DONDERS INSTITUTE

Newsletter 36

June 2020

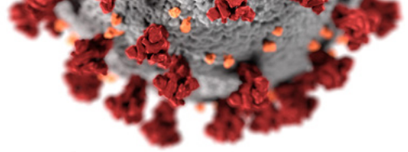
Donders during the pandemic
COVID-19: COPING, CARING AND CONTROL

The power of human communication
UNDERSTANDING EACH OTHER IN A SHARED COGNITIVE SPACE

Autism, big data and curiosity:
THE ABC'S OF THREE VICI GRANTS

dondersinstitute.nl

Radboud University Radboudumc



Donders during the pandemic

While Covid-19 turned the world upside down, research at the Donders Institute continued. It's been an unusual time for everyone, a time of uncertainty, but also a time of inspiration and perseverance.

Tansu Celikel started his term as Chair of the Donders Institute on January 1. Under his leadership, the institute had to cancel events, partly close buildings and find new ways to continue the study of brain, cognition, and behaviour. And we did find ways.

Research continued at home and via online platforms. Analyses evolved with new tools and methods. Fellow researchers met in digital hallways. Scientists started projects specifically designed to match the new circumstances, as described below.

We strongly commend all Donders researchers for their hard work during these challenging times. This Newsletter highlights just some of the great projects that started or continued during the exceptional first six months of 2020.

From the Donders Newsletter Editorial Board

HOW DO WE COPE WITH CORONA STRESS?

The Covid-19 pandemic is posing an enormous challenge to people around the world. Besides the threat to our physical health, the prospect of economic losses, the sudden loss of social interaction and the uncertainty about the future represent a considerable burden to our mental health. Judith van Leeuwen is part of an international team of researchers who have started a project to study the way people cope with stress during this crisis.

Previous research shows that most people remain psychologically rather healthy during and after difficult periods like this, but it is unclear which psychological mechanisms can help us. Van Leeuwen: "If we discover how some people maintain their mental health during this difficult time, we can help others through the current crisis – and into the future."

The study will be based on a survey among inhabitants of China, Israel, the USA and 21 countries in Europe. Its aim is to identify the psychological factors that protect individuals from developing psychological conditions such as stress, fear, and depression.

PARKINSON SMARTWATCH SEARCHES FOR CORONA INFECTIONS

A smartwatch that collects information about Parkinson's patients might be helpful in detecting Covid-19 at an early stage. Parkinson's researchers are investigating whether the watch could detect infections that are caused by the virus.

Over the past two years, the smartwatch has been used in the project 'Parkinson op maat' ('Parkinson's tailored') in the Netherlands. It collects information about physical health and lifestyle, such as activity, heart rate, sleep rhythm and skin impedance. Hundreds of patients are participating in this study, and some of them have probably had or will have a Covid-19 infection at some point.

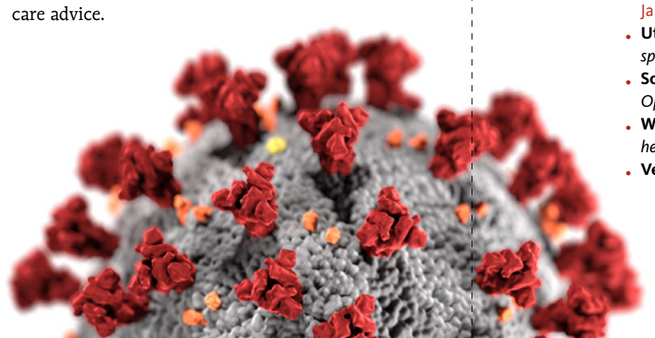
Analysis of the smartwatch data of patients infected by the virus may help identify early indicators of Covid-19. If this approach proves accurate, the parameters can be used to identify and isolate infected people at an earlier stage. The results will not only be useful for the current crisis. If successful, the smartwatch could help detect future pandemics involving other viruses as well.

ARE BABIES GETTING THE CARE THEY NEED?

Are young babies invisible victims of the corona crisis? Or is it the other way around: does the current situation provide parents with the opportunity to provide better care than usual? Psychobiologist Carolina de Weerth received a grant from the Dutch Research Council (NWO) to get answers.

The first months of a human life are crucial to development later in life. To prevent mental and physical disease, Dutch parents are advised to provide exclusive breastfeeding, routine immunisation and to sleep in the same room as the baby in the first six months after delivery. However, many babies do not receive this standard of care. For example, only 39% of Dutch infants are exclusively breastfed for six months.

On the one hand, the corona crisis may make care worse. This might be the case if parents postpone immunisation to prevent contagion, or because they are (financially) stressed. On the other hand, the crisis may actually improve care, because both parents are at home and have time for breastfeeding and sleeping in the same room as the baby at night. De Weerth will try to find out whether the crisis, as a kind of 'natural experiment', may hinder or strengthen parental adherence to care advice.



Go to our website to check out the latest news and events

Meanwhile at dondersinstitute.nl

SOME RECENT HEADLINES

- **Karin Roelofs and Bas Bloem elected to the KNAW**
  Neuroscientists Karin Roelofs and Bas Bloem have been appointed as members of the Royal Netherlands Academy of Arts and Sciences (KNAW). These two Donders Institute researchers are among eighteen new members chosen by the KNAW this year.
- **A grant of €6 million to reveal links between metabolic and brain disorders**
  Barbara Franke, Jan Buitelaar and Janita Bralten will explore how common molecular mechanisms may provide the key to linking metabolic disorders with brain disorders. Within this European funded project, they will focus on disorders such as diabetes, obesity, Alzheimer's disease, obsessive-compulsive disorder, and autism.
- **Royal honours for John van Opstal**
  Donders director John van Opstal has been awarded a royal honour for his scientific work on sound localisation, such as developing advanced hearing implants, a project which has proven societal merit. He has been named an Officer of the Order of Orange-Nassau.
- **Getting to know the architecture of the brain**
  Scientists from five universities are immersing themselves in the structure of networks. They will investigate how the highly advanced networks in biological systems, from molecules to the brain, are built and how information is transferred through them. The European Union awarded a grant of nearly €3.5 million for this work. Fleur Zeldenrust from the Donders Institute is leading this project, which is called SmartNets.

SOME RECENT HIGH-IMPACT PUBLICATIONS

- **Body language can also be heard**
  Most people gesture when they talk: from subtle wrist movements to complete sign language involving arms, hands, and fingers. This non-verbal communication reinforces what we say. This would be difficult if you can't see the other person, you'd think. A study by Wim Pouw published in *PNAS* shows that it isn't. When people move their hands and arms while talking, listeners are able to hear the difference. Even without seeing the messenger, we can pick up each other's body language.
- **Ritalin improves performance by increasing motivation**
  People often think that they're able to concentrate better with Ritalin or Adderall, and in a way they do. However, a new study in *Science* by Lieke Hofmans *et al.* shows that one reason why we can concentrate better is because these substances increase our cognitive motivation. We experience more benefit than cost when we are about to tackle a strenuous task. This effect is independent of any changes in our actual ability to perform the task.
- **Distraction diminishes the taste of food**
  If you eat while you're distracted, it may not taste as good because your brain processes the taste of the food less effectively. This effect has been demonstrated by Iris Duif *et al.* in an article published in *The American Journal of Clinical Nutrition*. Due to this mechanism, you may tend to eat more if you are distracted by a smartphone or television.

PhD defences

**Donders series number*

November 2019

- **Hong, D.H.,** *Acquisition and quantification techniques for proton magnetic resonance spectroscopy at 7T.*
- **Sollis, E.,** *A Network of Interacting Proteins Disrupted in Language-Related Disorders.*

December 2019

- **Chauvin, R.,** *The efficient brain: on how connectivity modulations underpin cognitive tasks.* DS 410*
- **Maas, D.,** *Myelin Matters in Schizophrenia. Neurobiological Insights from Rat Model and Human Studies.* DS 412.
- **Verbakel, S.K.,** *Inherited retinal diseases. Studies on genotype, phenotype and treatment.*

January 2020

- **Utzerath, C.,** *Hypopriors in autism spectrum disorder.* DS415.
- **Schreur, V.,** *Diabetic retinopathy. Optimizing management strategies.*
- **Woutersen, K.,** *Speed of vision in healthy aging and hemianopia.* DS 422.
- **Verbaarschot, C.S.,** *The brain intending action. Linking neural preparation and subjective experience of motor intentions.* DS 421.
- **Ferdek, M.,** *The vicious cycle of rumination. Effective connectivity study of repetitive negative thinking in clinical and non-clinical groups.* DS 416.
- **Sharoh, D.L.,** *Advances in layer specific fMRI for the study of language, cognition and directed brain networks.* DS 426.

February 2020

- **Duijnhoven, H.J.R. van,** *The challenges of dynamic balance and gait for people after stroke.* DS 424
- **Kyriakou, E.I.,** *Unravelling the behavioural and molecular hallmarks of Spinocerebellar Ataxia type 17 (SCA17). Studies on a transgenic rat model.* DS 423.
- **Thorin-Krutwig J.,** *Can you hear what you cannot say? The interactions of speech perception and production during non-native phoneme learning.* DS 420.
- **Zaadnoordijk, L.,** *Discovering Structure in the Confusion: An Interdisciplinary Approach to Studying the Sense of Agency and its Development.* DS 417.
- **Trujillo, J.P.,** *Movement Speaks for Itself: The Neural and Kinematic Dynamics of Communicative Action and Gesture.* DS 419.
- **Zheng, M. X.,** *Control and Monitoring in Bilingual Speech Production: Language Selection, Switching, and Intrusion.* DS 413.

March 2020

- **Wynn, S.,** *Haven't I seen you before? Measurement and manipulation of episodic memory confidence.* DS 418.
- **Dijkstra, N.,** *Envisioning imagination: neural overlap between visual imagery and perception.* DS 414.

April 2020

- **Goselink, R.J.M.,** *Growing up with FSHD. Characteristics of early-onset FSHD and childhood FSHD.* DS 425.
- **Eidhof, I.J.M.,** *Common Biological Denominators and Mechanisms underlying Ataxia-like Motor Dysfunction: from Human to Fly.* DS 428.

How we understand each other in a shared cognitive space

Why are we able to so easily understand a word, a gesture, and even abstract combinations of colons, dashes and brackets? Arjen Stolk and Ivan Toni are on a mission to find out as part of the interdisciplinary Language in Interaction project.

Suppose someone starts talking to you about a bank. They could refer to a riverbank, to the local ING bank, or even to a 'bank shot' during a basketball match. You'll probably know what they mean instantaneously because of the context: you're either on a fishing trip, someone is holding a bank card in his hand, or you've just finished watching a basketball match.

This is the effect of what Stolk and Toni call a 'shared cognitive space'. "Communication is about much more than just sending and receiving messages," Stolk explains. It involves a mixture of the existing knowledge of all the communicators, wherever you are, the history you share, the presumed goal of the interaction, and much more. "People have individual knowledge to start with, but we suspect that, in communication, they continuously negotiate in order to keep their knowledge aligned with others. By doing so, they develop a shared knowledge space that provides critical context for using and interpreting communicative messages."

Ivan Toni *Arjan Stolk*

Simply knowing all the possible meanings of sounds, gestures or language is not enough. Striking examples are the limits of artificial intelligence systems equipped with virtually unlimited vocabularies. Stolk: "Ask Apple's Siri for a river bank where there's good fishing and it will probably send you to the nearest ING bank. For some reason, this is not a problem for us humans. We often grasp an intended meaning quickly, even when we don't speak the same language or when we have completely different backgrounds. We want to understand how this is possible."

AUTISM

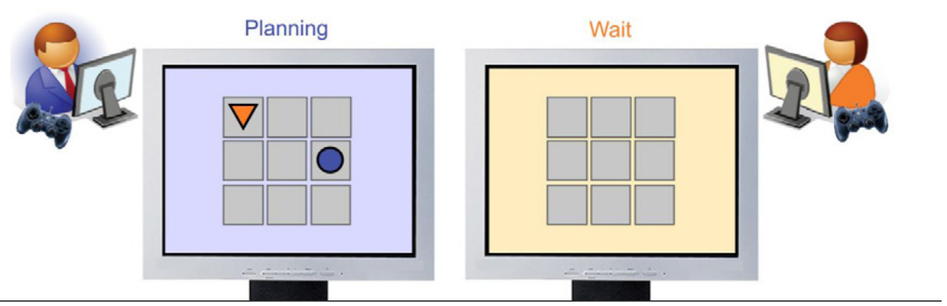
Last year, Stolk and Toni discovered that communicative problems experienced by people with autism are related to their ability to update this shared cognitive space. This is a refreshing view that challenges existing theories which trace the communicative challenges in autism to a lack of cognitive perseverance or social motivation. For his research on this, Arjen Stolk recently received a Rising Star award from the Association for Psychological Science.

Involving people with autism in this field of research has several advantages. Toni: "Investigating what goes wrong is a good way to understand the fundamentals of communication, and what we can do to fix the problem."

Right now, the 'shared cognitive space' is more an open question than a precise answer. Toni: "Thinking about that question is valuable because it helps us confront the complexity of human communication. In our daily interactions, we choose signals that help us to create a shared context on the fly. We are so focused on the signals that we often forget that we are continually generating the context needed to interpret those signals. This also explains how we can communicate even without a shared language. We constantly build and refine a shared cognitive space with our interlocutors, even when the signals don't (yet) refer to a commonly agreed meaning."

SYNCHRONISING THE BRAIN

In order to capture and understand how a shared cognitive space is constructed, Stolk and Toni created situations in which research participants needed to invent new ways to communicate. The participants did not know each other and they needed to find a way to interact via a computer screen, without seeing or hearing each other. They used two MRI scanners to measure the brain activity of two participants simultaneously.



The participants were shown a game board and a blue and orange shape (see image), each controlled by one or other of them. Only one of them saw the target configuration. This required him or her to 'tell' the other where the orange shape needed to go, using only movements of the blue shape.

The result was striking, Stolk explains. "We could see them creating their own system of communication. With signals like 'wiggling' the shape up and down, holding it in a place for a longer or shorter time." Even when the complexity was increased, the participants were able to rapidly adapt their communication system. Toni: "Of course they shared some general knowledge about computers, and they knew that they were both research participants but, other than that, their shared cognitive space was very limited at the start."

By stripping down everyday interactions, the researchers could see how a brand-new shared cognitive space was created and what happened in the brain. Stolk: "We see brain activity in particular brain areas synchronise when participants are inventing and developing a communication system." Interestingly, there was no synchrony when the participants didn't need to expand their communication system. In other words: synchronisation occurred only when they updated their shared cognitive space. What's more, the parts that became active are not typical language areas. Toni: "These areas are involved in flexible conceptual processing, such as the ones we use when we are making sense of the world around us."

THE POWER OF THE HUMAN BRAIN

The ability to constantly create a shared cognitive space is a powerful tool. It implies that we can instantly build new ways to communicate and understand each other in virtually infinite ways. "Communicative flexibility makes the human situation rather special," says Toni. "Communication between other animals is less ambiguous. They use signals that have clear and invariant meanings. A South African honeybee signalling the location of a patch of flowers would be immediately understood in a New Zealand beehive."

This field of research is relatively new. Stolk and Toni are currently setting up new experiments using laboratory tests like the one above. A big advantage of these experiments is that they are less boring for participants than typical laboratory tests. Stolk: "On some occasions, after opening the door of the scanning room, a participant walked straight passed me to discuss with the other participant what they meant to say with this or that move. They genuinely enjoy doing it!"

Roeland Segeren

Autism, big data and curiosity: the ABC's of three Vici grants

Three researchers at the Donders Institute were awarded the prestigious Vici grant this year. They will each receive €1.5 million from the Dutch Research Council (NWO) to set up their innovative line of research. The three scientists talk about their latest work and their drive for knowledge.

Associate professor ANNETTE SCHENCK will investigate the neuronal and molecular mechanisms underlying habituation, the most simple and ancient forms of learning. With her team, she will explore this as a translational tool in order to identify novel approaches to treating intellectual disability and co-occurring autism spectrum disorders (ID/ASD).

"I don't regard autism and intellectual disability as being untreatable"

"Currently, these disorders are regarded as untreatable. I don't share this view, and we'll aim to break this paradigm. If we succeed for even a single disorder, this would greatly stimulate research and research funding, leading to further successes."

"Habituation seems to be widely affected in ID/ASD disorders. We've established a pipeline to measure this, with high efficiency, in the fruit fly (Drosophila), a powerful genetic model organism. This opens up completely new possibilities."

"We will address which of more than a hundred ID/ASD fruit fly models with cognitive deficits are genetically reversible in adulthood. This will identify those disorders with the potential for intervention."

"We'll also test a large number of drugs that could rapidly be applied in the clinic for their potential to improve habituation learning deficits. Until now, it hasn't been possible to test large numbers of drugs for their ability to correct a cognitive defect in an animal model. The tests used in conventional vertebrate models are far too laborious and costly to conduct at such a scale. We believe we can uncover drugs with entirely new, unexpected mechanisms. For patients, this would mean novel, better drug candidates and better clinical trials. This could ultimately lead to treatment that improves the quality of life.

"Why do I work in this field? Because ID/ASD disorders are such a pressing medical problem. Their lifelong nature imposes an extreme burden on patients, families, and society. They affect millions of people and are the most expensive disease category to treat –more costly than cancer or diabetes. Even small improvements could have a large impact. And, like all neuroscientists, I want to understand how the brain works. Disorders can tell us a lot!"

Professor CHRISTIAN BECKMANN'S research focuses on developing novel methods for imaging neurosciences. His plan with the NWO grant is to develop new tools for brain connectomics.

"Two innovations have taken place in recent years within the field of big data. The first relates to the significant contributions that neuroimaging have made to our understanding of human brain function. We're able to detect more and more about gradual change and variations in the brain activity of a single patient."

"The second innovation has to do with analysing all the collected data. There's a large variety of imaging techniques at our disposal as well as other types of data, such as genetic data or information from questionnaires. Its intricate nature requires sophisticated modelling and analysis to infer interpretable quantities of interest. Tremendous progress has been made in this, and it's now possible to make assumptions about what an average, healthy, homogeneous patient would be like."

"The Vici grant will be used to embed these innovations and thus use big data within the medical domain for precision medicine. Precision medicine involves tailoring medical treatment to individuals' specific characteristics or making individualised predictions about the progression of a disorder. In other words, how can the medical data of patients help doctors find the best treatment for a particular patient?"

*"Big data **can** be used in precision medicine"*

"For this research, much of our data comes from the UK Biobank project, which will hold information on about 100,000 individuals. This data is being collected from NHS-registered patients in the UK. We'll see if we can use this data to make prognostic predictions about a novel cohort of Parkinson's disease patients that the 'Parkinson Op Maat' (Parkinson's tailored) project is imaging in Nijmegen.

"We not only hope to make correct predictions but that the approach we develop will also be generic so that we can apply it to patients with other conditions as well."

"From the start, I've been interested in how something seemingly simple can do complex things. A single neutron is simple but, working together, neutrons can perform extremely complicated tasks in the brain. How can we use mathematics and imaging to try to understand this better? That is where my passion lies."

"I've always been curious about curiosity"

Professor SABINE HUNNIUS examines the role of curiosity in child development. Together with her research group, she will explore the mechanisms underlying curiosity and whether children differ in their degree of curiosity.

"Studying curiosity means discovering what drives people to learn new things. I've always been curious about curiosity and its link with child development. It's an everyday miracle how a helpless baby learns to walk, point, and communicate. What makes young children explore and learn new things? In a series of behavioural and neuroimaging studies with young children, we'll examine the neurocognitive foundations of curiosity in early childhood. We'll study this phenomenon both in controlled lab situations as well as during natural development."

"Why does a baby try to learn to walk when he or she can get around just fine with crawling? This is one of the questions that fascinate me, namely what the driving force is behind developmental change. I think that babies might be intrinsically motivated to learn new things. In other words, once a baby no longer makes any progress with crawling, he may become interested in learning something new: walking."

"I also want to know whether some children are more curious than others and whether this has an impact on their long-term cognitive development. Do more curious children become smarter adults? To understand the effect of early curiosity on cognitive development, we'll follow a group of children from early childhood to school age."

"Finally, I'll investigate how curiosity-driven exploration can be fostered and consequently, how optimal circumstances for learning can be created for *all* children. We'll examine the malleability of children's curiosity in a set of experimental studies and then leverage the new insights to develop coaching for those working with young children."

Vanessa Deij

THE MACHINE

Size matters: slim, light-weight headband facilitates large-scale sleep research

A headband currently being developed by Arenar, a Nijmegen-based start-up, in collaboration with the Donders Institute, will help researchers to conduct more realistic large-scale sleep studies. It will make the complicated process of collecting data during sleep much easier.

Typical sleep studies cover only a few dozen participants. But, Arenar's thin, light-weight device can be worn by participants without external help. Thus, they don't need to be present at the institute to take part in studies. This results in longitudinal research involving hundreds of participants at a fraction of the cost for similar studies. Moreover, as the study is carried out at the participants' home, which is their natural environment, the quality of the collected data is better. "People sleep differently each night. In the past we couldn't pick up these patterns during typical sleep studies as we weren't able to study participants for a long period of time. The fact that you can wear it at home makes the results more realistic than in laboratory settings," said Dr Martin Dresler of the Donders Institute. The institute, which joined the project last year, is working towards acquiring scientific validation for the EEG sleeping band. "In a jointly supervised PhD project, we're developing and testing machine-learning algorithms so that recorded sleep data can be automatically analysed," added Dresler.

Arenar started developing the product, which it has tested extensively, three years ago. The device suffers from one significant disadvantage. As it consists of only three electrodes, it picks up fewer signals than the standard EEG device (which typically has between 8 and128 electrodes). However, Dresler says that for certain research applications, the advantages outweigh the issue of lower signal quality.

The device measures brain activity, eye and physical movements during sleep. Next to sleep research, the Donders Institute is planning to use it for other scientific purposes as well. One of them is depression research, as some sleep-related variables can be early indicators of changes in the state of depression.

Daan Appels

DONDERS INSTITUTE Newsletter

The Donders Newsletter is published twice a year by the Donders Institute for Brain, Cognition and Behaviour, which brings together research groups at Radboud University and the Radboudumc as well as the Max Planck Institute for Psycholinguistics. Its purpose is to keep you informed of developments within the Donders Institute and the wider field of neuroscience.

Editors: Roeland Segeren, Mike Gould, Ellen Lommerse, Eelke Spaak, Inti Brazil, Bert de Vries, Nathalie Bovy
Editorial Board: Eelke Spaak, Inti Brazil, Bert de Vries, Nathalie Bovy, Roeland Segeren
Text: Daan Appels, Vanessa Deij, Roeland Segeren
Photography: Dick van Aalst
Layout: gloedcommunicatie
Printing: DPN druk en print Nederland

Would you like to receive the Donders Newsletter or to inform us about a change of address? Please send an email to Marcia Viergever at m.viergever@donders.ru.nl