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Large EU Grant to Project on Haptic Perception

Prof. dr. Astrid Kappers from the Physics of Man group of the Helmholtz Institute participates in a collaborative project entitled ‘The hand embodied’, which was recently granted over seven million euro from the European Union. Nine research groups with backgrounds in industry as well as fundamental science will investigate how the properties of the physical hand (embodiment) determine its behaviour and the cognitive functions associated with it. For example, we have five fingers and twenty joints but only three fingers and nine joints are needed for grasping and manipulating of objects. This makes the hand seem overly complex, but the fingers and joints do not move completely independently: often the same combination of fingers and joints move, reducing the degrees of freedom and the complexity in the control of the hand. A major goal of the project is to determine these recurring motor patterns, or ‘synergies’, by neurophysiological and psychophysical measurements and to learn how they are used by the cognitive control functions. Kappers will conduct the psychophysical experiments since her lab has pioneered research on haptic perception, one of the main cognitive functions associated with the hand.

Haptic perception of three-dimensional shape provides an interesting case to study the relation between the physical properties of the hand and cognitive functioning, Kappers explains. When we touch an object, the perception of its shape seems almost effortless. But in fact the necessary processing is highly complex and needs cognitive knowledge of the physical structure of the hand. In her

lab, Kappers demonstrated that we are very good at sensing whether the cross-section of a cylinder is circular, but that this ability is greatly reduced for rectangular blocks. Thus, we are not sensitive to aspect ratio per se but to changing curvature. To feel the curvature of an object, information from the individual digits has to be combined. Moreover, their position has to be taken into account. If instead of calculating the position of the five fingers and twenty joints individually, the position of only a few synergies is used, the task would be greatly simplified.

The collaboration with the DLR (Deutsches Zentrum für Luft- und Raumfahrt in Germany makes it possible to test models of haptic perception directly on a hyper-realistic robot hand, an opportunity that Kappers is much looking forward to. The ultimate goal of the project is the development



of artificial hands or haptic interfaces which can have a real dialogue with the human counterpart, allowing for a more natural interaction with the environment. However, Kappers stresses that this is still a far stretch and that first a lot of experimental work has to be done. Compared to vision and audition, haptic perception is a largely uncovered field and is only recently gaining interest. The project not only gives Kappers the possibility to extend her work, it also shows that she has successfully promoted the field of haptic perception and that her group has become a reference in the European scientific community.

Walking in circles / Helmholtz Alumnus

When we have no clue where we are, we often end up walking in circles. Dr. Jan Souman, who obtained his PhD at the Experimental Psychology Group of the Helmholtz Institute, and is now at the Max Planck Institute (MPI) in Tuebingen, found empirical evidence for this common belief. In a recent *Current Biology* paper (September 2009), he shows how people, when asked to walk in a straight line, will walk in circles when walking in a forest on a cloudy day or in the desert at night. When people could use the sun as a directional reference, they managed to walk in an almost straight path.

Souman did not simply check whether people really walk in circles, he extensively investigated the underlying mechanism. Souman proposes that the circular path is probably due to the accumulation of sensory noise in the estimate of straight ahead, without external references to recalibrate it.

Accumulating noise in the directional estimate predicts that people will often end up going in circles, though not in a systematic direction.

We talked to Souman about how he uses his experience at the Helmholtz Institute in his current work. He feels that at the Helmholtz Institute, he received the technical training necessary to carefully design experiments and analyse the results. With this in mind, Souman mentions that whereas the field work in the desert and forest was much fun (how often do you get caught in a sand storm during your experiment?), it was also very difficult to do a well controlled study. When comparing working at the MPI and the Helmholtz Institute, Souman does not find many differences. The MPI may have even better research facilities, but this also brings with it a risk of getting too much concentrated on technology rather than science. Also, as more of the facilities are technical and sophisticated, more things that the researchers are unaware of can affect the experiments. Souman also notes that the MPI generates more media attention. The 'walking in circles' project attracted a lot of media attention and starred in a German television movie in 2007. Souman describes it as unexpected and even a bit overwhelming, but also rewarding and a lot of fun. From this experience, he learned how to be more selective about which interview to give or not, and to be more efficient, just by having prepared a few standard replies.

Souman's advice for new PhD students is to start running experiments as soon as possible because data often are the trigger for new ideas. At the same time he recommends starting to write a paper even before running the experiments, because this helps organizing ideas.



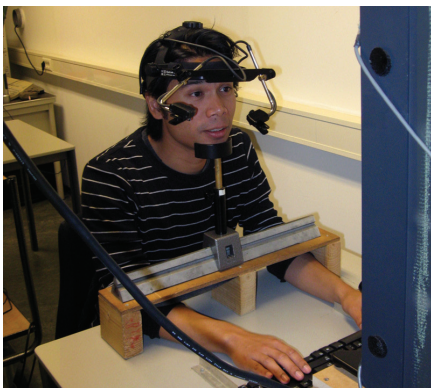
Bienwald forest (Germany). Trajectories from participants who walked on a cloudy day (blue trajectories) or when the sun was visible (yellow trajectories). One participant walked out of the forest and was asked to turn around.

Fundamental Versus Applied Science

Dr. Ignace Hooge from the Experimental Psychology group of the Helmholtz Institute has pioneered the use of eye tracking in the assessment of advertisement for research company IntoMart GfK. Recently, he explained on national television how the eyetracker can be used to check whether an advertisement manages to capture your eye movements. We ask him about his experiences with fundamental and applied science.

What attracted you in applied science?

I have years of expertise in eyetracking and eye movements which has been the subject of my PhD and my subsequent work as a postdoc at Berkeley and at Utrecht University. In advertising the eyetracker was already used, but often without enough knowledge about data analysis. I saw many possibilities for improvement and liked to translate my knowledge from one field to another. It is also fun to use knowledge from the lab for product improvement and communication. In fundamental research it is necessary to investigate some questions that do not seem very useful. But if you have made a discovery which can be of use to other people, you should not withhold your knowledge from them.



Stijn Massar demonstrates the Eyelink, a head mounted eye tracking device.

What differences do you find between applied and fundamental science?

The questions and answers are different, the process of problem solving in between is the same. For example, in fundamental science you'd ask whether a process is serial or parallel, but in applied

science you want to know whether a font is right for an advertisement. It is a different atmosphere, in applied science everything is about the application.



Heat plot of the target locations of individual eye movements (fixations). Red areas are frequently fixated.

What drawbacks do you experience in the applied work?

You have to watch out what you say, otherwise the sales people take a run with it. I feel that as a doctor you have responsibilities towards society and have to use the same quality standards for the applied and fundamental work. Sometimes it's difficult to maintain quality as you have less control over the entire process compared to experiments in the lab. In such cases you have to be creative, which opens new possibilities.

What results did you get from your applied work?

My teaching for the Applied Cognitive Psychology masters course at Utrecht University benefitted from my applied work. Many students do not want to work in academia and now I have a much better understanding of how their knowledge can be applied in industry. The applied work also brought new questions to my fundamental work. I was asked to give the global scanpath over an advertisement. This brought forth a more fundamental question on the degree of disorder between scanpaths of different observers. Now, I am searching for methods to catch scanpaths of hundreds of people over one image in one number. Your scope becomes bigger when you leave the ivory tower of fundamental science.

News & agenda

Helmholtz lectures

- December 11, 2009. Lynette A. Jones (MIT, USA) Role of thermal cues in object identification and discrimination.
- January 8, 2010. Eli Peli (Harvard, USA) Assistive devices for impaired vision.
- February 26, 2010. David Fitzpatrick (Duke, USA) Imaging experience dependent emergence of functional circuits in visual cortex.
- April 9, 2010. Irene M. Pepperberg (Brandeis/MIT, USA) Numerical abilities of grey parrots: Comparisons with apes and young children.
- May, 21, 2010. Matteo Carandini (UCL, UK) Making waves in visual cortex.
- June 18, 2010. Mark H. Johnson (London, UK) Developing a social brain.

PhD defences

- October 29, 2009. Dagmar Wismeijer (Physics of Man, Universiteit Utrecht) Eye movements in depth to visual illusions.
- November 2, 2009. Chris Muller (Human Movement Sciences, Vrije Universiteit) Uncertainty.

Media

- Newspaper 'De Telegraaf' featured an article about findings by Koen Bocker and Leon Kenemans (Experimental Psychology, Universiteit Utrecht) on cannabinoid modulation of working memory, which they recently published in *Journal of Cognitive Neuroscience*.
- VARA television show 'Weet wat je koopt' invited Ignace Hooge (Experimental Psychology, Universiteit Utrecht) to explain how we can measure whether an advertisement captures your eye movements.

New people

- Chantal Kemner (Experimental Psychology, Universiteit Utrecht) VICI project: 'I see what you mean: the basics of social processing'.
- Carlijn van den Boomen (PhD student), Suzan Nouwens (PhD student), Branka Milivojevic (postdoc) and Tineke Snijders (postdoc) will all be working on the VICI project of Chantal Kemner.
- Anouk Keizer, PhD student (Experimental Psychology) Project: 'Thinking, seeing, and feeling fat: Interactions between body attitude, body image, and body schema in Anorexia Nervosa.'
- Sjoerd Stuit, PhD student (Experimental Psychology, Universiteit Utrecht) Project: 'Long-range interactions in visual motion processing.'
- Siarhei Uzunbajakau, Technical assistant (Experimental Psychology, Universiteit Utrecht).
- Annelies Wester, Researcher, (Experimental Psychology) Project: 'The effects of atomoxetine on event-related potentials in response to auditory oddball stimuli during an on-the-road driving test in adult patients with ADHD.'

Grants and awards

- Astrid Kappers (Physics of Man, Universiteit Utrecht) participates in a project entitled 'The hand embodied,' which received a grant of seven million euro in the European theme 'Cognitive systems and robotics.'
- Stefan van der Stigchel (Experimental Psychology, Universiteit Utrecht) received an NWO Veni grant for a project entitled 'Eye can see it! Residual visual processing in the blind field of patients with visual field defects.'

Colofon:

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