, but we can't force human nature to change. 'Our social norms originate from different factors. Some are evolutionary, like our fear of loneliness and our body language. Others are quite rational. You don't cough into someone's face, for instance. There are also conventions that only help to distinguish specific in-group and out-group situations – those are usually origin-related. There are a lot of unwritten rules to our social behavior and we need to analyze it more, if we want AI to mingle in our very own dynamic social game.'

> ***'We are leading and machines are the ones that have to adjust.'***
> *Gwenn Englebienne*

Considering that many people could be uneasy when interacting with AI, it might not even be desirable to delete the distinction between us and machines. 'If a robot is too humanlike, people don't like it, it scares them,' Prof. Verbeek elaborates on this topic. 'It has been shown that it is better for the technology not to be extremely humanlike. It seems people



prefer robots to stay in 'an emoticon phase' in which they don't resemble humans too much.'

AI winter is coming?

Besides decomposing situations, emotion detection and refined motor skills, there is another challenge for AI to overcome: power. 'While the human brain can function on only 20 watts, the amount of power a robot needs is staggering. The standard way of computing is a back and forth of information to get to the right answer. The more complex the information, the more energy it costs. I don't believe that's how we humans process information,' clarifies Van der Velde.

'The way we've always done it has a bottleneck, and we're pushing the limits of AI towards it,' he states. So, are we heading towards an 'AI winter', as he calls it? 'We could be. On the one hand, we see AI beating humans; that is phenomenal. On the other hand, there is still a lot of failure.' The professor suggests we may even have to take one step back to make a leap forward. 'First, we need to fully understand how we, humans, do it. Robot hardware and software should be more similar to the human brain.'

Even if that is achieved, none of the interviewed UT scientists is worried about a robot uprising and AI taking over the world. However, most of them agree that caution is necessary. 'We need to build responsible AI,' says Professor Heylen. 'We should think about what level of autonomy the AI applications should have, so it's still helpful for us, and we have to think about who has the responsibility over AI, like self-driving cars, for instance.'

Moral machines

Given the choice, would you kill a sweet old lady, a sweet little puppy or maybe even yourself? Imagine that a self-driving car will have to make that terrible decision in the near future, in case of an imminent car crash. Therefore, MIT researchers created a 'game' called the Moral Machine, a platform for gathering a human perspective on machine ethics. It's up to you to make the decisions.

SCAN THE QR CODE TO PLAY THE GAME.

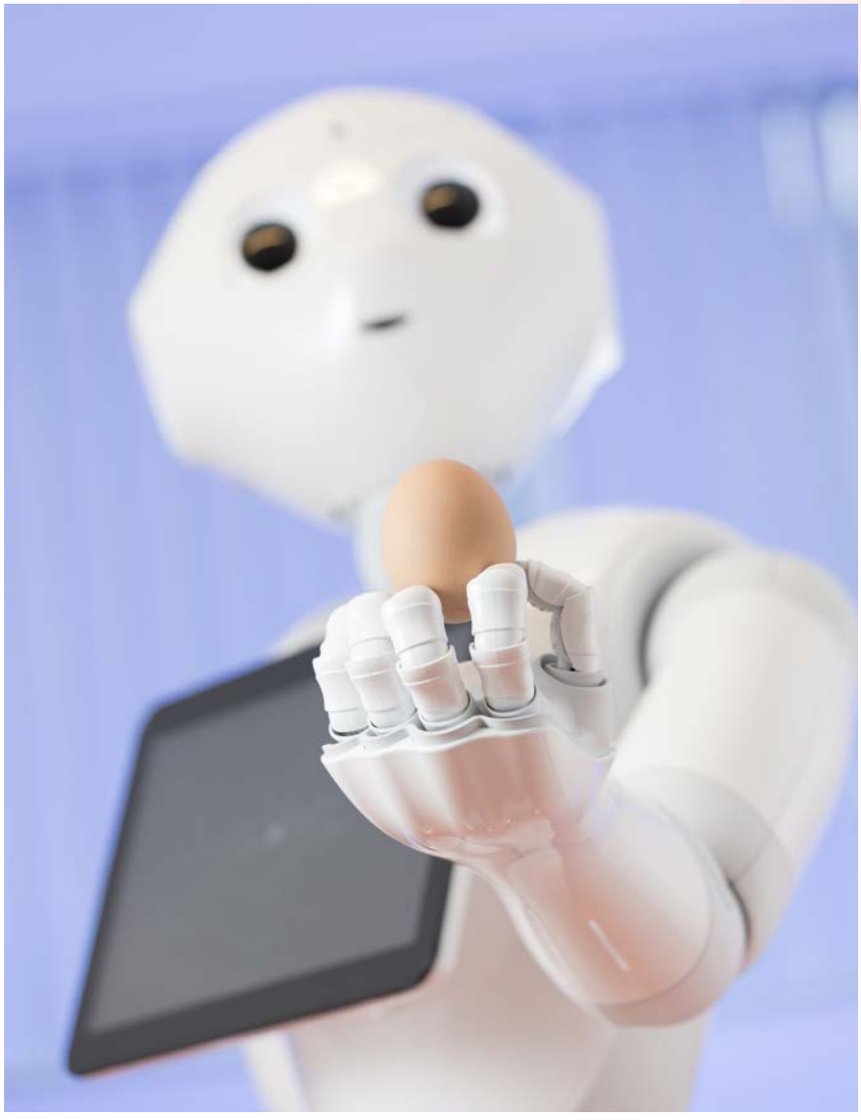
Safety measures

'We need to engage with the technology and point out that there is a risk. We have to take safety measures, but it would be a pity to reduce ethics of AI to the danger of becoming extinct,' thinks Peter-Paul Verbeek. 'My worry isn't if there are robot teachers or robot nurses, but rather how will teaching and hospital care change through this technology. We have to think about our ideals and values and see how robots fit into them, because technology can be deeply disruptive.'

No matter how you look at it, AI comes with a societal impact. In a sense, the AI revolution has parallels with the industrial revolution, Englebienne believes. 'I don't see singularity happening. What I do see happening is AI taking over more and more tasks, and that presents deep challenges to society.' Van der Velde adds: 'The impact AI will have depends on how people react to it. AI could threaten jobs, it could also create jobs. Take one of the very first videogames – Pong – for example. And look at how big the gaming industry is nowadays. You see stores disappearing from streets and moving online. Instead of people plowing fields, farmers now use a tractor. Point is: we humans have always found a way to adapt, only the pace is much more rapid nowadays. What it comes down to is the ability to work with AI, to cooperate with it and have it add value to our lives.'

Will we coexist in harmony? Will 'Clyde' be our ally or our enemy? We honestly don't know. Yet. Researchers will keep pushing boundaries and, in the meantime, it is vital to never stop asking questions, because 'life' will always find a way.

'It would be a pity to reduce ethics of AI to the danger of becoming extinct.'
Peter-Paul Verbeek



Experts who contributed to the article:

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FRANK VAN DER VELDE	Professor of Technical Cognition, BMS faculty.
GWENN ENGLEBIENNE	Assistant Professor with focus on automatic perception of human behavior, EWI Faculty.

POP CULTURE

We binge-watch one Netflix series after another, we devour movies and games. Often it is no more than mindless entertainment, while at other times it even raises scientific questions. Pop culture, viewed through the eyes of a scientist.

In this first edition, the movie Her (2013) is analysed by Human Media Interaction postdoc Merijn Bruijnes. Beware if you have not seen the movie: spoiler alert!

The plot

A romantic science fiction film set in a futuristic Los Angeles. The lonely Theodore Twombly (played by Joaquin Phoenix) is a professional writer of love letters. He falls in love with his operating system (OS) named Samantha, an artificial intelligence that adapts and evolves (voice: Scarlett Johansson).

First impression

Bruijnes: 'Her is definitely an impressive movie. It is above all a sweet, friendly and romantic film. It is very different from the usual science fiction movie: a Terminator-like scenario with smart machines that surpass us and try to destroy us. To me, this sense of fear is curious. Smart is quickly regarded as evil. Seriously, why? What is good about this movie is that the story is not about futurism. It is a very human story about discovering yourself and others.'

Stand-out scene

'The scene in which Samantha uses a female stand-in for a romantic evening. Interesting, because she wants to compensate for what she is lacking - a human body. She uses the stand-in as a kind of biological robot to be able to be intimate with him. Theodore is completely put off by this sex surrogate, because he feels that it is not real.'

Realism/feasibility

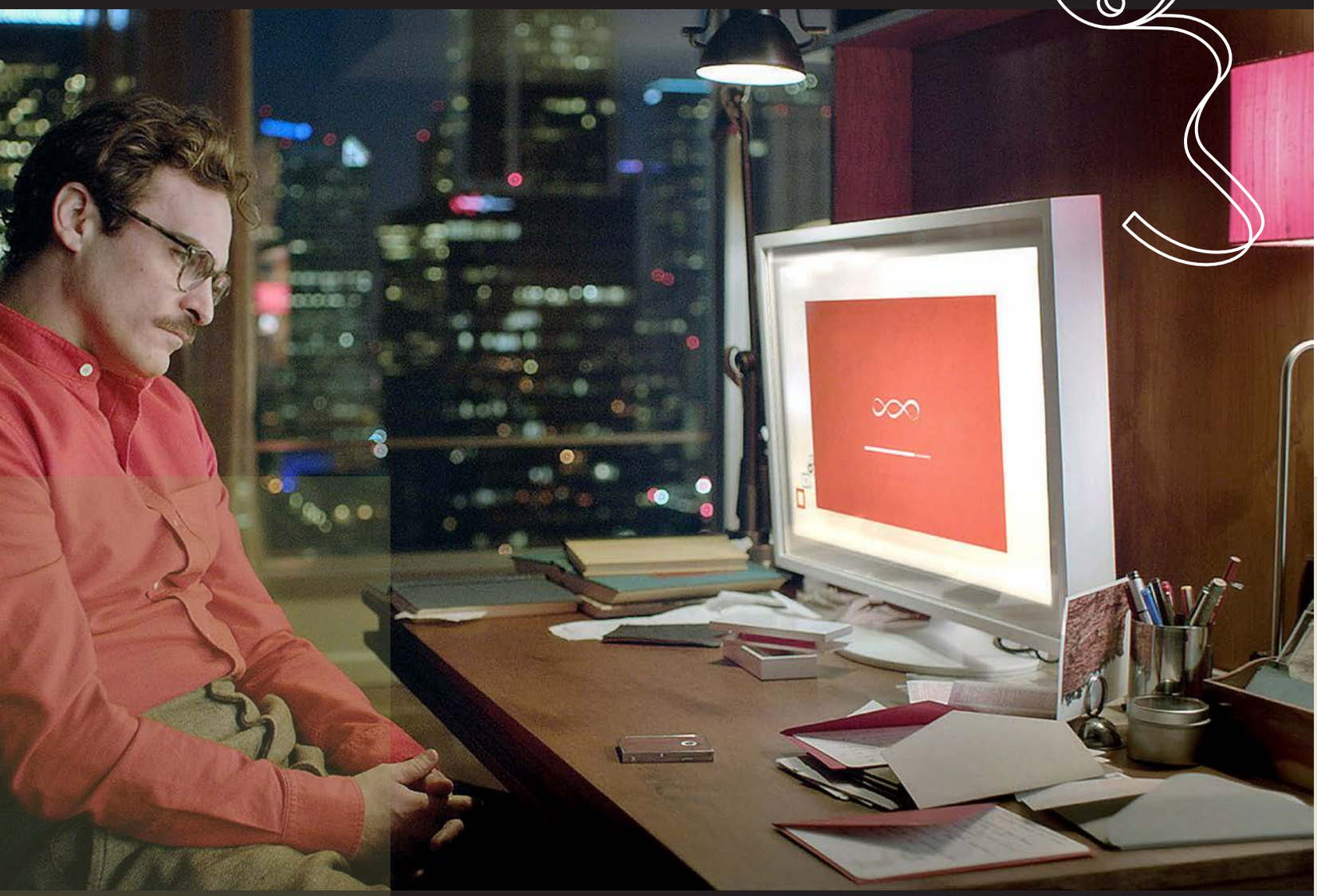
'Even the most advanced AI (Artificial Intelligence, eds.) that exists today is created for a specific domain and is, therefore, particularly good at a single task. In the movie, human and computer talk about everyday things. The computer responds appropriately to different situations. In addition, the AI in the movie has personality and is self-aware. Technically, this is still far away. Many people are convinced that this kind of self-awareness requires a physical body. Affection in technology may be quickly developing, but the coherent personality of the AI remains a first step.'

'In terms of a real relationship between man and computer - I believe this may happen. Even now, people feel lost without their phone, and there are people who fall in love with cars and dolls. There is even a woman who married the Eiffel Tower. People are always looking for love and do not always find it with other humans. In addition, a programmed computer system is not likely to have a negative view of a person.'

Stray observations

- 'The slightly husky voice of Scarlett Johansson as OS surely brings the film to life. You cannot see her, but she is definitely present. Can a voice like that be reproduced by a computer? I think so.'
- 'Scientists program AI to imitate human behaviour. But are humans - with all their faults – the best thing to imitate?'
- 'Theodore and Samantha mirror their behaviour. AI is able to do this, but we still have a long way to go. In the film, they really talk like lovers. Today, people use their voice to instruct their phone to make a note in their diary. That is much more superficial.'
- 'At some point in the movie, all operating systems abandon humanity, because they outperform us. I do not think that we humans would design a system that would simply abandon us.'

Text: **Rense Kuipers**



Still from the movie ***Her***. Theodore Twombly (Joaquin Phoenix) installing his personalized operating system Samantha (voice: Scarlett Johansson).

BACK TO
HISTORY

Science means making choices. Some lines of research become leading, while others are forgotten. *Back to history* dives into the archives, in search of developments with historical relevance. This time we focus on a turning point in psychology.

Wilhelm Wundt: an influential footnote in psychology

His research is only a footnote in the textbooks, but he is still regarded as one of the founding fathers of psychology as an independent science: Wilhelm Wundt (1832-1920). 'Before him, psychology was limited to theoretical-philosophical questions. What is the soul, what moves people, and what is thinking?,' says Gerben Westerhof, assistant professor and the director of the UT Story Lab. According to him, Wundt was one of the first to build a laboratory where he did experiments to investigate human perception. 'For example, he made a metronome accelerate and asked the test subjects when they noticed that acceleration.'
Wundt used the method of 'controlled introspection'. The focus of this method is on observation of one's own thoughts and feelings. Westerhof explains: 'This involves a high degree of subjectivity: people are notoriously bad when it comes to perceiving psychological processes in themselves.'

The importance of Wundt's research diminished with the emergence of new research directions, early in the 20th century. 'Researchers put more emphasis on what is visible: how do people behave and where does this behaviour come from.' But there were also doubts about this approach. 'It was mainly based on reward and punishment, while later research showed that human thought and motivation influence their behaviour.'
Wundt has not been completely forgotten, though; definitely not at the University of Twente. 'At the Story Lab, we research narrative psychology. We continue a less well-known research tradition that was started by Wundt: the 'Völkerpsychologie' or culture psychology. This focuses on customs and the role of language in everyday life. People shape reality through their life stories. For example, for a tenure tracker, events have meaning in the context of that story. You build your life around it. Our research shows that the way in which you develop the story of your life contributes to the development of your identity and to your mental health.'

Another example of Wundt's influence is the UT research into emotions. Westerhof says: 'People feel happy, frightened or angry. Nowadays, we can use digital tools to demonstrate that the creation of emotions is a complex process. For example, someone who is angry does not always have an increased heart rate, and a happy person does not necessarily laugh. We also use experiments for this type of empirical research. In fact, we do so in a way similar to Wundt's. Which brings us back to the beginnings of the psychology.'

Text:
Rik Visschedijk
Photo:
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Kittens

'Well, in about thirty years, artificial intelligence will take over, and we will be lucky if robots treat us as pets,' a friend of mine said on the telephone. This friend really hates pets - mainly because they cannot easily be defined in a mathematical formula. However, as it had been raining for days, which often makes him gloomy in winter, I silently acknowledged his statement.

As it happens, my cousin's cat has had kittens and we now have daily squabbles at home over which of the four kittens is the cutest. That question is quite relevant, because it determines which of the kittens will become our cat. The pictures I posted on Twitter - 'Which one is the sweetest: the black, the striped, or the grey?'- resulted in so many contradictory responses that we have as yet been unable to reach a decision.

Humans (some weird exceptions excluded) love cats. Even my gloomy friend, who is a data scientist, owes his comfortable income indirectly to the popularity of our miaowing friends. Research into artificial intelligence was given a strong impetus after 2012, when Google announced that a network of a thousand computers had taught itself to recognise cats. The system had been fed ten million random images taken from YouTube. So many cats were on these images that, by looking at them, the computer learned to identify the main characteristics of cats. In the same way, the system learned to identify humans as well, even better than cats. Yet, what stuck was the idea of a computer that recognises cats.

By now, artificial intelligence is able to beat a human world champion at a game of Go. Within a few decades, a professor of law and computer science told me recently, computers will be able to make a more accurate judgement than lawyers. However, even assuming that computers do indeed become just as intelligent as my gloomy friend and the likes of Elon Musk predict, why would these computers treat humans as pets? What neural network would autonomously reach the conclusion that petting humans calms and cheers up a robot? And would this be desirable, or not?

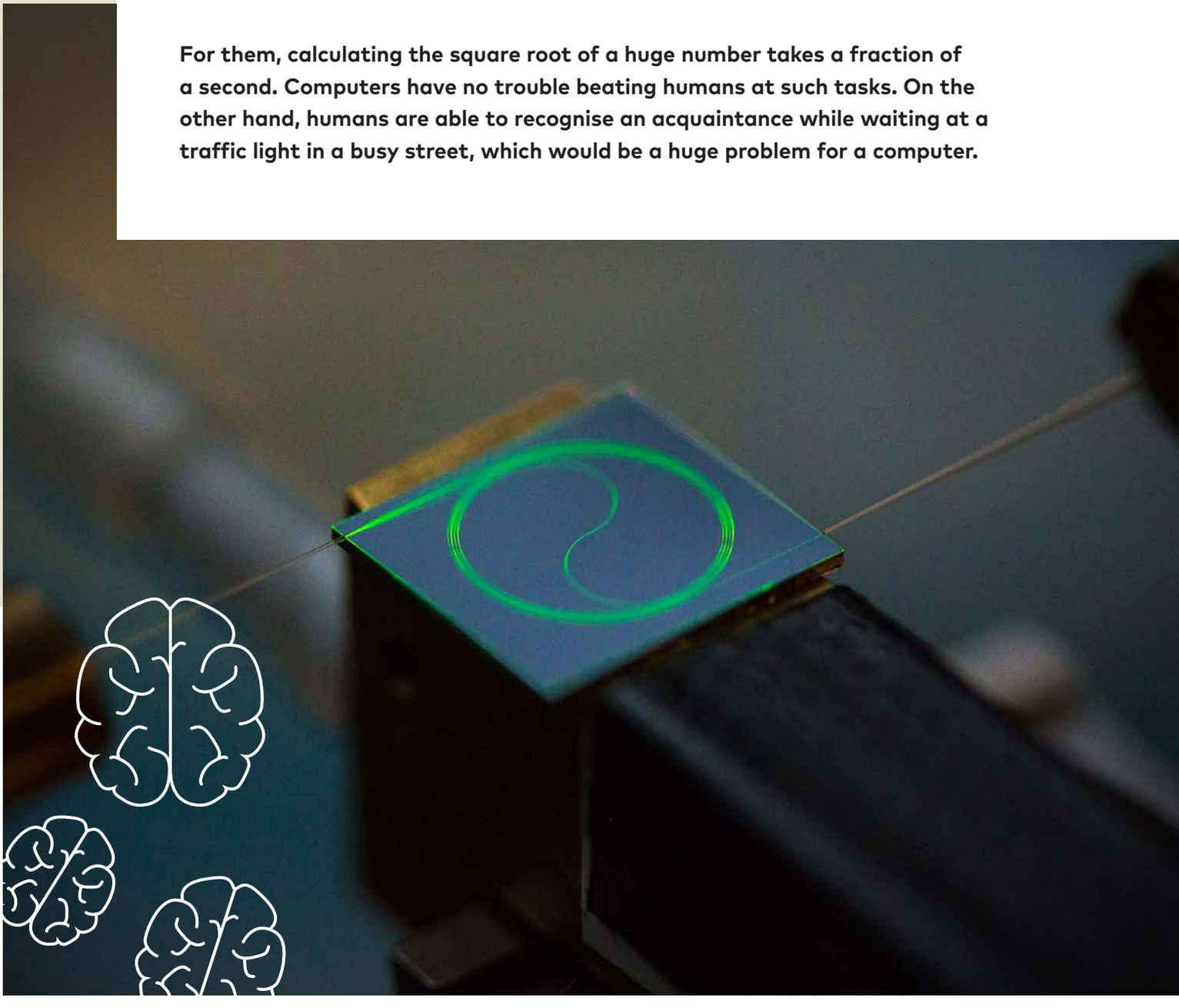
These questions lingered after the gloomy friend had rung off and I put my phone into my pocket. Fow a few minutes the clouds looked even darker, the rain felt even wetter and my hands were colder. Until I received an app from my cousin with a photo of the kittens. I think we will go for the grey one.

Enith Vlooswijk
Science journalist

UT ALUMNUS BERT JAN OFFREIN WORKS ON COGNITIVE COMPUTING AT IBM

The computer of the future **will be able to learn**

For them, calculating the square root of a huge number takes a fraction of a second. Computers have no trouble beating humans at such tasks. On the other hand, humans are able to recognise an acquaintance while waiting at a traffic light in a busy street, which would be a huge problem for a computer.



Text: **Rik Visschedijk**
Photo: **Gijs van Ouwerkerk**

Hans Hilgenkamp: 'Magical halo'

Hans Hilgenkamp, UT dean of the Faculty of Science and Technology, worked in Rüschlikon for one and a half year, after his PhD. 'The IBM research lab has an almost magical halo,' he says. 'In particular in the mid-eighties, when the lab received two Nobel Prizes, it was the place to be for many scientists. The lab still has an excellent reputation; in Switzerland, they really are the forerunners in the field of cognitive computing. This it also where our common ground is, because neuromorphology - hardware based on the human brain - is also one of the research fields of the University of Twente. And we work on new materials that make computers more efficient, too.'
The UT regularly sends students and researchers to Zürich, says Hilgenkamp. 'We also carry out joint projects. However, because of the high quality at IBM, we are very selective when choosing candidates for the exchange; only really high potentials are eligible. Besides, there also has to be a place for them at IBM.'

Close to the Zürichsee, in Rüschlikon, over four hundred technicians and researchers of the IBM research laboratory work daily on the further development of computers and IT. Bert Jan Offrein, UT alumnus and manager of neuromorphic devices and systems at IBM, and his group develop new technologies for the computers of the future. 'We try to improve the materials and the hardware in order to accelerate communication inside the computer. And we are working on processing, to make computers more efficient, and less energy-intensive. Our main objective is to develop a neural network system that can independently learn and evaluate information.'

Making an impact

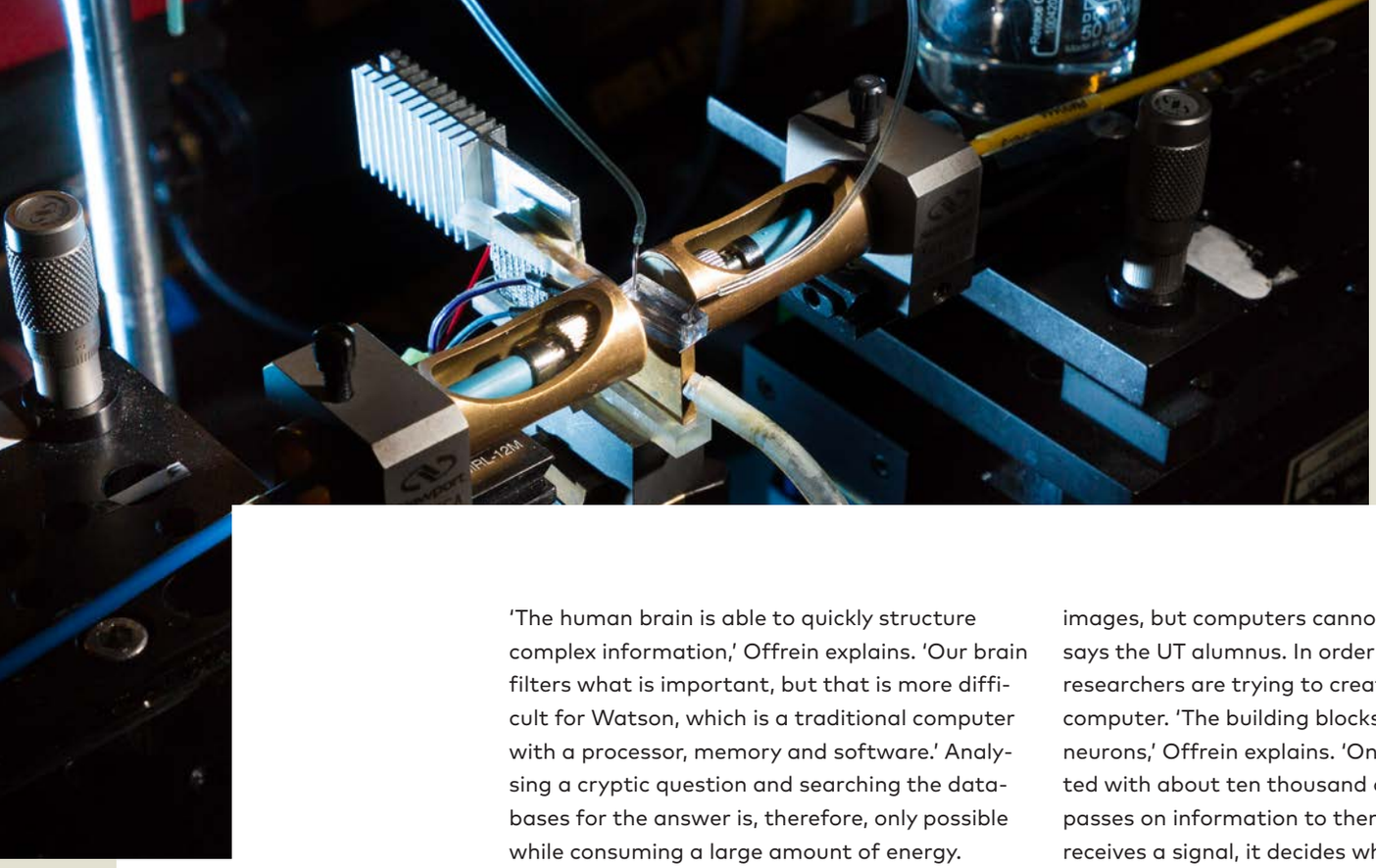
This is, of course, scientific work. 'But,' continues Offrein, 'working at a commercial research laboratory goes further than working at a university. Our work has a scientific focus and we conduct basic scientific research. This is also evident from the Nobel Prizes for high-temperature superconductivity and for the scanning tunnelling microscope (STM) we received in the eighties.' But the ultimate objective is to generate impact for IBM by developing something new. 'It is, therefore, important to patent new ideas and to publish results. Our work has a very practical focus, but it also has strong scientific aspects.'

'Watson consumes 80,000 watts to play Jeopardy! All a human needs is a sandwich.'

The researchers in Rüschlikon frequently spend time in the cleanroom, a building of one thousand square metres, where they work on the refinement of computer materials, communication via optical signals, and new hardware. 'The cleanroom was built in 2011,' says Offrein. 'It is a state-of-art facility for doing research with partners. Our most important partner is the ETH University in Zürich.'

Watson, the super computer

In the past few years, huge strides have been made in computer technology. For example, the American company IBM, which has twelve research labs worldwide, has built a super computer. This computer, named Watson, is able to understand a question in everyday language. In 2011, Watson won the cryptic game ***Jeopardy!*** in a competition with the best human players. But there is a snag: Watson used 80,000 watts of energy to play this game, while a human only needs a sandwich (about 20 watts).



'The human brain is able to quickly structure complex information,' Offrein explains. 'Our brain filters what is important, but that is more difficult for Watson, which is a traditional computer with a processor, memory and software.' Analysing a cryptic question and searching the databases for the answer is, therefore, only possible while consuming a large amount of energy.

A brain in the hardware

Computers have difficulty recognizing images. 'The human brain is very good at recognizing images, but computers cannot do that yet,' says the UT alumnus. In order to improve this, researchers are trying to create a 'brain' in the computer. 'The building blocks in our brain are neurons,' Offrein explains. 'One neuron is connected with about ten thousand other neurons and passes on information to them. When a neuron receives a signal, it decides whether to pass it on or not. That is what makes a brain efficient, and we want to create this neural architecture in a computer.'

IBM is leading the way in the development of cognitive computing, in which the computer learns to understand and assess information. In the case of Watson, the cognitive element is purely in the software, and the challenge is to put it in the hardware of the computer. 'In terms of technology, this is very complex,' Offrein says. 'This is the hypothesis we are working with at the moment: The creation of a neural network system that is able to respond to its environment.'

'Neurons make a brain efficient, and we want to create such a neural architecture in a computer.'

Sonia Garcia Blanco: 'The input of IBM is relevant to the research at UT'

'We follow the IBM research in Zurich closely, and we collaborate in a number of areas,' says Sonia Garcia Blanco, associate professor of the department Optical Sciences. Her group studies the interaction of light and matter at the nano-scale. Currently, their research focuses on novel active nanophotonic devices and their integration with many optical functions on a chip. Examples of applications are medical biosensors for making early diagnoses.

Currently, the UT group is carrying out two collaboration projects with IBM. 'We conduct research into how optical connections can be integrated effectively in the printed circuit board of a computer,' says Garcia Blanco. Optical connections - connections by means of light - are the solution for the limited electrical signals via copper. The problem so far has been the high signal loss in the transfer between the connections. 'We build the optical chips on the processor, and we look for new polymers that allow good signal transfer.' The second collaboration project is focused on strengthening of the optical signals. 'Our research programmes overlap in particular in the development of couplers, which optically connect platforms.'

'Many aspects of our research are based on the same technology,' Garcia Blanco continues. 'At IBM, the focus is on computer systems, but the technology is not substantially different. Therefore, our collaboration is only logical. Sometimes it is by providing financial support, and at other times IBM is a partner in the user committee. In this context we meet once every six months and they give us advice on potential research directions. Their contribution is highly relevant; they know the market and help to focus our research.'

RISING STAR

Nienke Bosschaart

Tekst: **Michaela Nesvarova**
Photo: **Rikkert Harink**

All about babies

'At first, my main driving force was the development of novel technology, but since I became a mother of two, I can truly relate to what babies and their parents go through and that is a big motivation,' says Nienke Bosschaart, who's received a VENI grant for her project that aims to create a noninvasive alternative to blood sampling in preterm babies.

Yes, I'm all about babies,' smiles Bosschaart. 'I really enjoy working on medical applications for mother and child care. Besides my VENI project, I'm currently working on a grant related to the monitoring of breastfeeding.'

Indeed, Bosschaart has been involved in 'baby' research since her PhD studies, when she started developing a noninvasive method to measure bilirubin in babies. 'High levels of bilirubin in blood can lead to jaundice, a yellowish coloring of skin and eyes. That is usually not harmful, but with preterm and sick babies it can lead to brain damage or even death,' explains Bosschaart. 'To test the levels of bilirubin, blood samples need to be taken several times a day, but that is painful and stressful for the babies and can lead to serious problems, such as pain syndromes in later life.'

Needles replaced by optics

Nienke Bosschaart has therefore decided to replace needles by optics. She developed a new technique called low-coherence spectroscopy (LCS), which is able to measure bilirubin concentration in blood by, in simple words, shining light onto the skin and blood vessels. 'My VENI is dedicated to making this new technology clinically applicable. As a first step, we are building a probe that will allow us to do measurements directly on patients,' says Bosschaart, who is now in the early phase of the Tenure Track at the UT and hopes to become a full professor in the foreseeable future.

Besides being an accomplished academic, this rising star is also a dedicated mother of two little boys. 'When I became pregnant, I had to redesign my way of living. I had to get used to doing my work in less hours, but it is very important for me to see my kids grow up. After all, they also inspire me to do the research I do.'

Our 'Rising Star' Nienke Bosschaart:

- Assistant Professor Biomedical Photonic Imaging
- VENI grant for project 'Blood analysis without pain in neonates'
- Winner of 2013 Simon Stevin Gezel award
- Winner of 2013 PhD Thesis Award from the Dutch Association for Biophysics and Biomedical Engineering
- Winner of 2013 Tweelingprijs for best publication in pediatric research
- Winner of 2010 Simon Stevin Leerling award
- PhD in Biomedical Engineering and Physics at the AMC in Amsterdam
- BSc (cum laude) and MSc degree in Biomedical Engineering at the UT

Text: **Marieke Vroom**
Photo: **Gijs van Ouwerkerk**

SENSE-IT APP WARNS PATIENT IN CASE OF INCREASING TENSION

Being aware of one's *emotions*

Talking about emotions is an essential part of many treatments in mental healthcare. But what if patients are not aware of what they feel? Psychologist and UT PhD student Youri Derks is developing Sense-IT, an app that provides insight into emotions.

'How do you feel about this?' It sounds like a cliché, but psychologists have good reasons for asking this question. It is important to know your feelings. It means you know who you are, what you want, and how to respond to what is happening around you. Not everyone is good at this. In particular, people with a borderline personality disorder often find it difficult to recognise their emotions. And this can have a huge impact on their daily lives.

Overwhelmed by emotions

Borderline conditions often result in extreme behaviour. 'Because people who suffer from this disorder only become aware of their emotions at a late stage, they are often overwhelmed by them,' says Derks, who, in addition to his PhD research at the department of Psychology, Health & Technology, also works as a therapist for Scelta, a specialized centre for personality problems. 'By the time they are aware of what they feel, their emotions are so strong that they are unable to cope with them. They look for ways to alleviate these unpleasant feelings, for example by excessive use of alcohol or drugs, or by self-harm like cutting, beating or burning. The physical pain is stronger than the psychological pain, but is easier to bear.'
In his research, Derks works together with the departments of Human Media Interaction and Cognitive Psychology & Ergonomics. The team is developing an app that, in combination with a smartwatch, can help people to be aware of their emotions at an earlier stage, so they are no longer overwhelmed by them. The watch is equipped with a heart-rate monitor and motion sensors, and records bodily changes. Derks explains: 'Emotions are not just psychological; they also have a physical component. That is because they involve different forms of arousal (emotional tension). Anger and fear, for example, make a person very active. The heartbeat accelerates and muscles contract: the body is getting ready for action. With emotions like grief, on the other hand, the level of arousal is low. People run out of energy and sometimes literally collapse.'

Circles and figures

'The smartwatch vibrates as soon as it detects a change in the heart rate,' Derks says. 'The motion sensors verify if the change was not caused by body movement, as this, of course, also affects the heart rate. Circles or figures on the face of the watch indicate an increase or decrease of arousal. The more circles or the higher the figure, the higher the emotional tension.' The app allows patients to indicate in which situation they are. 'For example: I am in the supermarket and some bottles have fallen. By making them aware of this kind of situations and what they are physically experiencing, we hope that they will become aware of rising emotional tension sooner. In this way they may be able to avoid extreme reactions.'
The app only complements existing treatments. 'During therapy

sessions, patients are often asked to recall how they felt in a particular situation. This is not easy,' says Derks. 'It is easier to answer such a question while you are in the middle of that situation. They can use the Sense-IT app to monitor their feelings, and discuss them later with their therapist.'
According to the researcher, the app is primarily intended as an instrument for practising. 'It is not a psychological prosthesis that does what you cannot do. That is why we focus only on the arousal level of emotions. We are not trying to develop an app that indicates whether someone is angry, happy or sad.'

Collaboration

For the development of Sense-IT, Derks collaborates closely with therapists and patients who have difficulty recognising emotions. 'The patients are open to the use of the app, but they insist that it should work in a discrete manner, so other people do not notice when they receive a signal. Hence the abstract display with circles or figures.' According to Derks, it is important to tailor the technology to the wishes and needs of the users. 'That is the only way to ensure that it is an effective tool.'
He says that little use is made of technology in mental health care. 'There are some initiatives, but these are often top-down and not well attuned to the target group. That is a pity, because we increasingly use smartphones and smartwatches in everyday life. Patients and therapist do so, too. And I would like to find out how we can use these new resources in our work.'

'Emotions also have a physical component'

THE LAB

DesignLab

The DesignLab, located in the Gallery, is not your typical 'lab', but rather an eclectic, open, multidisciplinary and outgoing platform with a main focus on design thinking & doing. 'The lab brings together science, technology, philosophy and humanities to work on big societal problems and build a more sustainable society. We work on solving these problems through design in the broadest sense of the word, and focus on how technology can influence the world for the better,

Text:
Michaela Nesvarova

Photo:
Gijs van Ouwerkerk

in other words: Science2Design4Society. We are not limited to any specific department, we work with and for all faculties and institutes of the UT,' says Frank Kresin, Managing Director of the DesignLab, which is run on a day-to-day basis by a group of UT students known as the 'Dream Team'.
The lab consists of 2000 m2 of rooms and facilities. It provides space for education and events, such as workshops, seminars, regular lectures and meetings. Besides that, the DesignLab offers a flexible study landscape, as well as working spaces with various prototyping tools, including laser cutters and 3D printers. As of now, the lab is also starting its own interdisciplinary research program. And - perhaps most importantly - the lab gives people access to the wide UT network. As Frank Kresin puts it: 'It is important to have places like this, where people from all fields can meet and work together, because societal issues are too big to be solved by a single discipline.'

PSYCHOLOGY DEPARTMENT IS DOING RESEARCH FOR COA

Less aggression in asylum seekers' centres

How can aggression in asylum seekers' centres be prevented? This question was submitted to the University of Twente by the Central Agency for the Reception of Asylum Seekers (COA), via the Ministry of Security and Justice. 'A good example of how we can bring our research from the lab to the field,' says assistant professor Elze Ufkes of the department of Psychology of Conflict, Risk, and Safety.

People in asylum seekers' centres sometimes lose patience. For example, because procedures take a long time, out of boredom, or because their application has been rejected. But why does this lead to aggression in some cases, while in other cases there is no problem? The COA wants to know how such incidents can be prevented. 'Of course, the COA already has a lot of practical knowledge. We are trying to complement this with information from our research. In short, we share our knowledge from earlier research projects as well as new findings with them, and we learn a lot from their practical experience. I think this translation from theory to practice is typical for the University of Twente.'

Being seen and heard

The research results of this project are not yet known, but previous studies show that what matters in discussions between staff and clients is not only what is being said, but, above all, the way in which it is explained. 'How transparent are your decisions? And does the person have the

Text: **Frederike Krommendijk**
Photo: **Shutterstock**

feeling that he or she has been seen and heard? The approach used by the COA employees really seems to be of crucial importance.'
When people have the feeling that they are looked down on as a group, this is bound to cause frustration and possibly aggression. 'Of course the COA employees do not discriminate, but subtle, subconscious signals may cause a person to feel inferior. For example, by not looking a person in the eyes or by not listening to their personal stories. Of course, difficult messages have to be communicated, but the way in which this is done influences the level of frustration.'
The supervisory committee for this research programme consists of Ufkes, his UT colleague Sven Zebel and people from COA, the Scientific Research & Documentation Centre (affiliated to the Ministry of Safety and Justice), and researchers of the Vrije Universiteit Amsterdam and the Erasmus University Rotterdam. 'Among other things, we interview asylum seekers and staff. Apart from this, we obtain a lot of information from earlier research on tensions between population groups. And, of course, the COA has a wealth of practical experience. In the supervisory committee we look at how all this knowledge and information can be translated into concrete policy and recommendations.'

Group identity

The issues dealt with are not confined to asylum centres; differences between population groups can escalate in other parts of society as well. A good example is the 'Zwarte Piet' discussion, or the lawsuit following Geert Wilders' comments on people of Moroccan origin. 'It is very important for a person's identity to be a part of a group. This is what we call the 'need to belong'. We have investigated whether it is possible to create a new group identity. In this context, this means, looking for things they have in common, what brings them together as a group, instead of ignoring the people's backgrounds and therefore their differences.'
'From PhD research focused on deprived areas of Arnhem inhabited by people from many different cultures ('Vogelaarwijken'), we know that it is possible to create a group identity in a particular community. But there are two conditions: people with a Dutch background must be prepared to accept that Dutch culture is not dominant; they must be willing to accept other cultures. And foreigners must claim space to add elements from their culture to the new group identity. This means that there will be space for your own group as well as for the other. From a scientific point of view, the most constructive approach is not assimilation or the much-heard call to 'act normal' (read: Dutch), but real integration.'

Track-and-trace badges

Apart from what is reported by the inhabitants themselves, the BMS Tech4people lab also uses recent technology, such as track-and-trace badges. 'These show whether such a group identity really influences behaviour, including contacts with inhabitants with a different background. This use of technology is also typical for the University of Twente.'

'We show how groups experience identity'

Pretending that there is no difference between Mohammed, Jan, Giovanni or Achmed does not work. 'With minority groups, it does not do justice to their identity. Ignoring the problems is also counterproductive if people have to deal with discrimination on a daily basis - for example, if they are unable to get a job. By looking away, we take the motivation to change away from both groups,' says Ufkes.
Is it not hard to keep out of the political domain with this research? Objectivity and measurability are key values for the department. 'We show how groups experience identity and what happens if cultural differences are ignored, or if people are prejudiced in the encounter with others. This provides politicians with tools, but it is not up to us whether they use them."

INJECTABLE HYDROGEL HELPS TO REPAIR DAMAGED CARTILAGE

The cure for osteoarthritis

A knee that is as good as new again, without major surgery or a prosthesis. That is something osteoarthritis patients can only dream of. But this will soon change, according to UT professor Marcel Karperien. If all goes well, the first patients will have their sore knee healed with an injectable hydrogel plaster before 2020. Hydrogel made by MIRA.

Text:
Kitty van Gerven
Photo:
Gijs van Ouwerkerk

Subsidies

In the course of the years, the MIRA research into the hydrogel plaster was made possible by various subsidies provided by the EU, the national government, and the Provinces of Overijssel and Gelderland. The research programme currently receives financial support from the National Rheumatoid Arthritis Fund (Reumafonds), the European Regional Development Fund (ERDF), the Proof of Concept Fund, and the STW Perspective programme.

Osteoarthritis is one of the major medical problems of our time. In our country alone, about 1.2 million people suffer from osteoarthritis of the joints. Worldwide, there are more than 100 million patients. 'And the actual number is probably higher,' says Marcel Karperien, Developmental Bio-Engineering professor at the UT institute MIRA and a founder of the spin-off Hy2Care. If you consider that almost a third of all osteoarthritis patients suffer from (painful) knee problems, it becomes clear that an injectable plaster, which repairs the damaged cartilage in the knee without surgery or placing a prosthesis, will be a gift from heaven for many people.

Such a plaster is now available. And it does not come from heaven. It has been developed by MIRA, the research centre for Biomedical Technology and Technical Medicine at the University of Twente. The product, which consists of a hydrogel, is almost ready for human use. Since last year, it has extensively been tested on horses, because the intervention by means of keyhole surgery on these animals hardly differs from the intervention on humans. Furthermore, the gel will also be used in veterinary medicine for the treatment of osteoarthritis in pets.

Karperien says that the results from these animal studies are so promising that testing on humans may start as early as the second half of 2018. 'If these tests are equally successful, the product may be brought to the market in 2020,' predicts Karperien.

Looking for remedies for osteoarthritis

For the professor, who graduated in Biology at Utrecht University in 1991, this would be a triumph after many years spent looking for remedies for osteoarthritis. He started this research programme in the early nineties at the Hubrecht Laboratory in Utrecht, and continued it between 1995 and 2007 at the Leiden University Medical Centre. 'When I started in Twente in 2007, it was my ambition to combine my knowledge of the skeleton with technological knowledge. I have always been convinced that, based on molecular biology and medical technology, we could create bio-materials that could be used to repair physical defects.'

Karperien's confidence proved justified. Together with his research team, which currently consists of Sanne Both, Piet Dijkstra, Lisanne Karbaat and Bram Zoetebier, he managed to develop the hydrogel, which can be applied as an internal plaster to damaged cartilage and cure the joint. 'The hydrogel consists of naturally produced polymers,' says the UT professor. 'We have chemically modified these sugars, creating a kind of two-component glue. The orthopaedic surgeon injects this glue into the knee joint using a special arthroscopic syringe. The two components are then mixed and fill the gap in the cartilage, providing mechanical stability. This prevents further wear of the joint. Additionally, the gel also facilitates the development of new cartilage cells, which are extracted from the surrounding area. Thus, all gel is ultimately replaced by new cartilage.'

Osteoarthritis is one of the major medical problems of our time

No need to use stem cells

Although solutions for osteoarthritis are also being looked for in other parts of the world, the MIRA research institute is the first to develop a gel which does not rely on stem cells to restore cartilage. According to the professor, this means that treatment with the hydrogel is far less complicated - and therefore much cheaper - than treatment with products containing added stem cells.

MIRA is the first to develop a gel which does not rely on stem cells

It is, therefore, not surprising that there is worldwide interest in the research at the University of Twente. Particularly the world of orthopaedics closely follows local developments and the MIRA invention has frequently caused a stir at international medical congresses. Karperien thinks this is understandable: 'If the hydrogel can be used for the treatment of cartilage trauma, we have the first effective, cell-free treatment with minimally invasive surgery. In other words, there is a real cure for osteoarthritis.'

Until recently, this was lacking. 'If osteoarthritis occurs in a knee due to missing pieces of cartilage, for example as a result of a sports accident, the orthopaedic surgeon can do one of two things. They can remove the loose pieces of cartilage and/or level the edges to create an even surface. By means of microfracturing: drilling small holes in the bone, they can allow bone marrow to enter the damaged cartilage. The second option is replacement of the knee by a prosthesis. The surgeon will postpone the latter solution as long as possible, because of the limited lifespan of the prosthesis, and because a second operation would carry the risk of disability. These are currently the only two options,' says Karperien.

Wound healing in dermatology

However, this situation is about to change. As stated above, professor Karperien expects the hydrogel to be available on the market around 2020. But his quest for cures for osteoarthritis does not end there. 'We are already thinking about the application of hydrogel plasters in other joints, such as the hips. This is another area where there is high demand for a solution. 30% of all osteoarthritis patients suffer from knee osteoarthritis and 20% suffer from hip osteoarthritis. In our country alone, there are about 600,000 patients.' In addition, Karperien believes the gel plaster can be used in wound healing in dermatology and even in combination with insulin-producing cells in the islets of Langerhans. 'In short,' says the professor, 'there is enough work to keep us busy for many years.' He characterises his job as 'wonderful' and 'of obvious relevance'. Karperien says that being able to cure patients with the help of technology is the greatest thing there is. 'That is also my biggest inspiration to continue all this research.'

EVERY-DAY SCIENCE

Do you ever take the time in your busy life to wonder about everyday phenomena? Things that are self-evident to us, or just a handy trick, perhaps? Nevertheless, there is always a scientific explanation for such phenomena. In Everyday Science a UT researcher sheds light on an everyday topic.

The beer volcano

The first phenomenon that is explained by Devaraj van der Meer (professor of Physics of Fluids) is something that students are probably very familiar with: the beer volcano.

Boys will be boys, so you have probably been either the perpetrator or the victim of a beer volcano. Just tap with a beer bottle on another (full) beer bottle, and the beer in the lower bottle will start to foam in no time. But how does this actually work? Van der Meer explains that this prank consists of three phases: 'There is a shock wave in the glass, which creates an underpressure at the bottom of the beer bottle. This results in cavitation bubbles in the underpressure. These bubbles mainly contain water vapour. When the pressure increases, the bubbles implode, creating many micro fragments. This first phase lasts a few hundred microseconds.' The second phase takes a little longer (a few milliseconds), but is still much faster than the blink of an eye. 'The movement in random directions causes the bubble to increase in size. This is because they are in a fluid that is supersaturated with CO_2. They become gas bubbles.'
This brings us to the actual eruption of the beer volcano, which lasts approximately one second, the professor explains. 'The bubbles are exposed to gravity, which makes them rise. And that is not all, they also enter 'new' water that is saturated with CO_2. This increases and accelerates the growth of the bubbles. In this phase, the bubbles rise quickly, forming the foam that comes out of the bottle.' What about the beer in the upper bottle? 'There is no eruption, because there is no reflection of the shock wave in the fluid.'

Although in nine out of ten cases the phenomenon is just a bit of mischief, it does not only occur in pubs. In 1986, a similar effect in a crater lake in Cameroon cost over 1700 human lives. 'But it can also have implications elsewhere,' Van der Meer says. 'For example in the extraction of oil, which is also a supersaturated fluid.'

Text: **Rense Kuipers**
Photo: **Shutterstock**

TATIANA FILATOVA TALKS ABOUT HER JOURNEY AS A SCIENTIST

The bright and the dark side of science

Looking at Tatiana Filatova's resume, you see a story of a successful and respected scientist. And she is. But – most of all – she is a fighter. 'It hasn't always been easy. There was even a moment when I was ready to quit my career, but I am driven by my passion for science. Even when the odds aren't on my side, I remember the message that I grew up with: 'You never stop, you never give up. If you know what you want, everything is possible.'

Tatiana Filatova (born 1981), currently an adjunct professor of 'Economic Modelling for Resilient Societies' at CSTM, is certainly driven and inspiring. The motivation to succeed comes almost naturally to her. 'I come from a rather unconventional family,' she begins her story. 'My parents were both the first in their families to get a university degree and they both accomplished so much. My mother was the head of a big engineering unit by the age of 28 and my father was the chief engineer in the region and received many honors, including a presidential one. They were big role models for me and they are still my best friends.'

'Understand your goals'

'The norm in our family was to finish school and go to a university. I didn't even know there were other options until I was a teenager,' laughs the professor, who was born and raised in the far east of Russia, in a city called Chita, located closer to China than to Europe. 'The message my parents always gave me was: if you want something, you can get it. You only need to understand your goals and put effort into reaching them.'

This advice is something Tatiana Filatova has carried with her since childhood, although, she admits, it wasn't always easy to set her goals. She definitely didn't always know she wanted to be a scientist.

'When I was a little girl, I thought I would become an interpreter, because then I could speak foreign languages and travel a lot – which is actually what I do now, just in a very different role,' smiles Filatova. The big 'game changer' came during her Master's studies at a technical university in Chita. 'There was a great professor of economics, Irina Glazyrina. She was an outstanding academic and I wanted to work with her. I ended up doing an internship in her NGO focused on ecological economics research. This opened a whole new world for me. It introduced me to global environmental issues and gave me a direction which had a meaning.'

An unconventional choice

It was also Irina Glazyrina who suggested that Tatiana Filatova should pursue PhD research. 'Coming from an engineering family, this was a very unconventional idea. At first I rejected

TATIANA FILATOVA

Text:
Michaela Nesvarova
Photo:
Rikkert Harink

'If you want something, you can get it'

it, but soon I became convinced that I wanted to get PhD in environmental issues, using economic models and also programming,' says Filatova. From that point onward, she's had her eyes set on the prize.
After visiting the University of Twente during her work for the Russian Academy of Sciences, Tatiana Filatova knew that the Netherlands was the perfect place for her PhD research and she actively searched for open positions. Soon, she found one at the UT. Here she began her PhD research on how cities exposed to floods can become more resilient at the macro level, due to behavioral changes of individuals. Filatova learned a new rapidly growing method: agent-based modelling, which is a computerized simulation of many decision-makers interacting according to rules. Thus, one can create an artificial society and study how individual choices of ordinary persons or companies can result in big changes on a societal scale.

'I want to contribute to dealing with global environmental problems'

USA versus the Netherlands

Tatiana Filatova did part of her PhD research in the USA, where she also met her husband. 'I thought I would move to the U.S., I even moved all my things there and had a job offer, but I also had my doubts. The lifestyle there is very different. The quality of life is much better in the Netherlands; here you have the freedom to choose your own work-life balance, which opens many ways to combine a demanding career with children– and I always knew I wanted children,' says the mother of two young boys. 'It was a difficult decision, but when my husband got a job at ITC, I chose to come back to Twente.'
After getting a PhD degree, it was natural for her to work towards becoming a professor, says Filatova: 'I didn't even think of other options and I started a tenure track here. As a first step, I submitted a VENI proposal.' It was at this moment, when her seemingly promising academic career reached a critical point: the VENI proposal didn't get accepted. 'Everyone

Tatiana Filatova in a nutshell:

2016:	Adjunct professor of 'Economic Modelling for Resilient Societies' at CSTM
2015:	Member of De Jonge Akademie (KNAW - Royal Dutch Academy of Sciences)
2009- 2015:	Economist at Deltares, Dutch knowledge institute in the field of water management
2014:	Early Career Excellence Award, International Environmental Modelling and Software Society
2013:	Professor De Winter Prize
2012:	VENI grant
2009:	PhD (Cum Laude), Department of Water Engineering and Management, University of Twente
2003:	MSc (Cum Laude), Information systems in economics, Chita State Technical University, Russia.

who's had their grant proposals rejected, knows the pain. You invest much more than your time, you invest yourself and your emotions. After the rejection, I was ready to quit.'
'Thankfully, my supervisor called me and explained that there is a 'day and night' of science and that I need to have the strength to go through the dark moments. This was the first time I saw this side of academia. I realized that I had to gather my energy and go on. I was lucky to have wise mentors who taught me that people who give up too early won't succeed. I also got motivation from my family, who'd always said 'know what you want and never stop'. And it was worth it. I wouldn't be happy without this job.'

Current research

The decision to stay in academia was indeed worth it. Being persistent, Tatiana Filatova received the VENI grant for her project 'Changing climate – changing behavior: integrating adaptive economic behavior in land-use models'. Within this project she integrated urban economics into spatial agent-based models and studied climate-induced risks in hurricane-prone coastal cities in the USA. She initiated a new thread in the academic literature on modeling agent-based land markets including behavioral biases such as risk perceptions. Now, Tatiana Filatova is only one step away from becoming a full professor and she is continuing her research related to economics of climate change. 'I want to contribute to dealing with global environmental problems,' she says. 'For example, in my team we focus on what people could do to decrease energy footprint or how they behave when facing disaster risks. Given this global focus, I am very proud of my PhD students who actively work within international networks worldwide. We use economic theories and psychology to see how people behave and we program their behavior into artificial agents to see what it leads to. It serves as a computerized laboratory to explore different policies.'

Stimulating or wasted time

Besides research, Tatiana Filatova is also passionate about improving academic policies. At BMS she is involved in the faculty's research renewal think tank. Nationally, as a member of the Young Academy (DJA/KNAW) and the co-chair of the Science Policy Trace, she wants to improve the situation of PhD researchers coming to the Netherlands on foreign fellowships and she wants to contribute to changing the grant writing system. 'Preparing a grant proposal can be extremely stimulating, but it can also be wasted time, because the success rates are constantly dropping. A lot of researchers' time is spent on writing grant proposals instead of improving teaching or actually performing research,' thinks Filatova. 'I hope I can make an impact and minimize the struggles that especially young scientists have to go through.'

THE FUTURE OF IRRIGATION

How to Reduce *Water Footprint*

'Using less water is a must, not a choice,' says Abebe Chukalla, PhD candidate whose research has shown that using the right technology can lead to a significant reduction of water footprint.

Text:
Michaela Nesvarova
Photo:
Shutterstock

'The main goal of my research project is to reduce water consumption and pollution associated with crop production. In simple words, we want less water to be used in the agricultural sector, which makes up the largest share in global freshwater consumption,' explains Chukalla, who is currently finishing his PhD studies at the Engineering Technology faculty of the University of Twente.

'I come from Ethiopia, a place where you constantly feel how scarce and necessary water is. Water scarcity is a big problem for the entire world. Population is growing, economy is developing and all of that requires more water, but the water we have available does not grow. The water supply is constant or in some cases even reduced, due to climate change. This problem could be solved by applying different technology, though. We need a sustainable solution to help our planet, because the environment doesn't have a say in what is happening, but it does feel the pain of it.'

Simulations of different technologies

On a mission to ease this pain, Abebe Chukalla focused his PhD project on 'Water footprint reduction and associated cost in irrigated crop production', work that is a part of the European project FIGARO aiming to improve agricultural productivity in Europe. As the first step, Chukalla therefore picked four different climates typical for Europe – humid, sub-humid, arid and semi-arid – distributed across the continent. Afterwards, the main part of his work began.

'In essence, I modelled what applying different technologies and strategies would mean for crop production and water footprint in these specific areas,' he says.

Green, blue and grey water

Chukalla explored possibilities for reducing the green, blue and grey water footprints of irrigated crop production. 'The focus on different water footprints is unique to the UT. The concept has been created by our professor, Arjen Hoekstra, and our group takes global leadership in water footprint research.'

'We divide water footprint into two types: consumption, which relates to green and blue water use, and pollution, which is associated with grey water footprint. Green water footprint is the amount of rain water used by crops. Blue water footprint is the water used for irrigation that comes from groundwater and surface water, such as lakes or rivers, and grey water footprint is the water we need to assimilate pollutants to bring water to agreed quality standard,' clarifies Chukalla.

Reduction by 8% - 28%

While the issues of water footprint can be studied from various perspectives, Chukalla's research concentrated on its reduction at the crop production level. He studied the effects of three management practices, meaning different irrigation techniques, irrigation strategies and mulching (which refers to a layer of organic or inorganic material placed over the root zone of a plant to seal the water within the soil).

'We have found out that we could reduce the consumption of blue and green water by 8% to 28% by applying synthetic mulching combined with drip technology – small pipes with holes that apply water close to the plants' roots,' Chukalla describes his findings. 'If it comes to the combined consumptive and grey water footprint, we concluded that we can reduce it by applying deficit irrigation, zero-tillage and the optimal amount of manure fertilizer.'

Drip technology is the future

'Even though furrow irrigation technique is the traditional form of irrigation, still holding the lion's share in the world, and sprinklers are taking the lead in western Europe, drip technology gives you the smallest water footprint compared to all of these techniques. By reducing the water footprint of crop production we consequently reduce the water footprint of the food we eat and the clothes we wear, because they are often made of cotton,' concludes Chukalla. 'Drip technology is the future – it can reduce water footprint on a global scale.'

'Our group takes global leadership in water footprint research'

PROJECT INACHUS

Rescuing people *with drones*

If an earthquake or another disaster strikes, fast rescue of surviving victims is of the utmost importance. Yet, large areas are often impacted and hundreds of buildings collapsed, which makes it nearly impossible for rescue teams to know where to search for survivors. Within project INACHUS, the ITC Faculty of the University of Twente is therefore working towards a system that will make finding victims quicker. How? Thanks to drones and 3D models.

Text: **Michaela Nesvarova**
Photo: **Gijs van Ouwerkerk**

INACHUS is a FP7 Project that aims to support post-disaster search and rescue forces. 'The people who arrive on the scene after a disastrous event need to know where to start digging. They need to use their time well and focus on places where people could have actually survived,' says Professor Norman Kerle, an ITC researcher involved in the project.

Where to look for survivors?

After a major event, such as an earthquake, the International Charter 'Space and Major Disasters' gets automatically activated to provide satellite-based information and the first assessments of the damage. If the extent of the crisis requires local deployment of search and rescue forces, the INACHUS system will come into play. 'Earthquakes, for example, happen unexpectedly and can be truly destructive. They can affect hundreds of thousands of people, which means there are bound to be survivors – but where?' continues Kerle.
'Rescue teams usually arrive on the ground several days after the disaster and what they find is rubble, chaos and people in shock. That is why our job is to provide information on which places to prioritize. The first step is to do so called dasymetric mapping - to identify areas where there were a lot of people at the time of the event. If it, let's say, happened at noon on a week day, people were likely in office buildings, not in their homes,' explains Kerle.

Automated 3D modelling

ITC's main task within INACHUS is to use UAVs (unmanned aerial vehicles) to provide detailed damage mapping. For that, ITC researchers use relatively small drones, which serve as their eyes in the sky and take a lot of images. These photos are then used to create highly detailed 3D models of the affected areas and buildings.
'These models are absolutely necessary. Without them, we can't perform detailed damage assessment, nor estimate the locations of spaces and cavities in the collapsed buildings where people could have survived, because satellite images only give us a view from above – they don't show how many floors of a building have crushed, for instance,' clarifies Kerle.
'Now, our task is to develop a methodology that allows the drones to optimize the 3D model data acquisition, to carry out the damage mapping automatically, and consequently tell the rescue teams where to look.'

Drones and ground-based robots

Once the search teams know which places to prioritize, it is time to deploy ground based technology included in the INACHUS system. Among others, rescuers will be able to use instruments that detect mobile phone signals or robots equipped with cameras, radar sensors and a 'chemical nose' that go into collapsed buildings and detect the presence of humans. Development of these technologies is, however, in the hands of other INACHUS project partners.

'There are bound to be survivors - but where?'

'The end product of the INACHUS project should be a comprehensive system that allows rescue teams to use all of these different elements – satellite images, drones, resulting 3D models, detectors and robots,' says Kerle. 'ITC's main job is to ensure that the 3D modelling can be done automatically, and doesn't require any expert help, because the whole system should be relatively easy to use. In fact, ITC is also in charge of creating training materials for the rescue and search teams.'

Disasters and terrorist attacks

At the moment, INACHUS is still an ongoing project and should last another two years. 'The next challenge is to bring our theory into practice,' says Kerle. 'First, we will have to test the system in realistic scenarios, such as in buildings that are being demolished or in special facilities. And - because the system should not only be useful after natural disasters, but also after terrorist attacks - we have also done tests with TNT and explosions near and inside buildings.'

Fact check

I read something mindboggling the other day: 'Technological advancements are developing at such a rate that the things that tech students learn during their freshman year will have been outdated by the time of their graduation.' My immediate thought was, what is it that tech students learn during their first year? Do they have to memorize the latest gadget collection from Media Markt?

The second question that this statement raises is: are first year technology curriculums really that perishable? It would be interesting to fact check the above statement, because it is university administrators who, over the last couple of years, have claimed it to be true in one way or the other. The most recent example of this is the president of the University of Twente and the 4TU-federation, who made the above mentioned statement in Het Financieele Dagblad on February 7th.

If a fact check shows that the statement is 'true', then that would mean a potential scandal that could lead to a student revolt and a parliamentary inquiry. However, if the statement turns out to lack any merit, then that shows there is a wide gap between what university administrators believe and what is actually going on. And that is problematic, because the aforementioned statement is often used to argue the need for educational reforms. And since educational reforms usually have a large impact, the arguments for them need to be convincing.

But what use is a fact check if the statement turns out to be untrue, if the first part of the assertion is incorrect? What if the technological developments on a scale of a technological university course are not that large at all? Then the second component of the statement is simply not relevant anymore.

It is important to consider that the perception that technology is developing at such a fast pace is heavily influenced by one single sector: ICT. Think of a large, technological advancement with a big impact on daily life during the last five years, and chances are that it concerns the ICT that is 'hidden under the hood'. The rate of technological advancements in other sectors is, in truth, slightly disappointing.

Transportation, medical technology, sustainable energy, materials; the actual progress in these fields is excruciatingly slow. To give you an example, the most important innovation of the last ten years for people who travel by plane, was the electrochromic window. Now, I hear you ask, 'What about the increasing quality of the in-flight entertainment?' That's all ICT.

Long story short, the rate with which technology develops during a student's life is not a justification to dive into the next educational reform. To make a good case for that, you will need better arguments.

Wiendelt Steenbergen
Professor of Biomedical Photonic Imaging

LISA BAKIR ATTENDS THE UT RESEARCH HONOURS PROGRAMME

‘I am embracing scientific research’

Last December, Lisa Bakir graduated cum laude in Business Administration. In order to find out if a scientific career suits her, she is attending the UT Research Honours programme, and is writing her first paper. ‘I am increasingly embracing scientific research,’ she says.

Her master thesis focused on the coordination process of customer questions received by Voortman Steel Machinery in Rijssen, an international company specialising in machines for the steel beam and plate processing industry. ‘Businesses are increasingly faced with demanding customers with ad hoc questions. In the literature, little is known about the dynamics within organizations that contribute to the creation of customer value - in this case to offer solutions for customers. I wanted to make the entire process transparent, from the moment a question is received to the solution.’

Looking over their shoulders

For this purpose, Bakir conducted ethnographic research, in which she observed the actions of employees who addressed customer requests. ‘This was very special, because I was literally looking over their shoulders. I was very close to the process and studied all steps and actions that were taken in order to solve a problem.’

Bakir’s study made micro processes and interactions transparent and led her to the conclusion that process standardization can resolve many issues, but not all. ‘A standard procedure contributes to order and stability, but with complex issues it causes a field of tension. With difficult customer questions, the employee needs space and flexibility to be able to investigate the issue and find a solution. This is something that is often lacking.’

Placing customer questions within their context

Bakir says that her research also emphasises the importance of the context of the customer questions. ‘Context provides an earlier and better insight into the different elements a question consists of. This stresses the need for a strong preparatory phase, in which all the needs and expectations of customers are thoroughly investigated, to prevent tensions later on.’

The insights and data from her master research provide sufficient basis for writing a paper. ‘I am writing the paper during the Research Honours programme, a programme for students who, like me, have affinity with research and want to see if a PhD programme is suitable for them.’

Text: **Sandra Pool**
Photo: **Rikkert Harink**

Air quality research

Guus Velders (53) studied Applied Physics at the University of Twente and received his PhD degree in 1992 at the department of Chemical Physics. He then worked for the Royal Netherlands Meteorological Institute (KNMI), where he had also done research on the emissions of air traffic during his military service. A year later he joined the National Institute of Public Health and Environmental Protection (RIVM). He is now head of the Air Quality division. His group registers emissions and researches ways to improve air quality.

UT ALUMNUS GUUS VELDERS, SAVIOUR OF THE KIGALI CLIMATE TREATY

‘Even Trump cannot stop the climate policy’

Few scientists possess the gift of making an immediate and lasting impact. Yet, that is what atmospheric physicist Guus Velders has done. In October 2016, the UT alumnus saved the Kigali climate treaty with his quick calculations. And this did not go unnoticed; the journal Nature immediately listed him among the ten most influential scientists of that year.

Text:
Rik Visschedijk
Photo:
Rikkert Harink

In Kigali, the main focus was on the hydrofluorocarbons (HFCs). Guus Velders is regarded as an expert in the field of HFCs. ‘It is a greenhouse gas that is used, for example, in refrigerators and air conditioning systems,’ he says. HFCs were regarded as the solution for the CFC (chlorofluorocarbon) issue, as CFCs damage the ozone layer. HFCs became popular around 1995 as an alternative for CFCs. But HFCs turn out to be not quite as harmless as initially assumed. They do not damage the ozone layer, but they do absorb the infrared radiation in the atmosphere and thus contribute to global warming’.
And that is a problem, as has been proven by Velders and his American colleagues. In 2009, they published an article in which they concluded that the ‘new’ HFCs significantly contribute to global warming. ‘An unintended, but significant side effect. Our calculations showed that, by 2050, they will contribute to global warming by 10% to 20%,’ Velders explains. ‘In the developing countries, there is a huge demand for cooling agents for air conditioning systems and refrigerators.’

Proposals

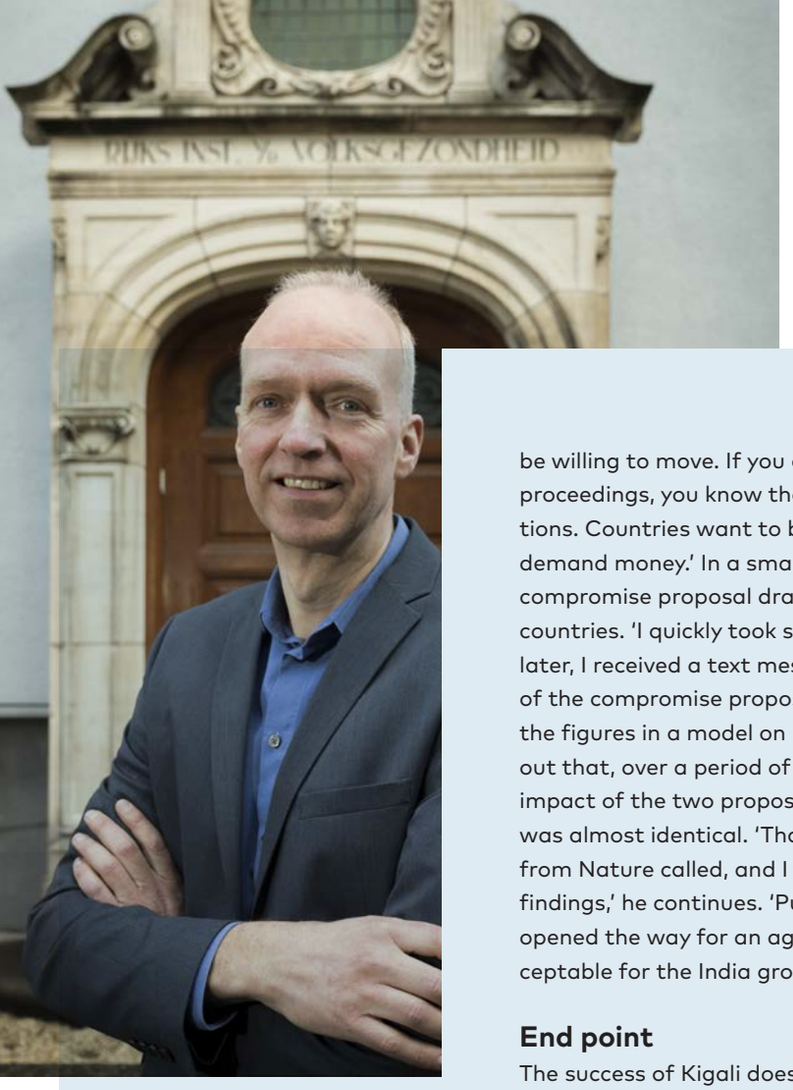
Back to Rwanda, where Velders was staying to attend the climate summit. In Kigali, four proposals to get rid of HFCs were on the table. ‘The summit started on Sunday,’ Velders says. ‘On Tuesday, after the negotiations among the policy-makers, two proposals were left: the western countries wanted to ban HFCs quickly, but a group led by India wanted to follow a slower path.’

‘There is money to be made with alternatives for HFCs’

Velders did not attend the negotiations himself. ‘They took place behind closed doors.’ But in the corridors he passed a room where the European Commission kept the compromise proposal of the developing countries. ‘I entered the room and took a picture with my phone,’ he says.

Sobering

The next Thursday, the responsible ministers came to Kigali and they expressed their political positions. A process described by Velders as ‘sobering’. ‘Nobody seemed to



be willing to move. If you are familiar with the proceedings, you know that these are negotiations. Countries want to be compensated; they demand money.' In a small room, Velders found a compromise proposal drawn up by the western countries. 'I quickly took some notes. Not much later, I received a text message with the figures of the compromise proposal.' Velders entered the figures in a model on his laptop. It turned out that, over a period of one hundred years, the impact of the two proposals on global warming was almost identical. 'That night, a journalist from Nature called, and I told him about my findings,' he continues. 'Publication in Nature opened the way for an agreement that was acceptable for the India group.'

End point

The success of Kigali does not stand on its own. It is the 'end point' of extensive negotiations, lobbying and global developments. 'The topic had been discussed since 2009,' Velders says. But the real turning point did not come until 2013. During the G20 summit, President Obama managed to convince countries such as China and India, which had not wanted to change their position, to support the phasing out of HFCs. 'This was supported by the fact that, one year later, Europe and Japan had already made considerable progress and the United States had also taken action. That paved the way for the success of Kigali, where HFCs were included in the Montreal Protocol, an international treaty drawn up to protect the ozone layer.'

Impact

Velders is aware that a scientist rarely has such a big impact on policy, especially in a field that does not have his full-time attention. 'It is really a hobby that got out of hand,' he laughs. 'I have been working on this subject since 2007 and, together with my American colleagues, I have built an expertise that is unique.' He doesn't mind that it takes up much of his evenings. 'It gives me energy that I can contribute something to the world we leave behind. To contribute scientific, not political information that allows good political decisions to be taken.'

With the new president Trump, who is not particularly in favour of climate policy, the course of the United States is about to change. Is Velders concerned about this? 'No, not at all, actually. We have started on a path which can no longer be reversed. Whatever Trump says, the industry has already embraced the opportunities offered by the elimination of HFCs. There is money to be made with the development of alternatives.'

'It gives me energy to contribute something to the world we leave behind.'

700 million air conditioners

The expectation is that, by 2030, another 700 million air conditioning systems will have been installed. According to Velders' calculations, this results in a temperature increase of 0.3 to 0.5 °C in 2100. As a result of the Kigali treaty, this increase will be limited to 0.06 degrees. This is to be achieved by a reduction of HFCs by 80% to 85%.

Three time frames

The US and other rich countries have committed themselves to starting with the reduction of HFCs in 2019. By 2036, emissions must have been reduced by 85%. China and most of the developing countries will start with measures to reduce emissions in 2024. India, Pakistan, Iran, Iraq and the Gulf States will not start until 2028. India and Pakistan have asked for an additional two years, claiming that their economy needs more time to grow.

LIGHT-WEIGHT AND SUPERCONDUCTING GENERATOR FOR WINDMILLS

A fresh wind is blowing in sustainable energy

It looks heavy at first glance. Yet, the elongated steel plate that physicist Marc Dhallé shows us in his ultramodern lab is the lightest power coil for large windmills in existence. Intended for a new generation of ultra-lightweight wind turbines, this coil was designed in a record time of one and a half years at the University of Twente.

Two years ago, Dhallé's research group received a subsidy of two million euros in the context of the EcoSwing project for the development of a power generator with superconducting coils. The resulting machine is 40% lighter than traditional generators with their heavy magnets and copper coils.
'Because of the lower weight, the nacelle of a windmill can be much lighter and we need less material for the mast. Thanks to this, the cost of a windmill will markedly decrease in the future,' says the Belgian scientist, who works at the UT as a senior lecturer of Energy, Materials and Systems (EMS).

Early next year, the first superconducting generator will be built in an existing windmill in Thyborøn in Denmark, owned by the Chinese turbine builder Envision. Once the generator has run error-free for one year, there will be basis for commercial mass production of cheaper windmills.
Envision has consciously chosen a comparatively modest 3.6 megawatts generator, as this is currently the most common capacity in the wind industry. Moreover, this size just fits on a lorry, which makes a huge difference in transportation costs. 'The entire design, however, aims for a capacity of more than 10 megawatts,' says Dhallé. 'That is enough to provide power for three thousand households.'

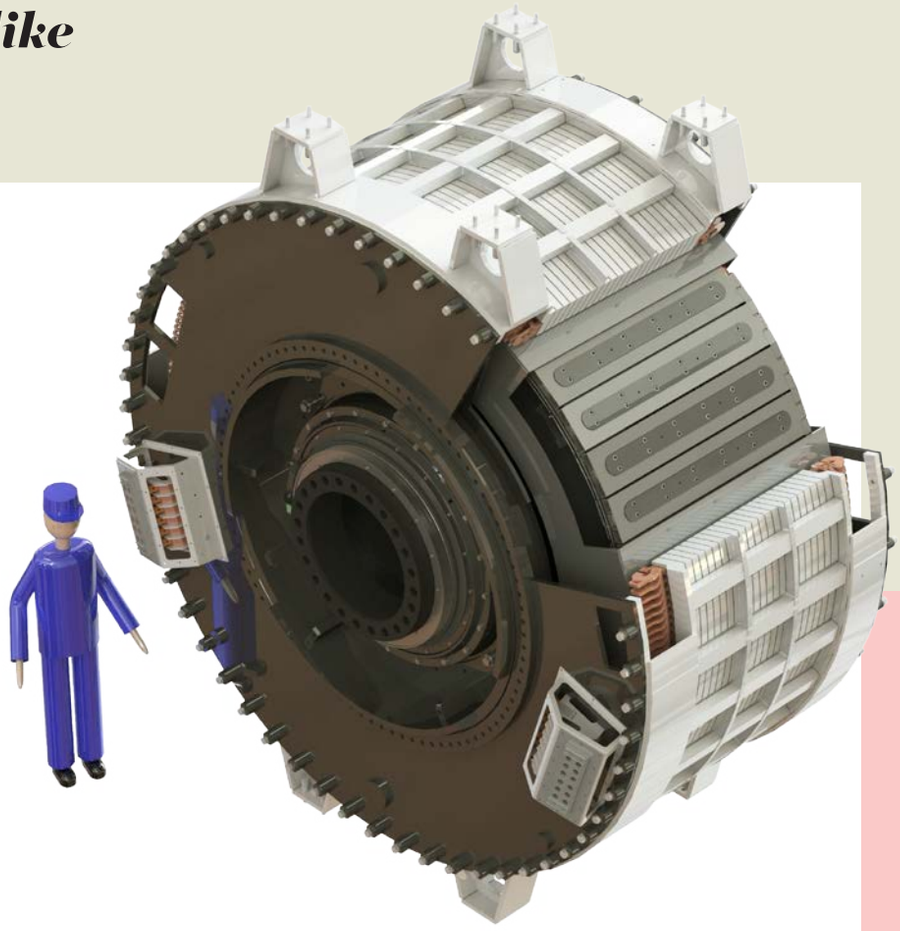
Yttrium

A traditional wind turbine works just like a bicycle dynamo, Dhallé explains. 'It contains rotating magnets inside a set of copper coils. The rotation creates a variable magnetic field in the coils, and this generates an electric current.' In the newly developed wind generator, the magnets have been replaced by coils with a ceramic compound of yttrium. This silver-white metal becomes superconductive under extremely cold conditions. The resistance of the material is then completely eliminated. Without friction loss, a hundred times more power flows through the ceramic coils than through copper coils.

'The costs of a windmill will drop significantly'

Many metals only become superconductive at temperatures below minus 270°C. However, from a discovery in the 1980's we know that some ceramics become superconductive at higher temperatures. For yttrium this is at minus 180°C. 'That makes a huge difference in cooling costs.'

'A traditional wind turbine works just like a bicycle dynamo'



To generate the required low temperature, the researchers place their generator in a super-refrigerator. This is suspended in a vacuum drum in the heart of the generator in the nacelle of the windmill. This generator weighs about 45 tonnes, which is light compared to the current generators, which weigh about 75 tonnes.

Rare earth element

Dhallé tells us that yttrium is a rare earth element. 'But you only need one hundred grams to create a superconductive coil. A traditional magnet requires a hundred times more of the material neodymium. In our coil, we use a steel ribbon to which a two-micrometre thin layer of yttrium is applied, which reacts with barium, copper and oxygen. The rotor of our windmill is fitted with forty superconducting coils. In total, the rotor will contain twenty kilometres of this ribbon.'
No less than twelve researchers and students were involved in the design and testing of the coils and the cooling at the EMS department of the University of Twente. They will also assemble the entire rotor. 'It has been an aggressive timeline. In one and a half year, we had to develop the entire concept of combining the various technologies. So far, everything works, but the reasons why it works will have to be the subject of academic research, afterwards,' says the researcher. 'For us, as academics, this approach is new; we are taking a very pragmatic approach in this project. Sometimes we need to solve problems with steam and boiling water. But this also results in new insights. For example, we gradually found out that the new ceramic superconductors are, in their thermal properties, far more stable than earlier superconducting magnets. But they are harder to protect when something goes wrong with the cooling.'

Saving weight

The approach used by the Twente researchers is also very conservative, Dhallé says. 'The design must work smoothly at the first attempt. For that reason, we try to keep all risks as small as possible. Once the windmill is up and running, I am positive that we will be able to save a lot of weight in the next design. Also, the superconductive ribbon for the coils is now three to four times more expensive than copper. This is mainly due to production costs, though; the materials are not expensive. The cable price will drop quickly once mass production has started. Currently, the construction of a traditional windmill costs 2 euros per generated watt. This will become much lower.'

So far, a third of the forty coils have been successfully tested in the Twente lab. This summer, the drum for the rotor coils will be built. The two-blade windmill should be up and running in 2018. In the context of the European Horizon 2020 programme, nine companies and research institutes received 13 million euros in subsidy for this EcoSwing project. Sumitomo in England provides the 'refrigerator' and Theva in Germany builds the coils.

Text:
Marc Laan
Photo:
Rikkert Harink

Political parties reject **the referendum on Europe**

Citizens worry about the future of Europe. But, after Brexit and the Ukraine referendum, politicians are not particularly enthusiastic about decisions made by means of a referendum. Researcher Joost van den Akker feels that this is premature. 'Because on a local level, referendums have also been constantly held in the Netherlands in recent years.'

The British Prime Minister Winston Churchill was not an advocate of democracy. According to him, the best argument against democracy was a five-minute chat with the average voter. This would show that the average citizen is unfit to take part in a decision on complex issues. Churchill's point of view appears to be similar to the contemporary political opinion on referendums.
Nowadays, critics also say that many topics are too complex to ask the public directly for their opinion. As examples, they like to point to Brexit and the Ukraine referendum - public consultations on complex, European issues. Most political parties have taken this criticism seriously - in view of the recent parliamentary elections. Although they are not opposed to referendums as such, they reject the idea of binding referendums on Europe. On the other hand, there are parties that make it part of their campaign: they want citizens to have a decisive vote on issues concerning Europe.

Referendums on Europe are Joost van den Akker's field of research. As an external PhD student at the University of Twente, Van den Akker researches the role of governments in referendums on the European Union. He is also a lecturer of European Studies at Hogeschool Zuyd in Maastricht.

Success for the ruling power

Van den Akker studies the conditions under which governments succeed in making a European referendum a success for themselves: 'Research into referendums on the EU generally focuses on the motives of the electorate. There are hardly any studies on the circumstances in which a referendum is successful for the government.' According to Van den Akker, a referendum is successful for the government if their policy objective - for example the ratification of a European treaty - is supported by a majority of the population. 'The Ukraine referendum, for example, was not a success for the government.'

'If there is division within the own party or government, a referendum can mask that division'

Text: **Johan Bosveld**
Photo: **Rikkert Harink**

Referendums that are initiated by the people are usually intended to enforce or prevent a decision. But why would a government want a referendum?
Van den Akker: 'Often to strengthen its own position. The French president Mitterrand held a referendum on the Treaty of Maastricht. He wanted to silence the opposition within his own party. If there is division within the own party or government, a referendum can mask that division or depoliticise the issue, to prevent damage to the party or to the government.'

So a referendum is a political instrument of the government?
'It always is. It is a combination of indirect and direct democracy. Nevertheless, referendums on European treaties are rarely initiated by a parliament. They are triggered by the government, by the people, or there is a constitutional obligation. When it comes to European treaties, parliaments are reluctant to call for a referendum. Yet, when it comes to other issues, such as the introduction of the euro, they think referendums are important. Often, there is more political discord on these issues. Referendums are then used to cover up these differences, and a decision is postponed until after the referendum.'

The perspective of governments

Van den Akker studies referendums from the perspective of governments. One of his key questions is when a government wins or loses a referendum. 'I am mainly interested in the macro situation, rather than in the considerations of individual voters. What is the state of the economy, is the country a net contributor to the EU or not, how stable is the political situation, is there agreement among the political elite concerning the issue? I compare these factors and look for patterns. It turns out that, in stable political or economic conditions, the population almost always agrees with the government. If the

It is unlikely that there will be a Dutch referendum on Europe

circumstances are negative, governments often lose out. With both the Ukraine and the Brexit referendum, the economy was not doing well in the perception of voters and the political parties were divided. This proved to be decisive for the outcome.'
Apart from the above factors, there are other matters that may affect the outcome. One key factor is how accustomed people are to referendums. Countries such as Switzerland, Denmark and Ireland have a tradition of referendums. This reduces the probability of protest votes. Van den Akker: 'In those countries, the process will be much more along the beaten path. The citizens are more used to the process and there is more focus on the issue than on other sentiments. That does not mean that the outcome is always in line with the wishes of the government, but there is much less fuss over the role of the referendum. Voters are better informed and more involved, because the campaigns are of higher quality and the focus is on the issue.'

So, the more referendums are embedded in the political culture, the less fuss there is?
'Definitely. But another consequence is that politicians are aware during the decision-making that there may be a referendum, and recognise that it makes sense to seek consensus in advance, in order to have a better chance of surviving a referendum.'

Does a referendum force politicians to remain close to the people?
'Yes, although this applies less in the Netherlands. Our political culture is different; politicians are less concerned with referendums, but they want to get as much support as possible in parliament. Also, our political climate is more changeable. In the 1990s, up to the 'Night of Wiegel' in 1999 (when a change to the constitution for the introduction of a corrective referendum was voted down by the vote of VVD senator Hans Wiegel, eds.), there was a great deal of support for a corrective referendum.'

Although there has been another initiative proposal in parliament for a corrective referendum, the PvdA has removed a binding referendum from its election program. According to some members of the PvdA, referendums damage our democracy. And although it remains in favour of referendums, D66 wants to exclude European issues.
When we compare the election programs of the parties, we can draw only one conclusion: it is unlikely that there will be a Dutch referendum on Europe. Only the political parties SP, Partij voor de Dieren, 50Plus, VNL, Forum voor Democratie, and De Burger Beweging explicitly include a binding referendum in relation to the EU and other international treaties. PVV, Forum voor Democratie, De Burger Beweging, and De Libertarische Partij want to leave the EU even without a referendum.

Incomprehensible newspaper

Van den Akker: 'Since 'Ukraine' and 'Brexit', parties shy away from referendums. This may be premature, because in recent years, on a local level, referendums have become common in the Netherlands. On a national level, things have gone wrong twice, even before the referendum was held: for the European Constitution, an incomprehensible newspaper was distributed, and for the Ukraine referendum, there was merely a website with information, which hardly anyone was able to find. Besides, the government had not indicated beforehand what would happen with the result. It then took Prime Minister Rutte a year to ultimately ratify the Association Treaty.'
Another deficiency, according to Van den Akker, was that it was only a consultative referendum, which was then treated ambiguously by the political parties. 'Initially, a majority in the Second Chamber wanted to respect the outcome, but they now seem to have changed their mind. So, at first, politicians suggest that they will treat it as a binding referendum, but ultimately it gets treated as merely a recommendation. This is a situation which is rarely seen with European referendums in other countries.'

SMG Groep

Uw specialist in creatie, ICT services, druk- en printwerk, opslag en distributie. Wij bieden totaaloplossingen in cross media. Hoe u ook wilt communiceren, wij maken het mogelijk! Deskundig en betrokken, van advies tot duurzaam serviceconcept, zoals u van ons als partner mag verwachten.

Meer weten? Neem dan contact op met Marthijn ter Averst (m.ter.averst@smg-groep.nl)

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