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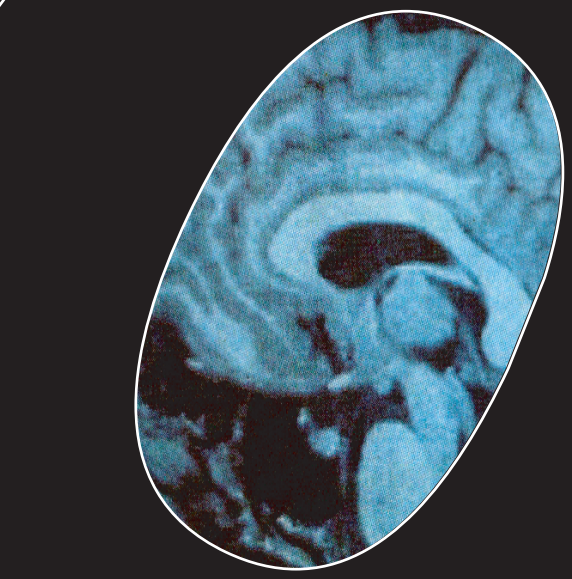
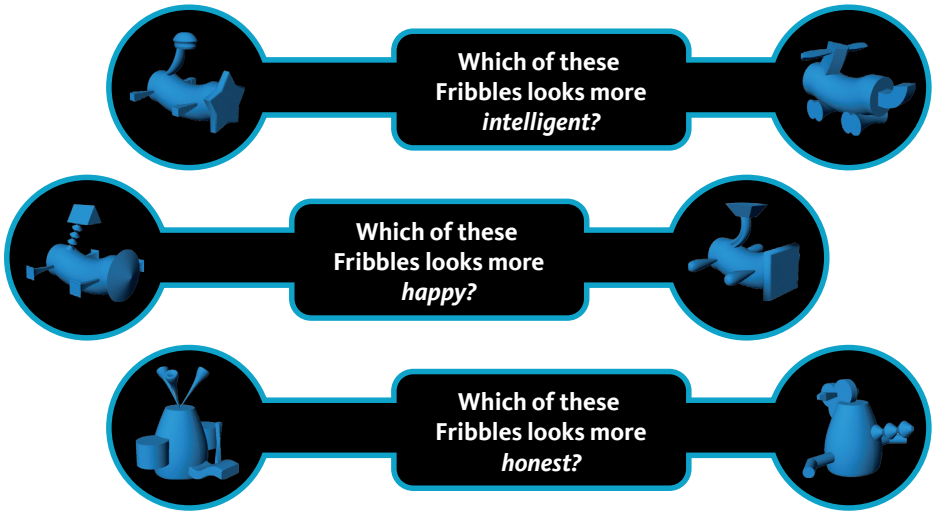
Donders Institute
for Brain, Cognition and Behaviour
Newsletter

The Donders Newsletter is published three times a year by the Donders Institute for Brain, Cognition and Behaviour, which consists of research groups at Radboud University Nijmegen and the Radboud University Nijmegen Medical Centre as well as the Max Planck Institute for Psycholinguistics. Its Purpose is to keep you informed of developments and important news in the field of neuroscience.



I should like to extend a warm welcome to readers of this edition of the Donders Institute Newsletter. In this we feature interviews with Markus Ullsperger of the Donders Institute and Daniel Casasanto of the Max Planck Institute. New features for the Newsletter are the interview with Guillén Fernández publicising the upcoming Donders Lecture of Eleanor Maguire and the short news items. Of course there are our regular items with Gunther Windau featured in the backbone and further information on ongoing activities in the Institute. I wish you all pleasant reading!

David Norris



How bodily experience shapes the mind

Daniel Casasanto and his colleagues explore big research questions, such as how do language, culture and bodily experience shape the human mind? Scholars have long believed that our repertoire of concepts is largely determined before birth. But, according to Casasanto, 'even our most abstract concepts depend on our experiences within both the physical and the social world.' Unravelling the mind through Fribbles, marbles and playing with dominoes...

How does experience shape the way people think? Are concepts universal or are they shaped by the particulars of our experience of the physical and social world? For a long time, cognitive scientists have thought that most of what is interesting about the human mind is innate. 'But experience shapes the mind in more ways than we realised and on different time scales,' says Daniel Casasanto, research scientist at the Donders Institute and the Max Planck Institute for Psycholinguistics.

Casasanto distinguished three broad streams of experience: language, culture and body. The distinction raises the research question: in what ways do people with different linguistic, cultural, or bodily experiences think differently? Scholars have long debated how language and culture shape the mind. But, because thinking depends on brain areas that control bodily actions, 'people with different kinds of bodies should think differently', Casasanto postulates in his 'Body-Specificity Hypothesis', which was formulated in 2009. 'People who interact with their physical environments in fundamentally different ways should form correspondingly different mental representations.' To test this theory, Casasanto conducted a series of experiments with right and left-handed people, who – it turns out – perform actions using different parts of the brain.

In one fMRI study, which was published in Psychological Science in January 2010, participants read words for actions that people usually perform with their dominant hands (such as throw and grasp), and actions they perform with other parts of their bodies (e.g. kneel and giggle). While reading words for hand actions, right-handers activated motor areas in the brain's left hemisphere (which controls the right hand), whereas left-handers activated motor areas in the right hemisphere.

'Cognitive neuroscientists had concluded that left-hemisphere motor circuits support the understanding of action verbs, presumably because language is left-lateralised,' says Casasanto. 'Our data show that the laterality of premotor activity during action language processing is not determined by the hemispheric correlates of language, but rather by the hemispheric correlates of bodily action.'

Daniel Casasanto, researcher and opera singer

'Experience shapes the mind in more ways than we realised and on different time scales...'

Smart and happy Fribbles

'It's one thing to show that people with different bodies understand particular actions differently,' says Casasanto, 'but a real challenge for body-specificity theory is to show how bodily experience shapes even highly abstract concepts such as 'goodness' and 'intelligence' – things we can't see with our eyes or touch with our hands.'

To find out whether abstract concepts can be body-specific, Casasanto showed university students pairs of alien creatures from the planet 'Fribbalia'. When right-handers saw Fribbles on the right side of a page, they judged them to be happier, smarter, more honest and more attractive than Fribbles on the left side. Left-handers showed exactly the opposite pattern. The same was true when 'righties' and 'lefties' judged which product to buy or which job applicant to hire (based on brief descriptions found on the left or right of a page.

So, is handedness merely correlated with differences in judgements, or does the way people use their hands shape their thoughts and feelings? 'The problem with comparing natural right and left-handers is that you can't establish causal relationships between hand and mind.' To solve this problem, Casasanto and team conducted a training study on natural right-handers, handicapping either the left or right hand with a bulky ski glove while they performed a motor task (arranging dominoes on a tabletop). 'Essentially, we turned half of our righties into lefties.'

After motor training, participants were ushered to a different room, with a different experimenter who was speaking a different language, where they performed a seemingly unrelated preference test using only verbal responses. 'Righties who had had their right hand free during training made implicit associations between 'good' and 'right', as expected. But righties who had worn the glove on their right hand showed the opposite pattern, implicitly associating 'good' with 'left', as do natural lefties.'

The ski glove experiments make a causal link from body to mind. Based on results such as these, Casasanto concludes, 'people's preferential judgements depend on the way they interact with the physical world. Even our most abstract ideas depend, at least in part, on the way our bodies work.'

Moving marbles modifies memories

Bodily experiences can have immediate influences on abstract thoughts. In a study published in the April 2010 issue of Cognition, Casasanto shows that motor actions can cause people to focus on the positive or the negative. Students were asked to move glass marbles upwards or downwards from one cardboard box to another, while recounting autobiographical memories. Moving marbles upwards caused participants to remember more positive life experiences, whereas downward movements prompted negative life experiences. 'Spatial metaphors for emotion, such as being on top of the world, or down in the dumps, correspond to such mental metaphors. Activating the mental metaphor 'good is up' can actually cause us to think happier thoughts.'

Language, culture, and body

The body provides a single 'stream of experience' but, as Casasanto emphasises, in other work his team have shown how language and culture also shape the way people think. 'We've discovered that experience shapes the mind in deeper ways than we thought. Differences between languages and cultures influence our most basic mental representations and differences between bodies shape the kinds of judgements we make on a daily basis. Part of the fun now is finding out why certain streams of experience shape particular mental capacities, and how the influences of language, culture, and body combine.' Time to go back to Fribbalia...

IR

Oops – I made a mistake

Last year Markus Ullsperger was proudly welcomed at the Donders Institute as Full Professor of Biological Psychology. He is working on the fascinating field of error detection in the brain. 'I'm very happy that I can broaden my research here in Nijmegen.'

In his office a so-called 'Wordle' brightens up the neat room. The size of the words is based on the word frequency in his research papers in the first decade of the 21st century. Error is the word that stands out most prominently.
Markus Ullsperger has a profound passion for neuro research. 'I was catching up recently with an old school friend from back in the days that East Germany still existed. He wrote to me enthusiastically that I was doing exactly what I was dreaming of in high school. I'd forgotten that I had been so explicit about my fascination for brain research... but, if he remembers it, it must be true. I was primed by my upbringing -- my father was involved in EEG studies and got me to write software for his tests as soon as a computer came into our house in the 1980s.'

'Nowadays you might choose to study psychology and try to specialize in cognitive neuroscience, but I went to med school. There I was presented with attractive alternatives like becoming a surgeon, a neurosurgeon preferably. But at the end of my studies I tried to get away from my father's path and took up a PhD position at a biochemical research lab. But I didn't get on so well with heat shock proteins...'

He found a job at a Berlin hospital but on the way to becoming a clinician he revived his old passion for research. He applied for and won a grant, and happily exchanged his work at the hospital for a position at the Max Planck Institute in Leipzig. He did his PhD on EEG correlates of inhibitory processes in memory. Since 2000 he has focused on performance monitoring, cognitive control and flexible, adaptive behaviour.

Genetic variation

So what precisely has Ullsperger contributed to this field? In 2007, he discovered a genetic variation underpinning discrepancies in learning ability in a healthy population (Science 2007). 'Learning is based on avoiding negative and gaining positive feedback. Animal and patient studies show that dopamine plays an important role in this. We've demonstrated that variations in learning ability are partly based on individual differences in a gene for the D2 dopamine receptor. A variant of this gene, called A1, results in up to a 30 percent reduction in the density of those receptors on nerve cell membranes. Participants who were A1 carriers were less able to remember – and avoid – negative feedback than those who did not have this form of the gene. Accordingly, our fMRI results show that the medial frontal cortex of A1 carriers generates a weaker response to errors than it does in other people, suggest-

Markus Ullsperger

'One of my ambitions is to participate in a genome-wide study to discover genetic variants linked to error detection, learning and behaviour.'

ing that this brain area is one site where dopamine affects learning from negative feedback.'
Now, three years later, Ullsperger puts his own results into perspective. 'One genetic variation is not so impressive these days. One of my ambitions is to participate in a genome-wide study to discover genetic variants linked to error detection, learning and behaviour. The BIG study, in which Radboud Universiteit Nijmegen is participating, provides a beautiful basis for this. I would like to do explorative research on this as well. If you only do hypothesis-driven research, there's a risk of missing new angles.'

Exciting vistas

Although Ullsperger had only started his own cognitive neurology group at the Max Planck Institute in Cologne two and a half years earlier, he made the move to Nijmegen in 2009. With his fortieth birthday in sight, tenure being sparse in Europe and considering his good experience with people at the Donders Institute, it was an obvious choice.
So, what are his plans? 'I've never had an animal lab before, so that opens exciting new vistas. There are many things you can't do with human subjects that are possible with rodents. For example, in animals we can use much more specific pharmaceuticals and we can apply them at specific locations (as opposed to systemically in humans). You can't make lesions in human brains either.

Will 'error' still be the most prominent feature of a wordle of Ullsperger's Nijmegen work made in say ten years from now? 'Hmm, good question. Probably not, although it will still stand out. In my new lab we have some good models for pain. Acute pain and error detection are closely linked: they are very instructive about the results of your actions. I'm even thinking about studying effort – also linked to risk avoidance. Before starting a task you make an estimate of the effort, the reward, the chances of making mistakes, the expected outcome etc. I'm really curious how the brain balances all these interests.'

IR

Coming soon:

Simultaneous EEG and fMRI: Recording, Analysis, and Application
Markus Ullsperger and Stefan Debener
(First edition, April 2010)
ISBN13: 9780195372731

Tell-tale changes

'Another important discovery is that many mistakes, whether made through inexperience or inattention, are foreshadowed by tell-tale changes in brain metabolism according to research my team published in 2008 in PNAS. Starting about 30 seconds before our subjects made an error, we found distinct but gradual changes in the activation of two brain networks. One of the regions, which belongs to the default mode network, is usually more active when you're at rest, and quietens down when you're engaged in a task. But, immediately prior to an error, the posterior part of this network, which includes the retrosplenial cortex (located at the surface near the centre of the brain), became more active, indicating that the mind was relaxing. Meanwhile activity has declined in areas of the frontal lobe that spring to life whenever a person is working hard on something, suggesting that he or she was becoming less engaged in the task at hand. Our results show that errors are the product of gradual changes in the brain rather than unpredictable blips in brain activity.'

Meanwhile at www.ru.nl/donders

Novel insights on Parkinson's disease

Some patients with Parkinson's disease have problems with walking, whereas they can cycle without any problems. These are patients who, while walking, suffer from unexpected 'freezing' of their movements, which can make them fall over. Registrar in neurology Anke Snijders and neurologist Prof. Bas Bloem explain this issue in the New England Journal of Medicine.

Remarkable movie experiment on memory formation

How the brain integrates new information within established knowledge networks is an intriguing question for memory researchers. It has now been shown that when there is insufficient prior knowledge on a certain subject, the brain seeks more resources in order to process new information adequately, not only during, but also after learning, when the brain is resting. Donders' neuroscientist Marlieke van Kesteren and colleagues examined this process by showing participants in a study the first part of a movie that was presented either in normal sequence or scrambled. The results were published in the Proceedings of the National Academy of Sciences of the USA (PNAS).

Brain database shows age and sex differences in brain functioning

By collecting brain scans from a number of universities around the world, researchers including Donders Professor Rolf Kötter have constructed a large database of resting-state brain scans. These scans, which are obtained while participants are resting (i.e. not performing a task) in an MRI scanner, can be used to discover how different brain regions cooperate with each other by measuring the connectivity between these regions. By comparing resting-state scans of 1,414 participants, the researchers were able to assess age and sex differences in the connectivity profiles. They found considerable differences between young and old as well as between male and female brains and published these findings in the Proceedings of the National Academy of Sciences of the USA.

Honorary degree for Marta Kutas

Radboud University Nijmegen will celebrate its 87th Dies Natalis on 20 May 2010 and on that occasion the university will present Professor Marta Kutas of the University of California in San Diego with an honorary degree.

Marta, who is one of the most respected neuroscientists in the world, made a major contribution to developing cognitive neuroscience during her distinguished career. She has helped our university set up neuroscientific research opportunities and she has collaborated with many scientists from Nijmegen. Marta is perhaps best known for her EEG research on the N400 effect, the EEG response to a word that doesn't fit properly in a sentence.

Ole Jensen receives a Vici grant

Ole Jensen, Principal Investigator at the Donders Institute for Brain, Cognition, and Behaviour, has received the prestigious Vici grant from the Dutch Science Foundation (NWO). This grant will give him the opportunity to set up a new research line within his group. Ole will use his Vici to investigate oscillatory mechanisms that regulate the information flow in the brain. By modulating neuronal oscillations using various behavioural tasks, while concurrently measuring electrophysiological brain activity, it will be possible to reveal how the brain regulates the continuous incoming stream of information. This information can be very helpful for optimizing brain-computer interface technologies.

Publication of the 5th issue of the Nijmegen CNS Journal

The fifth issue of the Nijmegen Cognitive Neuroscience Journal is now available. This unique student journal, which was first published in 2006, is the result of attempts to find a suitable platform for the scientific accomplishments of the students in the Research Masters programme in Cognitive Neuroscience and to share them with other institutes and laboratories. It also presents a unique opportunity for each student to become familiar with the process of scientific publication. Each year, the best Masters theses are published and all are available online, as is a digital version of the journal itself.

Pay a regular visit to our website to keep up to date on our news and events.

Taxi driver, a penny for your thoughts

In the Donders lecture series outstanding researchers in the field of brain and cognition present their work and ideas to a broad audience of scholars with a wide range of backgrounds – from neuroscience to psychology and linguistics. It is one of the ways the Donders Institute builds connections with the global scientific community.

Prof. Guillén Fernández, who works in cognitive neurology, invited Prof. Eleanor Maguire. Why?
'Because she's simply the most creative memory researcher in the world. The quality of her work is outstanding. She invents truly innovative approaches. Do you know the famous taxi-drivers experiment – the study that revealed structural and functional plasticity in the brain after the massive task of memorizing London's streets and alleys? Well, it's hers.

What have you learned from Prof. Maguire?
Her approach bridges the gap between highly controlled experimental settings and real life. For example she introduced movies as a tool for use in memory research. Remembering episodes in a movie is much more realistic than traditional tasks with words and simple pictures. We successfully adopted her movie idea, which resulted in a recent paper in PNAS on memory consolidation. But her most novel work involves relating patterns of brain activity to memories or spatial positions. And she really can 'read' the brain! Increasing the temporal and spatial resolution of brain imaging will make these results even more spectacular.

"Decoding memories in the human hippocampus"

Eleanor Maguire (3 June)
Wellcome Trust Centre for Neuroimaging, University College London, London, UK
Also see www.ru.nl/donders

Donders Backbone

Due to its academic nature and high ambitions, staffing at the Nijmegen-based Donders Institute is extremely dynamic. Postdoctoral researchers and PhD students fly in from around the globe. Technicians, lab workers and research assistants form the backbone of the institute. Günter Windau is one of those constant factors.

Günter Windau (43) has worked as an electrical engineer in the biophysics department of the Donders Centre for Neuroscience (DCN) since 1990. "We do a lot of experimental research with human subjects and animals. We are generally examining processes in the brain, such as the vestibular, visual and auditory systems (for balance, sight and hearing, respectively). How do brains process sensory stimuli? We construct the measurement setups for experiments and we're always trying to come up with beautiful, elegant solutions to technical problems. I have been an electronic engineer from the very beginning, and I've always been interested in measuring the human body. Medical electronic technology was a favourite subject during my training at Eindhoven HTS (Institute of Technology)."

"One of the best pieces of equipment that we've built – in partnership with the instrument-making section in the Faculty of Sciences – is a vestibular stimulator. It's a huge chair that can rotate in all directions to influence the vestibular system of test subjects, especially to see how their visual system responds. It was a considerable challenge to build. The heavy engine requires high voltage, but you want to be able to make subtle measurements, too, without interference from such a motor. Safety was also a factor, since the test subjects mustn't be harmed by a measurement rig. It's a nice mix of mechanical engineering, electrical engineering and software development."

Günther Windau

Three years ago, Günter discovered the saxophone. Playing music was one of those things he hadn't done in his youth, and he's always wanted to remedy that. "My two children are in a local brass band. Every Friday night their father sat at the practice session, waiting for them. Now Dad plays the saxophone himself. It's a beautiful instrument. You can play it soft and sultry or loud and funky. This afternoon, five of us from work will be in the canteen after work to kick up a ruckus. Once every two months we jam a little, just for fun. I enjoy it enormously. "

Making music was deliberately chosen as a kind of safety-valve. "I have a great sense of responsibility and I'm quite a perfectionist. Everything I start, I want to do as well as possible. I get most satisfaction in my job from combining systems management, programming and electrical engineering, but there are only 24 hours in a day. There's a real risk of getting over-stretched because of your own enthusiasm. I've pulled back from that a bit, which is also a reason for the music. I can express all of my feelings when I'm playing."

Agenda

3 June 2010, 16:15
Donders Lecture by Eleanor Maguire (Wellcome Trust Centre for Neuroimaging, University College London)
Linnaeusgebouw, Heyendaalseweg 137, Nijmegen

25 June 2010 15:45
Inaugural Lecture Paul Tiesinga (Donders Institute for Brain, Cognition and Behaviour)
Aula Radboud University Nijmegen, Comeniuslaan 2, Nijmegen

28 June - 2 July 2010
Toolkit of Cognitive Neuroscience 2010
Centre for Cognitive Neuroimaging, Kapittelweg 29, Nijmegen

6 July 2010
FENS: Donders Proudly Invites
Vertigo, Vondelpark 3A, Amsterdam.

2 September 2010, 16:15
Donders Lecture by John Gabrieli (Department of Brain and Cognitive Sciences, Harvard-MIT)
Linnaeusgebouw, Heyendaalseweg 137, Nijmegen

24 September 2010
EU Researchers' Night: Night of the Brains
Lux Theatre, Marienburg 38, Nijmegen

PhD defences

28 April 2010 - **Wyczesany, M.** (2010). Covariation of mood and brain activity. Integration of subjective self-report data with quantitative EEG measures.
27 May 2010 - **Derks, N.M.** (2010). The role of the non-preganglionic Edinger-Westphal nucleus in sex-dependent stress adaptation in rodents.
31 May 2010 - **Dado – Van Beek, H.E.A.** (2010). The regulation of cerebral perfusion in patients with Alzheimer's disease.
2 June 2010 - **Snijders, T.** (2010). More than words – neural and genetic dynamics of syntactic unification.
4 June 2010 - **van Dijk, J.P.** (2010). On the Number of Motor Units.
4 June 2010 - **Lapatki, B.G.** (2010). The Facial Musculature – Characterization at a Motor Unit Level.
8 June 2010 - **Kok, P.** (2010). Word Order and Verb Inflection in Agrammatic Sentence Production..
23 June 2010 - **Majdandzic, J.** (2010). Cerebral mechanisms of processing action goals in self and others.
24 June 2010 - **Beurze S.M.** (2010). Cortical mechanisms for reach planning.
28 June 2010 - **Nieuwenhuis I.L.C.** (2010) Memory consolidation: a process of integration. Converging evidence from MEG, fMRI and behavior.
2 July 2010 - **Menenti L.**(2010) The right language: differential hemispheric contributions to language production and comprehension in context.
26 August 2010 - **Grootens, K.P.** (2010). Cognitive dysfunction and effects of antipsychotics in schizophrenia and borderline personality disorder.

Donders Institute Newsletter

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