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Interview Willem B. Verwey

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Willem B. Verwey, Ph.D., B.Sc. is
Professor of Psychonomics and
Cognitive Ergonomics

1. To start with, could you tell us something about your work and your scientific interests?

My work has always been characterized by a combination of applied and basic research on the use and development of perceptual-motor skills. In applied research this concerns issues like skill training using modern media systems, the use and interpretation of mental and visual workload, and performance assessment

in everyday settings such as driving. My basis research involves the basic psychological and neurophysiological mechanisms underlying the skilled production of movement sequences.

2. What was your educational background? When, how and where did your career begin? When you were studying, did you have any idea about the field of research that you wanted to go into? What made you enter the field of Human Factors/ Ergonomics? When you look back now, what can you say about that?

Well, you could see that my career is an example of chaos theory: One tiny event determining the rest of my career. It all started when I studied mechanical engineering and met Andries Sanders, at the time a professor of experimental and applied psychology at the University of Aachen. Given my interest to 'study something else' than mechanical engineering, he recommended me to study psychology (of which I only knew it had something to do with, uh..., Freud?). Sanders told me that the combination of an engineering and a psychology background would truly allow, what he called, 'back-to-back research': applied questions leading to basic research questions and basic results allowing solutions to practical problems. Sanders argued that I should study psychology at the Technical University of Aachen, Germany. And that is what happened, after finishing mechanical engineering, I went on with psychology, first in Utrecht and Leiden in the Netherlands, and later in Aachen, Germany.

Later, while looking for a place to do my master thesis, there turned out to be a position at the Traffic Behaviour Research group at the TNO Institute for Perception in Soesterberg, the Netherlands (later known as the TNO Human Factors Research Institute). My first task at TNO, a study for the Dutch Ministry of Transport on the in-vehicle presentation of navigation information, led to my master thesis. I was so lucky that after graduating I could stay at TNO. The first of many EU projects I became involved in was a project initiated and coordinated by prof. John Michon, then heading the Traffic Research Centre in Groningen. In this GIDS (Generic Intelligent Driver System) project, we conceptualized and built an intelligent driver-car interface. I felt really at home in this multi-disciplinary group including psychologists, various kinds of engineers, and computer scientists. My own focus was on preventing the system from overloading the driver with messages in demanding driving situations. I developed the concept of a workload table that, given the type of driver (age, experience) and driving situation, estimated the level of driver visual and mental workload. The detailed way in which the ideas in GIDS were conceptualized and evaluated was new at the time, and I still consider them highly innovative (see Michon, J.A. (ed.), *Generic Intelligent Driver Support. A comprehensive report on GIDS*. London: Taylor & Francis). Following GIDS I got the opportunity to work in many other EU projects and continued my work on driver overload, and started working also on driver underload.

While working on issues like skill and workload in driving, I started wondering why and under what circumstances mental workload decreases with practice. This brought me to my basic research line. The central tenet of this research is that practice induces representations of movement sequences in memory -- 'motor chunks' -- that allow a highly efficient, almost automatic way of movement production. This led to a series of experiments which together formed my PhD thesis. So, while working at TNO on applied issues, I received my PhD thesis on a basic research topic with prof. Sanders, who by that time had moved to the Free University in Amsterdam. In hindsight, I may conclude that I was in the very fortunate position to have a permanent job at TNO where I could develop these applied and basic research lines.

With time, there came an increasing pressure at TNO to acquire contract money, accompanied by a decreasing investment in basic research. This made me quit and go to the Institute for Occupational Health in Dortmund, Germany (IFADO) where I was hired by prof. Herbert Heuer, a well-known expert in motor behavior. I became head of the Movement Coordination and Training group. During my work in Dortmund I continued both research lines: applied research on driver training (together with especially Dr. Sascha Sommer), and basic research on movement sequences. In this period I also was a guest teacher at the University of Utrecht where, following a study with transcranial stimulation of the premotor cortex (with TMS), I developed a neurophysiological model for movement sequence production. I habilitated at Münster University in 2002 on a collection of my applied publications.

In 2003 I got a professorship in Psychonomics and Cognitive Ergonomics at the Technical University of Twente in Enschede, the Netherlands. I have been

working there in a difficult period of faculties and departments merging and being reorganized. Not an easy time to start a group, but the need for the faculty to develop a psychology program gave me the possibility to build up a department with, again, a basic and an applied research line. So, some people in my department are now working in close cooperation with engineers and computer scientists at our university on the potential of simulators and virtual reality, while others are investigating basic issues of movement skills. Truly an example of Sanders's back-to-back research.

3. What do you consider to be your greatest findings, discoveries or insights? In relation to this, can you name a few publications that you are most proud of?

I consider the development and evaluation of the GIDS driver workload estimator as a nice piece of work. This work has been published in 2000 and I still regret I wasn't able to pursue this issue any further. In that same year, David Zaidel from the Technion in Israel and I published a multidimensional model showing the factors associated with drivers falling asleep behind the wheel. These factors include several personality and behavioural variables. As to my basic research, I showed that not timing as was generally believed, but chunking is responsible for enduring segmentation of movement sequences (Verwey, 1996), and I developed a neurophysiological theory of producing movement sequences (Verwey et al., 2002). The reason I like these studies in particular is that they reflect the development of new insights (at least for me).

Verwey, W.B. (1996). Buffer loading and chunking in sequential keypressing. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 544-562.

Verwey, W.B. & Zaidel, D.M. (2000). Predicting drowsiness accidents from personal attributes, eye blinks, and ongoing driving behaviour. *Personality and Individual Differences*, 28, 123-142.

Verwey, W.B. (2000). On-line driver workload estimation: Towards an adaptive human machine interface in the car of tomorrow. *Ergonomics*, 43, 187-209.

Verwey, W.B., Lammens, R., & van Honk, J. (2002). On the role of the SMA in the discrete sequence production task. A TMS study. *Neuropsychologia*, 40, 1268-1276.

4. As a teacher and mentor of graduate students and junior researchers what is your philosophy on teaching and mentoring? What do you expect from your students? What can your students expect from you?

First of all, I think it is important to be clear what you expect from your students and junior researchers. They should know that you are there if they have a problem. I only close my door if I have a meeting and usually respond to emails within a day, that is, I think it is important to be easily accessible. I tell my students how important it is to perform a lot of experiments and that these should be based on good hypotheses, and how important it is to publish about these experiments in the peer-reviewed (ISI) literature. This requires creativity and guts from them, but also good knowledge of the literature so I tell them to read a lot. Furthermore, I tell them not to be narrow-minded and to be able to communicate

with other disciplines (be it engineering for applied research, and neurophysiological and biological disciplines for basic research), but without becoming alienated from our own discipline, psychonomics. I also explain that research is not a nine-to-five job. And finally, that ergonomics evaluation of systems and interactions requires a gut feeling as to what aspects of the system are critical and require evaluation and improvement, and what aspects may be based on expert's opinions.

5. Could you tell us something about your scientific vision.

Important developments in the area of ergonomics and human factors undoubtedly involve the gradual infusion of information technology into our working environment and into society in general. Like mobile phones and PDAs having the computational power of a 1970s main frame computer. I tell my students that this is 'our time': Requirements for technical systems are increasingly determined by the one major constraint: the human user. Technically we can build almost any system and implement any functionality now, but people's capabilities do not change that much. We, as cognitive ergonomists and psychologists, will have to show that system design should be based more and more, not only on the capacities of the potential user, but also on their interests and emotions. This requires advancements of what by people like prof. Parasuraman has been called 'neuroergonomics'. This is the assessment of physiological measurements to determine the state of the user. We as ergonomists should provide the guidelines (based on a proper understanding of human capacities) and we should evaluate the product with real people (using the methods for proper, scientifically sound experimentation we as psychologists are usually quit good at). I am not pessimistic about our chances here. The engineers I work with do see that psychologists and ergonomists provide added value and consider cognitive ergonomics as more than just 'common sense' (though a good talk may be needed first!). These system builders acknowledge that, eventually, a system that is not of interest to the public is bound to disappear into oblivion.

6. What, according to you, should change in our field?

What I feel is one major shortcoming of applied research is that so little use is made of insights from basic research, and the fact that so few publications come out of all the applied research. It is surprising to see how much money has been pumped into EU projects since the late 1980s, and to see how few publications in ISI journals this has produced. I guess this has evolved because applied researchers are hired as problem solvers and the report to a ministry or company is their endproduct: Yet the contribution of this type of work to scientific progress is virtually zero. Ergonomists should make better use of the possibilities to publish about general issues in their field; not just evaluate a specific system, but develop and test general guidelines and ideas. It seems that applied researchers are not sufficiently trained in publishing in peer reviewed journals. I would like to remind them that peer reviewing is essential, not only for improving a particular paper, but also for improving one's own thinking and research skills.

A problem with applied research often is that researchers feel they have insufficient time for background research. However, especially in projects going on for a specific amount of time, like most EU projects, they may use the time provided by the need to wait for the system to be built. Rather than complaining that the engineers take so much time to build the system, ergonomics researchers should use this phase to do interesting experiments that go beyond evaluation of the system. Such more general studies may actually become the major product of such a project. I have seen so many researchers in EU projects who have failed to grasp this opportunity.

As to basic research, I often feel that researchers have an obligation to perform research that, at least, bears a promise to become applicable. Doing basic research is great and challenging, but there may be a point where a certain experimental paradigm no longer delivers new insights and new research paradigms should be developed that, in line with the back-to-back philosophy, are inspired by actual, real world problems.

7. What would you like to do in the coming years?

Extend my department and cooperate closely with other colleagues and disciplines at my own and other universities, research companies, and industry. Show the importance of the back-to-back concept: that proper ergonomics research needs knowledge of basic psychological phenomena, and that basic research is stimulated by trying to understand problems in the real world. With respect to my own research I hope to develop adjustable and adjusting human machine systems. And increase our insight in the cognitive and neurocognitive mechanisms of skilled behaviour.