Cicero in the Senate Accusing Catiline of Conspiracy.
Fresco by Maccari, Cesare (1840-1919). Palazzo Madama, Rome, Italy / Ancient Art and Architecture Collection Ltd. / The Bridgeman Art Library (Research: Centrum voor Kunsthistorische Documentatie, Radboud University Nijmegen)
The title of our Strategic Plan for 2009-2013, “Inspired by quality, focused on the future”, epitomizes the direction in which Radboud University Nijmegen will develop in the years ahead. We intend to be one of the best universities in Europe, based on the quality of our research and teaching. We have the necessary quality, especially in research, proof of which can be seen in our recent performance.

Research carried out in 2009 is documented in this report, which gives a detailed account of the many results that researchers at the University have achieved. In some cases, they are so spectacular that they make headlines around the world. For example, the theologian Professor Ellen van Wolde revisited the first lines of Genesis, after a long and careful examination of numerous sources. The phrase that is engraved in our minds: "In the beginning God created heaven and earth" turns out not to be an exact translation. It should actually be translated as: "In the beginning, God separated heaven and earth". Her re-translation was world news because it shows that there was no creatio ex nihilo, or creation out of nothing, but rather a separation of heaven and earth. Her work is an example of the kind of free, independent research that can have a major impact on global society.

The quality of research at Nijmegen can also be seen from the increase in the number of scientific publications in 2009, a statistic which has been rising steadily for six consecutive years, including articles in top journals such as Nature, Science, Proceedings of the National Academy of Sciences of the USA and the New England Journal of Medicine. In fact, the number of publications in these journals has tripled compared to 2004. It is only a matter of time before these achievements are reflected in the international rankings.

Our current Strategic Plan sets out a clear direction: we will build on the proven foundations of solid research performance. The University will maintain its benchmarked quality, while seeking to secure evaluations that are either ‘very good’ or ‘excellent’ for our research programmes. To this end, we will invest in further strengthening our research environment and facilities. It is also important to us that the results of our research are clear and visible: reason enough for publishing this Research Report, which is now in its seventh edition. The report is also a means of accounting for the resources that society has entrusted to us, demonstrating once again that Radboud University research benefits society.

R.J. de Wijkerslooth MSc  Prof. S.C.J.J. Kortmann  
President of the Executive Board  Rector Magnificus
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Radboud University Nijmegen is a broad, multidisciplinary, internationally-oriented research university with the ambition to become one of Europe’s top academic institutions. In 2009, we once again made good progress towards achieving this ambition. The numbers of academic publications, publications in top-ranking journals, and research grants – mostly obtained in strong competition with other universities – have increased substantially. More than 50 prestigious grants and prizes awarded to gifted young researchers across the University is evidence of the stimulating environment in Nijmegen.

Members of the University frequently contribute to debates, publish news items in the media and join advisory councils. There are numerous partnerships with both private and public institutions and close involvement in international scientific networks. The University plays a significant role in encouraging innovation by delivering new generations of well-trained researchers and through active dissemination of scientific results to society.

In 2009 four new directors of research institutes were appointed:
- Prof. E. (Elias) Vlieg, Institute for Molecules and Materials.
- Prof. R. (Ruurd) Ruben, Nijmegen Institute for voor Social & Cultural Research.
- Prof. P.J.J.M. (Paul) Bakker, Research Institute for Philosophy.
- Prof. J.B.A.M. (Hans) Schilderman, Research Institute for Religious Studies and Theology.

This report highlights the most significant achievements of the institutes within which all of the research at the University is organized.

**Strong international position**

We continually strive to strengthen our international position through publications in high-ranking international journals, the recruitment of international staff, acquisition of international research grants and by attracting visiting scholars from around the globe. The international context within which the University operates is clearly shown on the map on the inside cover of this report.

Below we provide some examples of research that has been carried out in an international setting.

Prof. Olivier Hekster chairs the executive board of the International Network ‘Impact of Empire’, which studies the Roman Empire and the consequences of its actions for the regions it dominated. The network is directed by an international board of highly respected scholars drawn from the Classics, Archaeology, Ancient History, and History of Law at the universities of Amsterdam (Free University), Brussels (Free University), Groningen, Heidelberg, Leiden, Metz, Münster, New York, Nijmegen, North Carolina, Nottingham, Oxford, Paris (Sorbonne), Rome (La Sapienza) and Toronto.

The European project Mobius, which was established to develop Proof-Carrying Code for Java-enabled devices, was successfully concluded and assessed as excellent in the final review.

Researchers from the Radboud University Medical Centre participate in various EU FP7 programmes such as TECHGENE, PROMARK, METOXIA, BIOMALPAR and HEROID.

In 2009 the Business and Law Research Centre (OO&R) established a number of new international working groups in insolvency law, company law and financial law.

Prof. Theo Rasing leads the large EU FP7 IFOX project, in which 18 partners from universities and companies such as IBM, Intel and Fiat have joined forces to investigate the potential for applying metal-oxides in new computers and communication systems.

Prof. Ans van Kemenade organized the highly successful 19th International Conference on Historical Linguistics (ICHL 19). The ICHL conferences are the premier forum for work on historical linguistics and changes in the languages of the world.

The ‘Centre for Migration Law’ is responsible for coordinating the European Network on Free Movement of Workers within the European Union.

The Radboud University Nijmegen Medical Centre, which is one of 18 European Institutes that form the Network of Core Institutions (NOCI) of the European Organisation on Research and Treatment of Cancer (EORTC), is represented on the Executive Board of EORTC.

Astronomers from the Institute for Mathematics, Astrophysics and Particle Physics (IMAPP) are joint members of the Pierre Auger Observatory Collaboration in Argentina.
Professor John Searle of the University of California, Berkeley, held his audience spellbound as he spoke on 'The Nature of Language'. This special lecture marked the official opening of the International Max Planck Research School (IMPRS) for Language Sciences, a joint initiative of the Max Plank Institute for Psycholinguistics, the Centre for Language Studies, and the Donders Institute for Brain, Cognition and Behaviour from Radboud University Nijmegen. The new research school, supported by the German Max Planck Society, provides an interdisciplinary training and research programme for excellent PhD students in all aspects of language sciences.

External evaluations
University research institutes such as those at Radboud University Nijmegen are periodically evaluated by an international committee of peers. Based upon their assessment and recommendations, plans for further improvements are implemented.

The Review Committees assess the institutes according to the Standard Evaluation Protocol for scientific research in the Netherlands. For each research programme, there are four criteria: 1) quality, 2) productivity, 3) relevance and 4) vitality & feasibility. The assessments range from excellent to unsatisfactory, and are defined as follows:

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**Key figures**

**Research staff**

**Tenured**
- Full Professors 151.3 FTE
- Associate Professors 82.1 FTE
- Assistant Professors 159.3 FTE
- Researchers 105.6 FTE
- Lecturers 1.7 FTE

**Non-tenured**
- Researchers 477.3 FTE
- Lecturers 8.8 FTE
- Doctoral candidates 900.9 FTE

**Research input**

- 2004: 15.3 FTE
- 2005: 15.3 FTE
- 2006: 15.3 FTE
- 2007: 15.3 FTE
- 2008: 15.3 FTE
- 2009: 15.3 FTE

**Research output**

- Dissertations 264
- Scientific publications 5467
- Professional publications 878
- Annotations 233
- Patents 12

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**Figure 2: Publications per year**

- Nature
- Science
- Proceedings of the National Academy of Sciences
- New England Journal of Medicine

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ERC Advanced Grant laureates
Prof. Pieter Muysken
Prof. Mike Jetten
Prof. Heino Falcke
Prof. Conny Aerts
Prof. Wilhelm Huck

• Excellent: leading, at the forefront worldwide
• Very good: internationally competitive, leading nationally
• Good: nationally competitive, visible internationally
• Satisfactory: visible nationally
• Unsatisfactory: not worth pursuing

In 2009 two research institutes at the University – the Institute for Water and Wetland Research and the Institute for Computing and Information Sciences, one Department: the Department of Mathematics at the Institute for Mathematics, Astrophysics and Particle Physics as well as the Research Centres of the Faculty of Law – were evaluated by independent international review committees.

In their Assessment Report, the Institute for Water and Wetland Research (IWWR) was commended for its chosen research strategy as well as the quality of its research and management. Points for improvement were greater international visibility and more coherence among the participating research groups. In response to the assessment the IWWR merged several research groups in order to sharpen their focus. Two new chairs (for Ecogenomics and Animal Ecology) were also established.

The Institute for Computing and Information Sciences (ICIS) participated in a national research exercise designed to evaluate Information Science. The Department of Mathematics at the Institute for Astrophysics and Particle Physics (IMAPP) and the Research Centres of the Faculty of Law also participated in a national research evaluation (on Mathematics and Law research, respectively). The final reports on these three evaluations are expected in the Spring of 2010.

The Business and Law Research Centre (OOR) was once again accredited by the Royal Netherlands Academy of Arts and Sciences.

The Donders Graduate School for Cognitive Neuroscience at Radboud University Nijmegen received a grant from the Netherlands Organisation for Scientific Research (NWO) to establish an excellent education and research environment for highly gifted young researchers. This school is integrated within the Donders Institute for Brain, Cognition and Behaviour.

Acknowledged excellence
Once again, many researchers at the University received prizes or prestigious personal grants for their academic research. Some of the highlights in 2009 are presented below.

International
The highly prestigious Advanced Investigator Grant of the European Research Council (ERC) was awarded to Prof. Wilhelm Huck for his research in Physical Organic Chemistry. Other ERC Advanced Investigator laureates at our University are experts in Linguistics, Astronomy or Microbiology, demonstrating the quality of research across a range of disciplines.

Prof. Elspeth Guild was honoured with the EU Jean Monnet Chair ad personam.

Prof. René Bindels received the Homer W. Smith Award from the American Society of Nephrology – a distinction that is awarded annually to an individual who has made an outstanding contribution in the field of nephrology. René also received the Robert F. Pitts and the Carl W. Gottschalk Lectureship in Kyoto and New Orleans.

Figure 3: Dissertations per year
respectively. Dr Roos Masereeuw was awarded the DPS Schering Plough Pharmacology prize for her innovative research on the regulation of drug transporters in renal damage and repair. This hat trick in international research prizes reflects the leading position of kidney research at the Radboud University Nijmegen Medical Centre.

Dr Marcel van Birgelen and Dr Olivier Furrer received Awards for Excellence from the Emerald Literati Club: Dr van Birgelen for his 2008 article in the International Journal of Manpower and Dr Furrer received two awards, for articles in the Journal of Strategy and Management and the European Journal of Innovation Management.

Prof. Bart-Jan Kullberg was awarded the Clinical Infectious Diseases Award for outstanding review. He also became a Fellow of the Royal College of Physicians (London).

Prof. Roy Kessels was elected as a member of the scientific advisory board of the Federation of European Neuropsychological Societies.

Prof. Hans de Kroon became a Research Associate at the Smithsonian Tropical Research Institute.

Prof. John Jansen was appointed as an Honorary Professor at Sichuan University, China.

Dr Rutger Vogel was awarded the first Energy4All Scholarship, which will allow him to investigate strategies for developing a therapy for mitochondrial disorders at the Harvard University in Boston, USA for one year.

Figure 4: Researchers (in FTEs) per year

Radboud University Nijmegen has the following faculties:
Faculty of Theology
Faculty of Religious Studies
Faculty of Philosophy
Faculty of Arts
Faculty of Law
Faculty of Social Sciences
Nijmegen School of Management
Faculty of Science
Medical Centre (Faculty of Medicine and University Hospital)

Fundamental and applied research is carried out within specialized institutes:
Research Institute for Religious Studies and Theology
Research Institute for Philosophy
Institute for Historical, Literary and Cultural Studies
Research Centres of the Faculty of Law
Institute for Management Research
Nijmegen Institute for Social & Cultural Research
Centre for Language Studies
Behavioural Science Institute
Donders Institute for Brain, Cognition and Behaviour
• Centre for Cognition
• Centre for Cognitive Neuroimaging
• Centre for Neuroscience
Institute for Genetic and Metabolic Diseases
Research Institute for Oncology
Nijmegen Institute for Infection, Inflammation and Immunity
Nijmegen Centre for Evidence-Based Practice
Nijmegen Centre for Molecular Life Sciences
Institute for Water and Wetland Research
Institute for Molecules and Materials
Institute for Mathematics, Astrophysics and Particle Physics
Institute for Computing and Information Sciences
Institute for Science, Innovation & Society

Preparing for a career in research with Research Masters studies:
Behavioural science: the study of behavioural regulation
Cognitive neuroscience
Historical sciences
Art and visual culture
Language and communication: the empirical study of human communicative capacities
Literature and literary sciences: new philology
Molecular mechanisms of disease
Business and Law
Philosophy
Social cultural science: comparative research on societies
Academic reputation

Spinoza Award laureates

2008 Prof. Theo Rasing
2006 Prof. Carl Figdor
2005 Prof. Peter Hagoort
2002 Prof. Henk Barendregt
2001 Prof. Bert Meijer
1999 Prof. Anne Cutler
1998 Prof. Pieter Muysken

National

Sijbrand de Jong and his team won the National Academic Year Prize 2009 for a proposal entitled Cosmic Sensation.

An STW valorization grant for developing BCI Technology to help ALS patients was awarded to Prof. Peter Desain.

Dr Joop Schaminee won the Prins Bernhard Cultuurfonds prize for Nature Conservation.

Prof. Ria Nijhuis-van der Sanden and her research team received the Dutch Open Health 2.0 Challenge Award for their research project ‘Choose to Move’. Dr Monique van Eijken received the Anna Reynvaan prize (AMC) for ‘best scientific publication in nursing science.’

In 2009 ZonMw awarded the Pearl Status to the national concept ParkinsonNet, which was developed by Dr Martin Munneke and Prof. Bas Bloem.

Prof. Willy Jansen and Prof. Ben Vermeulen were elected as Members of the Royal Netherlands Academy of Arts and Sciences.

Dr Bé Breij and Dr Joost Hoenderop were elected to the Young Academy of the Royal Netherlands Academy of Arts and Sciences.

Grants for excellent young scientists

Young scientists and Research Masters students at the University continue to deliver outstanding results. In 2009, more than fifty excellent young researchers won prestigious national or international grants, competing with some of the best in the world.

Thirteen talented young researchers received an NWO Veni grant in 2009, which will enable them to do research for three years after graduating with a PhD. The winners are Drs: Corien Bary, Sándor Chardonnens, Rob Collin, Marcel Coolsen, Gert-Jan van der Heiden, Arjen Hommersom, Marloes Kleinjan, Nanda Lambregts-Rommelse, Floris de Lange, Laura van Niftrik, Richard Notebaart, Maarten de Pourcq and Haske van der Vorst.

Eight post-doctoral researchers received NWO Vidi grants, which will enable them to develop their line of research for five years. These grants were awarded to Drs: Jörgen Bruhn, Reinout van Crevel, Andrea Evers, Christian Fiebach, Roland Kuiper, Anouk Scheres, Anna Simon and Katarina Wolf.

Three NWO Vici grants, which permits senior scientists to put together their own research group, were won by Drs Ole Jensen, Mihai Netea and Hans Spelbrink.

Ten young researchers received an NWO Rubicon Scholarship to enable them to go to another country to conduct research immediately after gaining their doctorates. These scholarships were awarded to Drs: Corien Bary, Haili Hu, Chris Heunen, Clancy James, Lise de Jonge, Wilco Verberk, Lotte Hogeweg, Wim Noorduin, Sake van Wageningen and Erik Schwartz.

Three talented medical students (Lucas van Eijk, Sakia Koene and Dennis Vriend) won a ZonMW AGIKO grant that will allow them to be trained both as medical specialists and as clinical researchers.

Three Research Masters students (Inti Brazil, Qian Feng, and Sahar Noor) were awarded an NWO Mozaiek Grant for four-year PhD research programmes which they designed themselves. The NWO Mozaiek Grant, which is given to talented students from ethnic minorities, is designed to support their academic careers.

Three prestigious Starting Grants from the European Research Council were awarded to Drs Asli Özyürek, Neck Enfield, and Tom Scheenen.

Particularly remarkable were the achievements of Corien Bary, who graduated cum laude with her dissertation entitled Aspect in Ancient Greek: a Semantic Analysis of the Aorist and Imperfective. Dr Bary received one after the other: an NWO Veni grant, an NWO Rubicon scholarship and a stipend from the Niels Stensen Foundation.
Another astonishing achievement was made by an earlier cum laude PhD graduate: Dr Maud Graff, who again won several prizes in 2009, including the Catharina Pijls award 2009 and the Astrid Kinebanian ergotherapy award 2009 for best dissertation.

Finally, the following young researchers also won major prizes in 2009:
- Dr Marieke van den Brink (after graduating cum laude, won the Praemium Erasmianum 2009 – the award for the best dissertation in the social sciences and humanities in the Netherlands)
- Dr Jörg Henseler (Best Paper Award from the 17th International Colloquium in Relationship Marketing)
- Dr Jan Kees Helderman (Van Poelje award for the best dissertation in Flemish and Dutch public administration)
- Dr Madelijn Strick (2009 ASPO dissertation award)
- Dr Floris de Lange (2007-2009 Dutch Psychonomic Society dissertation award)
- Dr Micha Wilhelmus (2009 Brain Research Young Investigator Award)
- Dr Frank van de Veerdonk (Junior Investigator award from the International Cytokine Society)
- Dr Clancy James (Bragg Medal for best Physics thesis in Australia).

Finding solutions for major challenges in science and society
Researchers at Radboud University Nijmegen regularly provide ground-breaking insight into issues that are currently recognized as of great importance to the strategy of the Netherlands and Europe. These grand challenges in science and society are reflected in a number of large domains to which researchers at our University make a significant contribution:
- Cognitive neuroscience and psycholinguistics
- Life sciences, health and ageing
- Arts, history and culture
- Law and governance
- Smart systems and mechanisms
- Molecules and materials
- Behaviour and society

For each of these domains we present the significance, relevance and achievements of Radboud University research below. These achievements have led to an increase in the absolute numbers of publications and in particular to a larger number of publications in high-ranking scientific journals.

Cognitive neuroscience and psycholinguistics
According to the World Health Organization, diseases of the nervous system will become the most important medical priority this century. Cognitive neuroscience contributes to our understanding of cognitive deficits related to nervous system disorders such as Alzheimer dementia (memory), aphasia (language), neglect (attention), motor function (Parkinson’s disease), among other conditions. In addition, life-long learning is crucial to technologically advanced societies. According to the OECD, a brain-based learning science is urgently needed. The excellent infrastructure and expertise at the Donders Institute for Brain, Cognition and Behaviour allows our University to make a significant contribution.

Some achievements in 2009:
- Dr Ivan Toni and his group found that, contrary to conventional wisdom, our communicative abilities are distinct from both sensorimotor processes and linguistic abilities.
- Within the BrainGain consortium research results are being translated into commercial products with the help of both small and large industrial partners. A spin-off company, RE-phrase,

Key publications Cognitive neuroscience and psycholinguistics
has put chat-by-click technology and an innovative product called E-coaches for Autism on the market.

- The TM4IP project, in which Dr Nelleke Oostdijk and Dr Suzanne Verberne participate, is fully funded by a company that is looking for improved tools for patent mining. It is expected that the knowledge gained in this project can also be exploited in a range of other domains where there is a need to find information quickly and efficiently.

Life sciences, health and ageing

A number of human diseases dominate health care globally, but infectious disease is the number one cause of morbidity and mortality. Cancer – a major health problem in developed countries – has an enormous physical and mental impact on patients and their families. After an era in which many years have been added to the average life, the world now faces the challenge of improving the quality of life in those extra years.

Many projects at the Nijmegen Institute for Infection, Inflammation and Immunity, such as those focusing on poverty-related infection, vaccines and antibiotics are designed to tackle infectious diseases. Disorders of inflammation and immunity also play an important role in other diseases which are studied within the framework of this institute.

The Institute for Oncology improves prevention, diagnosis and therapy of cancer as well as psycho-social assistance, which are important to the well-being of society as a whole. Whereas the regulation of normal and pathological processes is the key issue at the Nijmegen Centre for Molecular Life Sciences (NCMLS), this institute is known in particular for its research on enhancing immunity to infectious diseases and tumours.

The Nijmegen Centre for Evidence-Based Practice (NCEBP) and the Donders Centre for Neuroscience have an excellent reputation in research on age-related diseases and are well-equipped to play an important role in finding solutions to problems caused by ageing.

Life science processes inspire much of the research at the Institute for Molecules and Materials (IMM) and most groups are engaged in extensive collaboration with multinational industrial partners.

The impact on society of research in this domain includes:

- Dr Tatjana van Strien’s membership of the Dutch Health Board (Gezondheidsraad) committee on preventing overweight and evaluating the risks of eating disorders.
- The discovery of a deficiency of the dectin-1 receptor in patients with recurrent fungal infections of the skin, nails and vagina. Dectin-1 recognizes beta-glucan, one of the sugars on the surface of the fungus Candida albicans. This finding not only provides insight into why these nasty infections may arise, but also opens up new approaches to treatment.
- Cooperation between IMM and NCMLS, resulting in non-invasive diagnostic tools, including the ‘breath test’, which allows researchers to analyze the trace gas constituents of human breath for diagnostic purposes.

Arts, history and culture

Another way in which the University shares its knowledge and expertise is by contributing to exhibitions, museums and other cultural activities, in which the general public profits from new insights and state-of-the-art developments in research. Public and political debates on ethical and moral issues are also informed by the solid knowledge base and scholarship in Philosophy and Religious Studies.

Some results in 2009 illustrating developments in this domain:

- Prof. Christoph Lüthy’s book De maakbare mens (Perfecting man) was launched during a public debate at the Royal Academy and discussed on television, on the radio and in newspapers.

Key publications Life sciences, health and ageing


Key publications Arts, history and culture

• The Research Institute for Philosophy hosted a highly successful Bedrijvendag (Business Day), which was jointly organized by staff and students and intended to shed light on the role of philosophy in business and government.

• In his book Romeinse keizers. De macht van het imago (Roman Emperors: presentation, politics and power), Prof. Olivier Hekster discusses how the most powerful men of the Roman Empire saw themselves – and were seen by others. Prof. Hekster shows a general audience how some emperors became ‘good’, and others became ‘bad’.

• The programme ‘Religion and Care’ co-organized a symposium on ‘Spirituality in palliative care’ (Faculty of Religious Studies/UMC Radboud, 160 participants).

• A breakthrough in Biblical Studies came as the result of applying cognitive linguistics to biblical scholarship. Prof. Ellen van Wolde developed both a new cognitive theoretical framework and a new cognitive linguistic method for studying culturally embedded concepts and transformations in ancient religious views.

Law and governance
The global financial crisis, international migration, prevention and punishment of criminal activities as well as the changing roles of government bodies all substantially influence the public and political debate. The societal impact of research conducted by the Business and Law Research Centre can be seen in relation to the financial turmoil during the credit crisis. The availability and cost of credit, best practices in terms of corporate governance, shareholder activism and financial markets supervision are just a few examples of research topics which have triggered a great deal of public debate and controversy.

The Institute for Management Research, is seriously involved in finding solutions to dilemmas faced by governments such as those related to spatial planning.

Examples of societal contributions:
• Most senior researchers at the Business and Law Research Centre hold key positions in law reform committees, courts, the Netherlands Authority for the Financial Markets, law firms, banks and/or companies.
• Prof. Ybo Buruma chairs the Admittance Committee Regarding the Evaluation of Completed Criminal Cases.
• Prof. Monique Leyenaar was appointed as a member of the Council for Public Administration (Raad voor Openbaar Bestuur) and was appointed to the Electoral Council (De Kiesraad).

Smart systems and mechanisms
Most of the breakthroughs in science start as fundamental research that is designed to extend the horizons of current knowledge. This research then leads to many strategic and applied developments. Fundamental research on magnetism, for instance, provides tools for manipulating structures on the nanoscale, while basic ecological research closely relates to major environmental problems including climate change, pollution, and eutrophication. Researchers disclosing the secrets of the universe provide valuable insights for those designing new instruments, which often find their way into commercial products and diagnostic equipment.

Some key achievements in 2009:
• Research at the Institute for Mathematics, Astrophysics and Particle Physics (IMAPP) on the foundations of quantum theory and its relationship with classical physics led to a link being established between quantum theory and topos theory, paving the way for improving our understanding of quantum information theory.
• In the past year the X-Shooter spectrograph was completed for the Very Large Telescope (VLT) of the Southern European Observatory (this work was done by IMAPP). It was shipped to Chile early in 2009, commissioned at the telescope and regular observations started in October 2009. In its first semester it was

Key publications Law and governance

Key publications Smart systems and mechanisms
• Lam, P., et al. (2009). Revising the nitrogen cycle in the Peruvian oxygen minimum zone. Proceedings of the National Academy of Science USA, 106(12), 4752-4757.
A tool for model-based testing developed at the Institute for Computing and Information Sciences (ICIS) has proven its worth in testing the new Dutch electronic passport. Probabilistic graphical approaches were also investigated for mammographic diagnosis of breast cancer and demonstrated their advantages over ‘black-box’ models such as neural networks used for the same task.

Plant scientists at the Institute for Water and Wetland Research (IWW) showed that ABA sensitivity in plants can be modulated by the expression of SIPP2C1.

The team led by Prof. Rasing has discovered a second novel mechanism for magnetization reorientation using sub-picosecond laser pulses. Under the impact of the laser pulse, the magnetization of a ferromagnetic thin film first collapses and then reappears in the direction defined by the polarization of the pulse. Using this method, magnetic information was recorded by a sub-picosecond laser pulse and read out by a second pulse within 30 picoseconds.

The IMAPP plays an important role in national discussions on science and mathematics in secondary education. The Nijmegen Annual Mathematics Tournament and the international Kangaroo mathematics competition, organized and co-organized by IMAPP, have significantly improved the popularity and visibility of mathematics among school children.

**Molecules and materials**
Producing sustainable products and targeted drug-delivery systems requires an advanced understanding of molecules and materials and the ability to design, synthesize and manipulate inorganic, organic, and biomolecules. By combining experimental and theoretical research and applying an interdisciplinary approach at the interface between biology, chemistry and physics, the Institute for Molecules and Materials (IMM) offers an excellent platform for scientific breakthroughs, making it an attractive partner for industrial companies.

Some examples illustrating results achieved in 2009:

- The group led by Hageman and Schermer at IMM developed solar cells with world-record efficiencies (up to 26.1%). Efficiency can be significantly increased with III-V semiconductors that make it possible to integrate several sub-cells using different parts of the solar spectrum.
- Prof. Nolte and colleagues have started a programme using the capsid (i.e., the empty shell) of the Cowpea chlorotic mottle virus as a nano-sized reaction vessel. A procedure was developed for attaching the guest protein or enzyme to the capsid protein dimers prior to assembly. This new strategy is currently being used to encapsulate various types of enzymes into viral capsids, thus creating multi-enzyme nanoreactors.
- Prof. Rutjes and colleagues worked on fast efficient modification of enzymes, proteins and other biomolecules, a technique which is of great importance in chemical biology. They have developed copper-free click chemistry for efficient enzyme PEGylation and demonstrated its bio-applicability.
- The team led by Prof. Buydens investigated the misalignment of chromatograms from liquid chromatography-mass spectrometers, which is a major problem in analytical chemistry. Several improvements were made to an existing alignment algorithm called parametric time warping, which extends its alignment capabilities to include proteomic data.

**Behaviour and society**
Alcohol abuse as well as addiction to other substances is a major concern in modern society. The treatment of anti-social behaviour, either due to psychopathological characteristics such as ADHD or autism or to an extreme lack of respect, is also a high priority.

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**Key publications Molecules and materials**


**Key publications Behaviour and society**

The Behavioural Science Institute (BSI) is a key player in research on individual human behaviour under both normal and psychopathological conditions. Striking phenomena and trends in society such as those affecting the use of mass media are among the topics studied at the Nijmegen Institute for Social & Cultural Research (NISCO). The Institute for Science, Innovation & Society (ISIS) addresses the impact from science and technology on society and vice versa.

Some highlights in 2009:

• Studies on automatic behavioural tendencies have shown that automatic avoidance behaviour is a key mechanism in anxiety disorders such as spider phobia and that automatic approach tendencies in relation to alcohol stimuli are critical in heavy drinkers. People with both conditions can be re-trained and the severity of their affliction can be reduced.
• Drs Haske van der Vorst and Marloes Kleinjan, and Prof. Rutger Engels, collaborate intensively with the Trimbos Institute on prevention and intervention programmes focusing on juvenile substance use. Together they organized an international conference for the Kettil Bruun Society on adolescent binge drinking, which received considerable media attention.
• The public website www.watisgenomics.nl (hosted by ISIS) has about 20,000 hits each month.
• Research on fair trade revealed that its impact on domestic welfare in developing countries is rather modest, whereas the organizational and behavioural effects as well as regional externalities are considerable.

In the following chapters each institute presents its current research, facilities, societal impact, highlights in 2009, and looks forward to future developments. The scientific achievements presented here show the vitality of research across Radboud University Nijmegen.
The Research Institute for Religious Studies and Theology (RST) brings together the academic research of the Faculties of Religious Studies and of Theology at Radboud University Nijmegen. Its point of departure is the continuing relevance of religion for present-day societies, with a focus on religions’ presence and interaction in their various social, cultural and political habitats. Its aim is to develop, integrate, facilitate, perform and valorise excellent research in religious studies and theology and to educate and supervise new generations of scholars.

Research focus
The research programme ‘Religions and Transformation in Contexts’ (RATIC) (2007-2012) makes a scientifically and socially relevant contribution to our insight into religious dynamics by focusing on the concept of transformation. While this concept is commonly associated with dynamics, it is seldom accurately defined or operationalized. In the RATIC programme transformation is studied as a process of change in religious and spiritual identities, both at the level of the individual believer and at the collective level of communities and institutions. The programme ‘Religions and Transformation in Contexts’ is carried out by five research groups:

Trajectories of Religiosity
(Prof. Gerard Wiegers and Prof. Eric Venbrux)
This programme, which combines comparative religious studies with anthropology of religion, focuses on the transformations of Islam, Asian religions, and new religious movements (including indigenous and local religions) in relationship to the Western world. There is a focus on 1) ritual and religiosity (death rites, pilgrimage, and religious tourism), 2) religion and the arts, 3) religion, conflict, and media, 4) methods and theories of comparative religious studies, and 5) the history of religions.

Reframing Spirituality and Mysticism in Past and Present
(Prof. Frans Maas)
This programme starts from the observation that there is growing interest in spirituality and mysticism in contemporary Western societies. Recent social and cultural developments have deeply transformed both socio-cultural manifestations of spirituality and mysticism and awareness of the inner structures of spirituality and mysticism and their relationship to texts, material objects, images, social and economic culture, histories, practices, and theoretical presuppositions.

Biblical Studies, Ancient Judaism, Early Christianity, and Gnosticism
(Prof. Ellen van Wolde)
This programme focuses on biblical and extra-biblical texts that mirror religious transformations in social, political, or religious
contexts. Research concentrates on interpreting a number of key texts on religious transformations, different levels of interpretation, and re-interpreting early Christian and Jewish texts, as well as their historical, religious and hermeneutical backgrounds.

Transformation of Religion within the Frameworks of Modernity (Prof. Georg Essen)
The aim of this programme is to investigate the effects of social and cultural transformation on the normative quality of religious interpretive systems. It includes the following subjects: 1) the crisis of theism in modernity, 2) science and theology, 3) conflict and cohesion, and 4) chronology and topography. Researchers from the former Heyendaal Institute have joined this research cluster, in which historical and systematic research concentrates on cultural and religious transformation processes against the background of the crisis of theism. It focuses on two topics: ‘Evil, modernity, and the making of tradition’ and ‘The problem of divine and human agency within a scientific world view.’

Religious Identity Transformation in Context (Prof. Chris Hermans)
This research programme develops theories about the transformation of religious identity within a pluralizing and individualizing context that involves various types of interactions between religions. Transformation of religious identity is studied as a continuity or discontinuity of religious identity in time, through adaptation within its current contexts and within an explanatory framework of its antecedents and consequents. The context within which religious identity is transformed includes both intended and unintentional interactions between individuals and groups with different religions and their impact on social cohesion.

In order to sharpen the focus and enhance the profile of this research, the programme was reorganised in the latter half of 2009. From 1 January 2010, there will be a Religious Studies and a Theological research programme at the institute. The number of sub-programmes will be reduced from five to two, while the structure will be aligned with the international academic profiles.
After a close study of the original Hebrew and its context, Prof. Ellen van Wolde concluded that the first verse of Genesis describes the separation of heaven and earth within infinite swirling waters and not *creatio ex nihilo* (creation out of nothing).
funded project, Prof. van Nieuwkerk), the influence of religion on the struggle between Muslims and Christians in North Maluku in Indonesia (NWO Veni-funded) project (Prof. Hermkens), and on gender discourse in Islam (Dr Sahar Noor, NWO Mozaïek-funded). The renewed significance of religion was also demonstrated in studies of changing mortuary rituals and bereavement (NWO-funded). Additional studies were presented on western reception of ancient Buddhism (Prof. van der Velde) and holistic tendencies in popular religiosity (Prof. Jespers).

Biblical Studies, Ancient Judaism, Christianity, and Gnosticism

A breakthrough in this cluster came as the result of applying cognitive linguistics to biblical scholarship. Prof. van Wolde developed a new cognitive theoretical framework and cognitive linguistic method to study culturally embedded concepts and transformations in ancient religious views. She presented conference papers in Ciudad Real, Rome and Atlanta, Georgia. Prof. van der Watt focused on the linguistic basis underlying John’s view of religious and ethical transformation. He presented conference papers in Pretoria, Mainz and Yale. Prof. van Oort studied the transformation of ideas in early Christianity (including Irenaeus) in relationship to Gnostic texts such as the Gospel of Judas.

Transformation of Religions within the Frameworks of Modernity

A successful priority within this cluster proved to be the reinterpretation of Christian tradition in light of its contribution to the modern state and its constitution. Prof. Essen analyzed ways in which modern constitutions affirm the secular principles of profane legal orders and handle religious conflicts. He addressed this issue in keynote lectures at international conferences in Berlin, Alexandria, Houston, and Rostock. Prof. van den Brandt studied the transition from communicative memory to historical memory in her research on “Witnesses of Theresienstadt, Jews deported from the Netherlands (1943-1945)”, which was funded by the Dutch government (VWS).

Reframing Spirituality and Mysticism in Past and Present

Researchers in this cluster invested in an innovative methodology that has been grafted onto a theological epistemology of mystical knowing (“via negativa”) and is exemplified in a study of Meister Eckhart’s vision. Research on Eastern Christianity focused on the function of orthodoxy in terms of the integration and disintegration of European identity. One of the spin-offs of this research is a symposium on the relationship between orthodoxy and human rights. Prof. Teule reported on intercultural and interreligious issues at conferences in Leuven, Bagdad/Irbil, Beirut, Lviv, Bergamo, Vienna, Moscow and Birmingham.

Religious Identity Transformation and Social Cohesion

Researchers in this cluster achieved their ambition to clarify the process of eu-functions and dysfunctions of religion for social cohesion issues in contemporary society. Profs. Scheepers and Schilderman studied change in religious identity and its consequences for social capital in Europe, with papers presented at conferences in London and Nijmegen. Dr Sterkens and Dr Hadiwitanto studied the religious origins of violence in the Malukan province of Indonesia by clarifying the relationship between religion, antagonistic cultural attitudes and authoritarian networks. Prof. van der Ven presented his international research on human rights and religion at institutes in Manila and Oslo. Prof. Hermans studied the significance of abductive reasoning processes for empirical research.

Societal impact

The Faculty of Religious Studies signed an agreement on 29 September with the Dominican Study Centre for Theology and Society in Amsterdam (DSTS), with the aim of addressing socially and politically engaged audiences that take an interest in religion and social or existential issues. With a similar aim, the Faculties of Theology and Religious Studies participate in the Soeterbeeck programme of the Radboud University Nijmegen.

The RST intends to relate its research to the Faculties’ priorities in Master’s programmes on care, culture and policy. With this in mind, the research group Reframing Spirituality and Mysticism in Past and Present focuses on the topic of ‘societal spirituality.’ It participated in a discussion organized by the KSGV on Mindfulness and Christian prayer (Utrecht and Groningen, 500 participants), and the symposia ‘Perspectives on spirituality’ (Radboud University Nijmegen, 4 March, 120 participants), ‘Levensbeschouwelijke vorming’ of the Thijmgenootschap (Utrecht University, 4 February; 110 participants), and ‘workplace spirituality’ (Katholiek Netwerk / VKMO in Utrecht, 19 September, 90 participants). The chair of the programme ‘Religion and Care’ co-organized a symposium on ‘Spirituality in palliative care’ (Faculty of Religious Studies/UMC Radboud, 28 January, 160 participants).

Several conferences were organized by the research clusters with the aim of disseminating and discussing research results. The Annual Faculty Symposium (25 March, 340 participants) was co-organized by the Centre for Thanatology with ‘changing death rites’ as its topic. On 8 May, the research group hosted the Conference ‘Dynamics of Islamic Culture’ at Radboud University Nijmegen they. The Heyendaal research programme organized a conference on ‘God and Darwin! Evolution biology and theology of creation in evolution’ on 16 December. Holocaust survivor Fred Schwarz gave a lecture on Holocaust Memorial Day, which was organized by RST.

Five inaugural lectures received broad attention. Prof. van der Vliet (30 January) gave a lecture on the origins of the Coptic language in Egypt. Prof. Müller’s lecture was on the historical ascription of Catharism (19 March). Prof. Schilderman’s lecture on May 15 on the philosophical assumptions in spiritual care was frequented by
Key publications


Dissertations: 8
Scientific publications: 214
Professional publications: 77
Director: Prof. Hans Schilderman

Prof. Schilderman specializes in Religion and Care. He coordinates the international research programme ‘EURESOURCE’, which studies the impact of religion on solidarity in a cross-national and longitudinal survey of European countries. Schilderman publications on spiritual care, solidarity, ritual and empirical research methods in theology. He is a Board Member of the International Society of Empirical Research in Theology (ISERT).

Future research

In the latter half of 2009 an initiative began to reformulate the research programme and increase the effectiveness of the Institute. New research programme texts have been discussed and edited. As of 1 January 2010, the Institute will have abandoned its former five-part ‘Religion and Transformation in Context’ programme and established complementary programmes for Religious Studies: ‘Dynamics of Religious Change’ and Theology: ‘Quest for God.’

In 2010 an NWO-funded research project entitled ‘Ethno-Religious Conflicts in Indonesia and the Philippines (involving one postdoc and four PhD researchers) will start. A comparative study funded by the NWO programme on Conflict and Safety, lasting from January 2010 to December 2013, was granted to Profs. Sterkens, Hüsken and Scheepers. It will focus on the influence of ethno-religious identification on support for collective violence in areas of actual and potential conflict in Indonesia (Maluku and Yogyakarta) and the Philippines (Mindanao and Metro-Manila).

With the inclusion of the Department of Islam and Arabic, an excellent research group has joined the Institute. Several high-quality research applications have been submitted for NWO funding (Profs. Motzki and Van Nieuwkerk). The Centre for Thanatology intends to focus future research on a comparison of changing European ways of death, and extend current research on newly emerging rituals to include the celebration of All Souls’ Day. Profs. Nissen and Jespers are planning new research which will compare historical and contemporary forms of new religiosity.

Prof. Hermans is planning to undertake research on intercultural education as part of citizenship education. Applications for research on topics related to interreligious communication have been submitted to EU FP7 and Marie Curie ITN and for educational research to PROO NWO. Contacts have been established with universities in South-Africa (Unisa-Pretoria; Pietermaritzburg) and Indonesia (Universitas Christen Duca Watana, Yogyakarta) to carry out research on religion and conflict.
Research Institute for Philosophy

The central research topic of the Research Institute for Philosophy is the concept of rationality. Rationality is often seen as a distinctive characteristic of human beings. But what does it mean to be a rational being and how can ‘rationality’ be defined? The systematic study of rationality takes place in the context of the following four research programmes, which interconnect and intersect in various ways.

- Cognition, Interpretation and Context (Prof. R. van der Sandt)
- The Project of a Hermeneutic Philosophy (Prof. P. van Haute)
- From Natural Philosophy to Science (Prof. P. Bakker)
- Practical Philosophy (Prof. P. van Tongeren)

These four programmes explore different aspects of a range of things that are considered ‘rational’: beliefs, individual actions, and social practices. From what standpoint can we judge the rationality of the beliefs, actions and practices of ourselves and others? Do our categories of reasoning and our standards of truth and consistency enhance or distort our understanding and interpretation of others? What are the foundations of rationality and how has the concept of rationality developed over time?

These questions are addressed in the four research programmes. The first relates to conceptions of belief, cognition and language. It analyses the various ways in which we interpret and understand human behaviour – linguistic and otherwise – in its physical and social context. In the second, the relationship between rationality, meaning and interpretation is examined. The third programme focuses on the emergence of science as the key paradigm of rational thinking in Western Europe, and traces the history of long-term developments and transformations in scientific thinking from its philosophical beginnings. The fourth programme focuses on the concept of practical rationality and its impact on ethics, politics, and religion.

The four research programmes employ a variety of methodological approaches: analytical, hermeneutical, critical, and historical. This makes the Institute one of the few places where a dialogue between people taking these very different approaches is possible. Hence, initiatives that encourage this dialogue are actively promoted. The Institute’s researchers attach particular value to the works of past thinkers, either as ‘partners’ in an ongoing systematic philosophical discussion or as historical subjects in their own right.

Research facilities
The faculty library, which is integrated in the central humanities library, houses one of the finest collections of books and journals on philosophy – and particularly on the history of philosophy – in
the Netherlands, and one of the world’s largest microfilm collections of medieval and Renaissance manuscripts on logic, semantics and natural philosophy.

**Collaboration**

Individual researchers are members of research schools such as the Netherlands Research School for Medieval Studies and the Netherlands School for Research in Practical Philosophy.

The Research Institute for Philosophy has formal cooperative agreements with the Universities of Leuven and Stellenbosch, and the University of Münster, which also participates in the IRUN network. There are similar arrangements with the University of Parma, the University of Pretoria, the University of Kwazulu Natal, De Paul University (Chicago), the University of Sao Paolo and the Pontifical University of Sao Paolo, as well as the ‘Nederlands-Afrikaanstalig Genootschap voor Wijsbegeerte’.

In addition, members of the research programmes have close contacts with institutions such as the Departments of Philosophy at the Universities of Middlesex and Hertfordshire (UK), Antwerp, Stuttgart and Tübingen, and the Humboldt University in Berlin, the Università degli Studi di Macerata, the Université de Fribourg (Switzerland), Fordham University and Columbia University (New York), Emory University (Atlanta), and the Centre of Excellence ‘History of Mind Research Unit’ at the University of Helsinki.

In 2009, the Institute hosted guest researchers from a number of countries.

**Research results**

In 2009, five PhD theses were defended, one *cum laude*: Corien Bary, *Aspect in Ancient Greek: a Semantic Analysis of the Aorist and Imperfective*. This study provides a new, more insightful analysis of the expression of temporality in language in general and in Ancient Greek in particular.

Members of the research programme *Cognition, Interpretation and Context* have been very successful in obtaining external funding for research projects and network activities. Dr Corien Bary was
awarded a Rubicon fellowship, a Veni grant, and a stipend from the Niels Stensen Foundation. Dr Bart Geurts obtained a project in NWO’s Free Competition in the Humanities programme. Together with colleagues from Lyon and Berlin, he raised funding for an ESF Network called ‘EuroXprag’, which has the aim of fostering interdisciplinary approaches to the pragmatics of natural language through collaborations, workshops, and conferences. Dr Geurts finished a book on so-called ‘quantity implicatures’, which is due to appear with Cambridge University Press. Within the same research programme, Marco van Leeuwen defended his PhD thesis which developed a new theory of embodied and embedded concepts (Thinking Outside The Box). Dr Chris Buskes, the Institute’s acclaimed Darwin expert, co-published a book on the life, works and intellectual heritage of Charles Darwin (In Darwin’s woorden). His bestseller Evolutionair denken (2006) appeared in a Spanish translation. Prof. Marc Slors organized a series of expert meetings on the relationship between philosophy of mind and psychiatry (in collaboration with the University of Leiden and the VU University Amsterdam), and an international workshop on Narrative, Simulation and Identification (together with Prof. Hans Hoeken of the Centre for Language Studies).

Within the research programme The Project of a Hermeneutic Philosophy, Dr Gert-Jan van der Heiden obtained a Veni grant for a research project on recently developed ontological models of plurality and their implications for political philosophy. He also completed a book entitled The Truth (and Untruth) of Language, which focuses on the various conceptions of language in contemporary continental philosophy. More specifically, his study offers a detailed analysis of the notions of ‘disclosure’ and ‘displacement’ in the works of Heidegger, Ricoeur, and Derrida. Dr Benda Hofmeyr, who is also carrying out a Veni project at the Institute, published a collection of essays on the French philosopher Emmanuel Levinas (Radical Passivity). The book focuses on the ethical significance of Levinas’s idea of ‘radical passivity’ and deals with various criticisms levelled against Levinas’s prioritization of the Other as the cornerstone of ethics.

Within the programme From Natural Philosophy to Science, Annemarie Nooijen defended her PhD thesis on Balthasar Bekker’s book De betoverde wereld (1691-1693) and its influence on German Enlightenment thought (in collaboration with Prof. G. van Gemert of the Institute for Historical, Literary and Cultural Studies). Prof. Paul Bakker delivered his inaugural address (Tabula rasa). He also organized an international conference on Philosophical Psychology in Late-Medieval Commentaries on Peter Lombard’s Sentences. Prof. Christoph Lüthy co-published a collection of essays (De maakbare mens) analyzing various aspects of the cluster of current developments and public fears that relate to the untranslatable Dutch phrase ‘De maakbare mens’. Looking at the issues involved from the point of view of genetic engineers, human rights lawyers, biologists, artificial intelligence specialists, philosophers, historians, and sociologists, this book shows where the fears are well-grounded and where they are imaginary. Alexis Smets, junior researcher in Prof. Hans Thijssen’s NWO project on Visualizing the Invisible, was awarded a research fellowship at the Chemical Heritage Foundation in Philadelphia. Prof. Thijssen, Prof. Bakker and Dr M. Streijger completed their edition of John Buridan’s commentary on Aristotle’s De generatione et corruptione, a key text in fourteenth-century natural philosophy. Finally, the senior members of the programme success-
fully applied for a research professorship for Prof. Edith Dudley Sylla (North Carolina State University, USA) in the Royal Academy’s Visiting Professors Programme.

Within the research programme Practical Philosophy two PhD theses were defended: Chiel van den Akker on truth, language and the past (Bewerken en Tonen) and Willem van der Kuylen on Kant’s notion of ‘Realrepugnanz’. Dr Bas van Stokkom and Dr Marcel Becker were awarded a short-term project on Citizens as ‘Trustees’ as part of NWO’s research programme Contested Democracy. Dr Evert van der Zweerde completed his exploring study on Islamic Democratic Repertoires. His study demonstrates that the allegedly problematic relationship between Islam and democracy is the result of the contingent intersection of a perceived crisis of democracy, on the one hand, and a rapid process of transformation of the Islamic tradition itself, on the other. Dr Marcel Becker and Prof. Paul van Tongeren published a collection of essays on the ethical significance of literature (Sprekende werken). Dr Marin Terpstra and Dr Inigo Bocken successfully applied for a project in the Royal Academy’s Student Assistants Programme. Ten promising MA students were offered the opportunity to participate as research assistants in a project on Limits and Chances in the Dialogue between Reason and Religion. This project is a joint initiative of the Research Institute for Philosophy and the Research Institute for Religious Studies and Theology.

Finally, members of several research programmes participated in a workshop on Alliances: The Future of Philosophy organized at De Paul University (Chicago) to celebrate the continuing cooperation with the Research Institute for Philosophy.

Societal impact
Members of the Institute regularly participate in forum discussions and contribute to public debate by publishing articles in newspapers, giving talks on the radio and in other media, thus reaching a wider audience than the scientific community alone. 2009 was celebrated as the Year of Darwin. Throughout the year, Dr Chris Buskes was seen in forum discussions, television programmes, newspapers and symposia dedicated to Charles Darwin and his influence. Dr Evert van der Zweerde acted as commentator on public lectures by Prof. Tariq Ramadan, Prof. Herman Wijffels, and Dr Shahrukh Alam, all organized by Radboud University Nijmegen’s Soeterbeeck Programme. Dr Marcel Becker continued his activities as member of the board of Nijmegen’s Sprekende werken, which aims to bridge the gap between academic philosophical research and a non-academic audience. Prof. Christoph Lüthy’s book De maakhare mens was launched during a public debate at the Royal Academy and discussed on television, on the radio and in newspapers. Several members of the Institute were involved in a series of evening lectures intended for philosophy teachers in secondary schools on the topic of Rationality and Religion, and gave lectures in secondary schools and at HOVO (Higher Education for the Elderly). Finally, the

Institute hosted a highly successful ‘Business Day’ (Bedrijvendag), jointly organized by staff and students and intended to shed light on the role of philosophy in business and government.

Future research
The Institute intends to intensify and expand its cooperation with the Research Institute for Religious Studies and Theology, the Institute for Historical, Literary and Cultural Studies and the Centre of Language Studies, in order to reinforce research in the humanities at Radboud University Nijmegen. A few joint multidisciplinary PhD projects have already been developed and many others will follow.

Within the Research Institute for Philosophy, several PhD theses have almost been completed and will be defended in 2010, two of them on the basis of international co-tutelle agreements: Miene Dobre (agreement with the University of Bucharest) and Delphine Bellis (agreement with the University of Paris IV).

Dr Bart Geurts will start his new project on quantity implicatures (Quantity matters: Building a theory of Q-implicature). Dr Corien Bary will start her Veni project on report constructions in Ancient Greek (Reports from the Past), more specifically on the differences between direct and indirect reports, and on the related language-philosophical distinction between ‘mention’ and ‘use’. She will spend a few months at the Department of English and American


Dissertations: 4
Scientific publications: 102
Professional publications: 29
Social Sciences. Dr Cees Leijenhorst and Prof. Paul Bakker will publish a collection of essays on the development of the science of the soul from the late Middle Ages to the eighteenth century: *Psychology and the Other Disciplines*. Prof. Christoph Lüthy will publish two collections of articles: one on scientifically relevant objects in the early modern Low Countries (*Silent Messengers*, with Sven Dupré, University of Ghent) and one on the Faculty of Science at Radboud University Nijmegen between 1957 and 2007 (*The Growth of the Faculty Tree*, with Wim Thijssen and Ton Rijken). Finally, Prof. Edith Sylla will supervise a series of research seminars on late-medieval natural philosophy as part of her visiting professorship.

The MA students involved in the *Student Assistants* project on *Limits and Chances in the Dialogue between Reason and Religion* will present their results at a conference to be organized by Dr Marin Terpstra and Dr Inigo Bocken. Dr Terpstra will also organize a series of expert meetings on ethics, politics and religion, and publish a book on democracy and political theology (*Democratie als cultus*). Members of the research group *Repertoires of Democracy*, led by Dr Evert van der Zweerde, will publish a volume on *Creative Crises of Democracy* and organize a workshop in which the results of the project will be made available to a larger audience.

Finally, the 32nd conference of Dutch and Flemish philosophers (Nederlands-Vlaamse Filosofiedag) will be hosted by the Institute in cooperation with Radboud University’s Soeterbeek Programme.
Institute for Historical, Literary and Cultural Studies

The Institute for Historical, Literary and Cultural Studies (HLCS) is part of the Faculty of Arts. Its main objective is to create a stimulating research environment for high-quality, innovative research in the fields of literature and literary theory, cultural studies, history, art history and archaeology. HLCS research is organized in programmes that are based on common research issues, themes, methodologies or a common focus on a specific period. Each programme is designed to maximize integration through joint projects. By sharpening the profile by combining expertise and making a clear choice for high-level research and talent, HLCS ensures that the research conducted in Nijmegen remains prominent both nationally and internationally.

There are five research programmes:

- The Ancient World
- Christian Cultural Heritage
- History after the Middle Ages
- Studying Criticism And Reception Across Borders (SCARAB)
- Performances of Memory

In 2009, the department of Arabic Language and Culture was transferred from the Faculty of Arts to the Faculty of Religious Studies. The new department of Islam and Arabic meets the needs of specialists in these fields. As a result, the successful research programme The Dynamics of Islamic Culture was discontinued within the HLCS.

In November Dr Bé Breij became a Young Academy member of the Royal Netherlands Academy of Arts and Sciences. She is one of ten new members, researchers working in various disciplines who have been selected for their scientific achievements and received their doctorates within the last decade. The Young Academy, which was established in 2005 in order to foster communication among young researchers working in different disciplines, organizes interdisciplinary conferences, expresses opinions on various social and political issues, and works to generate public enthusiasm for academic work. Dr Breij’s research is interdisciplinary: she uses Latin rhetorical texts from a specific literary context in order to study the social and cultural problems of the Roman Empire. This has proved an innovative and highly successful research strategy.

Research facilities

- The Humaniora Library (155,000 volumes, 15,500 serial volumes, 750 serial subscriptions and 600 manuscripts).
- Centre for the Documentation of Art History: collections of pictures, photographs, and slides (www.ru.nl/ckd).
Staff

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Professors:
- Prof. R.A.M. Aerts (o)
- Prof. A.L.L.M. Asselbergs (e)
- Prof. C.C. van Baalen (p)
- Prof. J.T.J. Bak (o)
- Prof. H. Bekkering (p)
- Prof. C.M.G. Berkvens-Stevelinck (e)
- Prof. S.L. de Blauw (p)
- Prof. O. Dekkers (o)
- Prof. Th.L.M. Engelen (p)
- Prof. M. Erdrich (o)
- Prof. F.J.M. de Feijter (o)
- Prof. P.J. Fuhring (e)
- Prof. G.C.A.M. van Gemert (p)
- Prof. O.J. Hekster (o)
- Prof. J.H.T. Joosten (o)
- Prof. P.M.M. Klep (o)
- Prof. A.M. Koldewey (o)
- Prof. A.P.M.H. Lardinois (o)
- Prof. S.A. Levié (o)
- Prof. V. Manuth (o)
- Prof. J.R. ter Molen (e)
- Prof. M.E. Monteiro (o)
- Prof. E.M. Moormann (o)
- Prof. I.J.A. Nijenhuis (e)
- Prof. J.B. Oosterman (o)
- Prof. M.G.M. van der Poel (o)
- Prof. P.G.J.M. Raedts (o)
- Prof. P.J.A.N. Rietbergen (o)
- Prof. F.M.J. Schuerrwegen (o)
- Prof. A.M. Smelik (p)
- Prof. M. Steenmeijer (o)
- Prof. T.H.G. Verhoeven (e)
- Prof. C.H.M. Versteegh (o)
- Prof. K.G. de Vries (e)

Collaboration

Prof. André Lardinois is one of the founders of a network engaged in the study of archaic Greek lyric, iambic and elegiac poetry and song, with representatives in most European countries and from the main American universities. The aim of this network is to pool the resources of individual scholars, who now often work in isolation, by holding regular meetings, keeping in contact through a network website and a newsletter, and defining topics of common interest within archaic Greek poetry that groups of scholars in different countries can work on together.

Dr Stephan Mols is a member of the board of the Association Internationale pour la Peinture murale Antique (AIPMA), an international network of researchers on ancient wall painting. This board organises conferences and the editions of a reference bibliography. Prof. Moormann, who also belongs to this network, collaborates on the edition of the bibliographical bulletin Apelles.

Prof. Marit Monteiro is a member of the board of RELINS-Europe (European Forum on the History of Religious institutes in the

- The Auxilia archaeological project bureau (Provincial Roman History; revaluation of material gathered in excavations in the former territories of Germania Inferior, especially in Ulpa Noviomagus Batavorum (www.ru.nl/auxilia).
Institute for Historical, Literary and Cultural Studies

19th and 20th centuries), a collaborative venture between KADOC Leuven, Université Fribourg, Hochschule Vallendar, and Radboud University Nijmegen.

Prof. Theo Engelen is director of a joint venture involving historians and anthropologists at the N.W. Posthumus Instituut, Stanford University and Academia Sinica (Taiwan) called ‘Population and Society in Taiwan and the Netherlands’.

Prof. Carla van Baalen is a member of the board of the Montesquieu Institute for the study of comparative European parliamentary history and constitutional development in The Hague. The Institute collaborates with other research centres and institutes in Europe on research and educational programmes that focus on parliamentary history, political culture, and political relations and developments in the EU member states and the European Union.

Prof. Anneke Smelik collaborates with ArtEZ Institute of the Arts in Arnhem, the Saxion Universities, the Premselect Institute for Fashion and Design, the Amsterdam Fashion Institute and the University of Amsterdam in the Netherlands Organisation for Scientific Research and Cultural Dynamics programme ‘Dutch fashion in a globalised world’.

Research results

In 2009 seventeen dissertations were defended, including two cum laude: Louis van den Hengel, Imag. Romeinse keizerbeelden en de belichaming van gender, and Matthijs Ilsink, Bosch en Bruegel als Bosch. Kunst over kunst bij Pieter Bruegel (c. 1528-1569) and Jheronimus Bosch (c. 1450-1516).

The University library holds a collection of manuscripts from the library of the former Augustinian convent Soeterbeeck. Many of these manuscripts are severely damaged, while others consist of fragments only. An exhibition in the library from December 2009 until the end of February 2010 shows, among other exhibits, fragments that were used as material for binding or repairing other books. These include a fifteenth-century graduale, a book with Latin liturgical hymns that was recently purchased by the University and restored to the Soeterbeeck collection to which it previously belonged. This exhibition, put together by researchers in the Christian Cultural Heritage programme, offers insight into the way medieval books were recycled, from the sixteenth century until late in the twentieth century.

Theo Engelen, Professor of Historical Demography, published Van 2 naar 16 miljoen mensen. Demografie van Nederland 1800-nu. Around 1800 the Netherlands had approximately two million inhabitants, whereas now there are 16.5 million and the four largest towns together have more than two million residents. For the first time in thirty years, all demographical information on the Netherlands is gathered in one book, dealing with developments such as emancipation, migration and ageing. As to this last topic Engelen demonstrates something remarkable: the first signs of ageing were already apparent in 1900, but were not noticed until 85 years later.

In seventeenth-century Holland, people had a huge repertoire of songs at their disposal. In company or a loan, at home and in public: the Dutch would sing happy, sad, bawdy or sacred songs all day long. Many of these songs people knew by heart, but they were also available on paper. Nowhere else in seventeenth-century Europe were so many song books published as in the Netherlands. In her book Zingend door het leven. Het Nederlandse liedboek in de Gouden Eeuw Dr Natascha Veldhorst describes this phenomenon, which had not received any attention previously. Dr Veldhorst shows us the important role of songs in every day life – a role that in a way is comparable to that of MP3 players nowadays.

Societal impact

In his book Romeinse keizers. De macht van het imago Prof. Olivier Hekster discusses how the most powerful men of the Roman Empire saw themselves – and were seen by others. Roman emperors were absolute rulers of probably the most successful empire in Western history but, without the support of many others, it was difficult for them to rule this huge territory. To satisfy all kinds of people, they created a certain images. Romeinse keizers answers the question as to what extent these images correspond with reality. By using a variety of classical sources, Hekster shows a general audience how some emperors became ‘good’, and others became ‘bad’.

From 10 October 2009 to 3 January 2010 the Valkhof Museum in Nijmegen presented the exhibition ‘Catherine’s world. Devotion, demons and daily life in the 15th century’. The show focuses on miniature illustrations in the most important late medieval manuscript from the Northern Netherlands: the Hours of Catherine of Cleves (c. 1440). This anonymous masterpiece from The Morgan Library & Museum in New York was disbound for the occasion so that more than 100 pages could be displayed separately. Daily life in the Middle Ages was illustrated with medieval costumes and Catherine of Cleves’ original household account books were also on show. A reduced version of the exhibition will be shown at The Morgan Library & Museum in New York from 5 February to 2 May 2010. Several HLCS researchers helped set up the exhibition.

The Nijmegen Canon Commission, chaired by Prof. Dolly Verhoeven, composed the Canon of Nijmegen, which in accordance with the national historical canon, consists of fifty ‘windows’. Each window gives a view of an event, person or development that has been important in the history of Nijmegen. Wherever possible, each window is connected to an actual site in Nijmegen or to a special object. And, where relevant, a connection is made between the Canon of Nijmegen and the Dutch Canon. De Canon van Nijmegen is available...
as a book and on the Web. Current and former HLCS researchers Jan Kuijs, Hans Bots, Jac Geurts, Paul Klep and Dolly Verhoeven contributed to *De Canon van Nijmegen*.

On February 22, 1944, American fliers bombed Nijmegen. Dr Joost Rosendaal’s book *Nijmegen ‘44. Verwoesting, verdriet en verwerking* is mostly concerned with the way Nijmegen residents experienced this bombardment of their city, but Rosendaal also wanted to know precisely what happened on that very day. The usual explanation given for the bombing is that the Americans mistakenly took Nijmegen for one of the nearby German cities Goch or Kleve. Rosendaal found only one statement in support of this story, made by the commander of the twelve pilots who were involved in the bombing. Other statements, especially those made by the pilots immediately after returning from their mission, brought Rosendaal to the conclusion that the Americans knowingly bombed a target they had not identified.

**Future research**

The archaeological bureau Auxilia was successful in acquiring funding from the Netherlands Organisation for Scientific Research for a long-term research programme on Roman Nijmegen (Odysseegelden), in collaboration with the University of Leiden and the archaeological unit of the City of Nijmegen, in order to publish the excavations carried out on the ‘Kops Plateau’ at Nijmegen in 1986-1995 by the former Dutch State Archaeological Service (ROB, now RACM). Here was the earliest Roman military site in the Netherlands, one of the key sites for understanding the Roman presence in Nijmegen and in the Netherlands, and without any doubt also for understanding the Roman military expansion into north-western Europe up to AD 16. The site was not completely excavated and about one third is protected so that it remains available for future investigations. This enhances its significance at both a national and an international level.

A Rubicon grant was awarded to Dr Tesse Stek for his project ‘A world of villages. Non-urban settlement organization and Roman expansion in the Roman Republic (4th-2nd centuries BC)’. This project explores the role of Roman non-urban settlements in this formative phase of the Roman Empire. Both ancient and modern viewers have portrayed Roman colonies as key-factors in the spread of the urban model, contrasting sharply with the non-urban settlement organization that prevailed in the conquered areas. Several aspects of this model have been attacked by recent studies however, and it is now clear that non-urban settlements and institutions must have also played an important role in early Roman expansion and colonization. Dr Stek, who also received a Marie Curie fellowship for this project, will work at Oxford and Glasgow universities to develop his research plans into various field projects and publications.

A Veni grant was awarded to Dr Maarten De Pourcq for his proposal on ‘Challenging the classical tradition: receptions of antiquity in Julia Kristeva’s theory of intertextuality’. Throughout the history of Western thinking Greco-Roman antiquity has been used as an authoritative archive to inform the development of theoretical
paradigms, especially in the humanities. This project will develop a completely novel theoretical framework for assessing the discursive functions of antiquity in twentieth-century literary theory. It opens up new areas of research in the fields of reception studies and discourse analysis. The great appeal of the project is that its results can be extrapolated to other cases of cultural criticism, given the strength of the classical tradition Western thinking.

Dr Sándor Chardonnens obtained a Veni grant for his project ‘From Science to Popular Culture: Artes magicae in England between the Scriptorium and the Printing Press, 1200-1500’. In the early medieval period, the artes magicae were characteristic of scientific, monastic learning, while at the end of the Middle Ages they had become part of popular culture. In contrast to the insights of continental artes research, the mechanisms underlying the change of artes magicae from science to folklore are not well understood in the English-speaking world. Chardonnens will study the form, status and audience of magical arts between twelfth-century scriptoria and early modern popular culture by analysing contemporaneous magical texts from English manuscripts and early print
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Director: Prof. Eric Moormann

Eric Moormann has been a Full Professor of Classical Archaeology at Radboud University Nijmegen since 2002. Before that he was Assistant Professor at the University of Amsterdam and worked at the Netherlands Institute in Rome. He is an expert in the archaeology of the Hellenistic-Roman era, in particular the citizen’s environment in ancient times (housing, furniture, decoration and city structure). Prof. Moormann has been a Corresponding Member of the German Archaeological Institute since 1998. He is editor-in-chief of the Bulletin Antieke Beschaving, a peer-reviewed annual publication on archaeological studies in the Mediterranean region. He received the Winkelman Medal for his research on this 18th-century pioneer scholar of Classical Archaeology.

Dr Wim van Meurs’ exploratory study ‘Boerenpartijen en democraziseren in Oost-Europa rond 1900’ received funding from the NWO in the framework of its research programme ‘Contested Democracy’. In both Eastern and Western Europe, the emergence of modern political parties and the introduction of universal suffrage took place in the late 19th and early 20th centuries. Unlike in Western Europe, however, in every East European polity peasants’ parties played an important role in this process of democratisation. Yet, their views on parliamentary democracy per se, the role of mass politics and institutional designs varied widely. This study envisages a comparative literature-based of major peasants’ parties in five countries (Estonia, Poland, Bulgaria, Croatia and Romania). Its objective is to identify structural factors beyond the confines of specific national aspects that explain the parties’ shifting attitudes vis-à-vis parliamentary democracy and its institutions as well as their contribution to political innovations such as universal suffrage and the institutionalisation of modern political parties.

Prof. Maarten Steenmeijer obtained an NWO grant for his research project “A Deep Need in Contemporary Fiction”. A Polysystemic Approach to the International Reception of Jorge Luis Borges.” In the 1950s and 1960s, the Argentine writer Jorge Luis Borges (1899-1986) astonished the literary establishments of Western Europe and the United States with his works and poetics, which had a pivotal impact on influential writers and critics. The aim of this research project is to offer a better understanding of the reception of Borges, using polysystem theory as its methodological foundation, adopting a comparative perspective. It will focus on the reception of Borges in three literary domains: the centre (France, Germany, England, US), the semi-periphery (the Netherlands) and the periphery (Argentina, Spain during the Franco dictatorship). Polysystem theory’s concepts will be operationalised so that a phenomenon which has not only national, but also international and transnational dimensions, can be analysed and described adequately.
Research Centres of the Faculty of Law

The Business and Law Research Centre
(Prof. C.J.H. Jansen)

The Business and Law Research Centre – known in the Netherlands by its Dutch acronym ‘OO&R’ (Onderzoekcentrum Onderneming & Recht) – is a cooperative venture between the Law Faculty of the Radboud University of Nijmegen and thirteen prominent, mostly international, law firms and multinationals: ABP Pension Funds, AkzoNobel, Allen & Overy, De Brauw Blackstone Westbroek, Clifford Chance, Eumedion, Houthoff Buruma, ING, Loyens & Loeff, Nauta Dutilh, Pels Rijcken & Droogleever Fortuijn, Rabobank Netherlands and Stibbe. These partners are extensively involved in research at the Centre. Furthermore, they provide recommendations on the governance, focus and prospective research projects of the OO&R through their participation in the Advisory Board.

The Centre, which conducts fundamental research in the field of Business and Law, critically analyses national and international developments in legislation, case law and best practices related to this field of law. It also provides a thorough educational programme for gifted young scholars and is actively involved in a wide variety of postgraduate educational and professional training programmes.

The financial crisis and insolvency are ‘hot’ topics at the Business and Law Research Centre.

The OO&R’s main strength lies in combining academic excellence with the expertise and practical experience of its partners. This unique collaboration has led to continuing cross-fertilization between legal practice and the academic world.

The four key research programmes of the OO&R are:
• Company Law
• Banking, Finance and Insolvency Law
• Business and Patrimonial Law
• Business and Financial Law

The research conducted by the OO&R – across all research programmes – focuses strongly on European private law and private
Staff

Prof. I.P. Asscher-Vonk (o)
Prof. S.E. Bartels (o)
Prof. F.E.J. Beekhoven van den Boezem (e)
Prof. J.M.A. Berkvens (e)
Prof. P.P.T. Bovend’Eert (o)
Prof. Y. Buruma (o)
Prof. E.C. Coppens (e)
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Prof. N.E.D. Faber (o)
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Prof. K.C. Wellens (o)

Tenured
Full Professors 10.6 FTE
Associate Professors 5.6 FTE
Assistant Professors 2.6 FTE
Researchers 2.6 FTE
Lecturers 1.3 FTE

Non-tenured
Researchers 3.5 FTE
Lecturers 8.8 FTE
Doctoral candidates 32.3 FTE

Collaboration

Within the framework of the International Working Group on Protected Funds in the EU and the International Working Group on Security Rights in Europe (both established by the OO&R and chaired by Prof. S.C.J.J. Kortmann), the OO&R cooperated in 2009 with leading academics from a broad range of universities across the EU and beyond, in particular with senior researchers at the following universities: Berlin – Humboldt (Germany), Bern (Switzerland), Budapest (Hungary), Edinburgh (Scotland), Leuven (Belgium), Linz (Austria), London – King’s College (UK), Luxembourg (Luxembourg), Madrid (Spain), Milan – Bicocca (Italy), Montpellier (France), Ohio (USA), Oxford (UK), Paderborn (Germany), Paris II (France), Prague (Czech Republic), Rome – Luiss Guido Carli (Italy) and Thessaloniki (Greece). The OO&R also collaborated with INSOL Europe and UNCITRAL.

In 2009 the OO&R established new International Working Groups in the field of insolvency law, company law and financial law.

international law. This focus is complemented by research on the practical applications of the law, international and comparative research and multi-disciplinary research.

The OO&R, which was established in 1991, is recognized as a research school by the Royal Netherlands Academy of Arts and Sciences (KNAW). In 2009 this accreditation was renewed until 2015. The OO&R’s educational programme for gifted young scholars was accredited by the Accreditation Organisation of the Netherlands and Flanders (NVAO).

Research facilities

The OO&R houses the Information and Documentation Centre for Business and Law (CIDOR) – a centre of expertise which supplements the library of the Faculty of Law with a collection of books, journals and electronic publications on international and domestic Business Law that is unique in the Netherlands.
Research results
The causes, consequences and future remedies for the global credit crisis were discussed during a major conference organized by the OO&R at ING House on 11 September 2009. A forthcoming volume in which the Credit Crisis is analyzed from both a domestic and comparative legal and economic perspective will be published in the beginning of 2010. Legislative and policy reforms were advocated in various other research projects. An important example was the publication of the Draft EU Directive on Protected Funds which could – given possible future consideration by the European Commission – change the legal landscape of trust arrangements across the European Union. The monetary policies of the Dutch Central Bank concerning credit claims were critically addressed by Prof. F.E.J. Beekhoven van den Boezem in his inaugural lecture.

Examples of practical experience of the effectiveness of specialist courts proceedings were collected by a research team at the OO&R (commissioned by the Council for the Administration of Justice; Raad voor de Rechtspraak).

The ‘position of execution creditors’ and ‘the law applicable to employment contracts’ were extensively analyzed in separate volumes published by the OO&R and discussed during conferences organized or co-organized by the OO&R at Rabobank Netherlands and at the University of Antwerp. In cooperation with the Ministry of Justice, the OO&R organized a seminar at WTC Amsterdam on potential legislative reform to enhance capabilities for combating insolvency fraud. The new volume published by Cambridge University Press on the legal position of the unauthorized agent was presented at an international expert meeting organized by the OO&R at De Brauw Blackstone Westbroek in Amsterdam. In November 2009 the Van der Heijden Institute (the company law department at the OO&R) organized a major biennial conference on internal disputes between corporate entities.

Major new editions were published in the prominent Asser Series in the field of Company Law, Contract Law and the General Law of Obligations. A new textbook was published in which the law applicable to investment institutions is systematically examined. The OO&R also published on a monthly basis the leading case law review relating to ‘Business and Law’ (Jurisprudentie Onderneming en Recht).

Dr M.S. Houwerzijl presented the results of an EU-funded project focusing on the ‘Representation of Agency Workers’ in Europe.

Societal impact
The societal impact of research conducted by the OO&R can be seen in relation to the financial turmoil during the credit crisis. The availability and cost of credit, best practices in terms of corporate governance, shareholder activism and financial markets supervision are just a few examples of topics which have triggered a great deal of public debate and controversy and which represent a core strand of the research done at the OO&R. Other research topics which directly influence the financial and commercial climate both in the Netherlands and internationally include trusts and protected funds arrangements, secured transactions, the effects of the opening of the insolvency proceedings, combating insolvency fraud, asset management, pension funds, corporate litigation and the use of flexible corporate entities.
The societal impact of research done at the OO&R is further enhanced by the extensive involvement of its partners in large-scale, and often permanent research projects. This unique institutional cooperation generates results which are often directly applicable in practice and/or which contain recommendations for legislative and policy reforms designed to meet particular societal needs.

Most senior researchers at the OO&R hold key positions in law reform committees, courts, the Netherlands Authority for the Financial Markets, law firms, banks and/or companies.

**Future research**

Pending and future research projects include ‘Corporate governance and compliance’, ‘The position of shareholders’, ‘Securities in patrimonial law’, ‘Structured finance’, ‘The credit crisis in domestic and comparative perspective’, ‘Business law in relation to pension schemes and funds’, ‘Security rights in Europe from a comparative perspective’ and ‘Corporate Criminal Law.’ Permanent research is conducted by the OO&R within the framework of several volumes published in the prominent Asser Series. Early in 2010, the EU-funded project study on the legal aspect of the posting of workers will start.

A major research project was initiated by the OO&R in which core topics of insolvency law are compared in 25 selected countries both within and outside Europe. The outcome of this project will be published in fifteen volumes (which are destined to function as a main source of reference in the field of international and comparative insolvency law). Other International Working Groups recently established by the OO&R will thoroughly examine applicable laws and best practices relating to ‘The One Tier Board’ and ‘The Liability of Asset Managers.’ These projects were established to critically analyze the domestic legal regimes of selected European countries and to advance recommendations for European harmonization.

The OO&R will organize various conferences and seminars on a wide range of topics in the field of ‘Business and Law.’ Furthermore, researchers at the OO&R are expected to continue to participate in activities organized by UNCITRAL, INSOL International and INSOL Europe. International expert meetings will be organized by the International Working Groups established by the OO&R.

**Research Centre for State and Law**  
*(Prof. R.J.N. Schlössels)*

The Centre for State and Law – known in the Netherlands by its Dutch abbreviation ‘SteR’ (Onderzoekcentrum voor Staat en Recht) – focuses on key issues and basic principles in public law. Its researchers critically analyze national, European and international developments in constitutional law, administrative law and criminal law. The Centre aims to create a stimulating environment in which high-quality, national and international multidisciplinary research can flourish. SteR runs three major research programmes:

1. Centre for Migration Law  
2. Administration of Justice  

The ‘Centre for Migration Law’ (CMR) programme brings together researchers from a variety of disciplines to provide a stimulating context for high-quality fundamental and applied research, both legal and empirical, on migration and the protection of minorities. The CMR is unique in Europe for its interdisciplinary approach and the composition of its staff, which includes lawyers, sociologists, anthropologists and political scientists. It is also known for its comparative international approach.

The CMR provides a thorough academic training and a stimulating research climate, operating a guest programme that receives promising PhD students and young postdocs from all over Europe. Its staff conduct research for international organizations such as the European Community, the Council of Europe, the UNHCR, the International Organization for Migration, the UN Centre for Human Rights, Amnesty International and the European Council on Refugees and Exiles.

The CMR also contributes to drafting new European migration law. It organizes international conferences, edits a journal (European Journal of Migration and Law), a book series (Immigration Law and Policy in Europe) and a yearbook on Dutch and international migration law (Rechtspraak Vreemdelingenrecht).

The ‘Administration of Justice’ programme focuses on law in action – the working of the courts, public prosecutors and the legal profession. Special attention is paid to the phenomenon of convergence of civil, criminal and administrative procedural law. Exploration of common principles and concepts of legal proceedings is also an important research topic. ‘Administration of Justice’ involves research in four main areas:

1. Legislation and case law relating to procedural law, including the position of citizens in adjudication  
2. Organizational design and practice of the Administration of Justice  
3. The quality of Administration of Justice from the point of view of legality, effectiveness and efficiency  
4. The legitimacy of the Administration of Justice, from the perspective of the ethics of legal professionals (magistrates, lawyers and others).

The ‘Principles of Public Law’ programme focuses on the main principles of public law from a national, European and international perspective. Researchers investigate the relationship between principles of the democratic constitutional state (*i.e.* the rule of law, human rights, the democratic order, and accountability) and
Research Centres of the Faculty of Law

Key publications

**The Business and Law Research Centre**


**Research Centre for State and Law**


national and international social developments. The principles are studied with a keen eye on European and global developments. The programme combines the expertise and know-how of constitutional, administrative, criminal, European and jurisprudential lawyers.

In 2009 the project ‘Fundamentals of a global legal order’ started, based on a Netherlands Organisation for Scientific Research (NWO) Vidi grant for a senior researcher in Philosophy of Law. P.H.P.H.M.C. van Kempen was appointed as Professor in Criminal Law and Procedural Criminal Law. He also holds the chair of Human Rights. H.J.B. Sackers was appointed Professor in Administrative Sanction Law.

Awards and acknowledgements
• Prof. E. Guild was granted a Jean Monnet chair ad personam.
• Prof. C.A.J.M. Kortmann received the Royal Honour ‘Knight in the Order of the Dutch Lion’.

Collaboration
SteR participates in the International Research Universities Network (IRUN), collaborating with the universities of Münster, Kiel, Leuven, Poitiers, Montpellier, and Exeter. The Centre also has international associations with the Max Planck Institute for Foreign and International Criminal Law (Freiburg, Germany), the Challenge project (Challenge Landscape of European Liberty and Security), the International Penal and Penitentiary Foundation, the EU-AGIS program and the Working Group on Comparative Studies of Legal Profession. Within the Netherlands SteR collaborates with the Council for the Judiciary, the Ministry of Justice, several courts, municipalities and lawyers. In 2009 SteR celebrated five years of collaboration with the Court of Appeal and the District Court in Arnhem.

The ‘Centre for Migration Law’ is responsible for coordinating the European Network on Free Movement of Workers within the European Union, which is funded by the European Commission. The CMR has long-term collaborative arrangements with the Research Centre for Institutional Behaviour and European Integration at the Austrian Academy of Sciences, the European Centre for Social Welfare Policy and Research in Vienna (Austria), the Centre for European Policy Studies (Belgium), the Danish Institute for Human Rights in Copenhagen (Denmark), the Research Centre for International and European Immigration and Asylum Law at the University of Constance (Germany), the Institute of Political Science in Paris (France), the London School of Economics (UK) and the Odysseus Network of Experts in European Migration and Asylum Law.

Research results
In general, SteR makes its results known through leading publications (including its own book series), and it also disseminates these results through lectures, conferences and symposia.

The Centre for Notarial Law


Dissertations: 8
Scientific publications: 259
Professional publications: 189
Annotations : 232
CMR researchers D.P.L.M. van Dam LL.M., M.H.A. Strik LL.M. and Dr K.M. Zwaan prepared the Dutch report for a UNHCR project titled: Improving EU Asylum Procedures: Comparative analysis and Recommendations for Law and Practice. Dr C.A.F.M. Grütters conducted research on the Settlement of the old Aliens Act Estate Scheme (the pardon scheme).

‘International Exploration on Forced Marriages’ is a study on legal initiatives, policies and public discussions in Belgium, France, Germany, the UK and Switzerland related to forced marriages. The study is the result of an interdisciplinary project between the Institute for Sociology of Law and the Department of Cultural Anthropology and Development Studies at Radboud University Nijmegen.

The programme ‘Administration of Justice’ carried out two research projects funded by the Council for the Judiciary. One was conducted by Dr A.G.M. Böcker, Dr T. Havinga, Prof. C.J.M. Klassen and Dr A. Jettinghoff on the Specialisation of Judges, the other, on Collegial Courts, by R. Baas MSc, Dr M.T.A.B. Laemers and Prof. L.E. de Groot-van Leeuwen.

Prof. J.D.A. den Tonkelaar delivered his inaugural lecture on Selecting Judges in September 2009. Prof. A.B. Terlouw delivered her inaugural lecture on ‘Fear and Regulation’ in the same month. Prof. R.E.C.M. Niessen held his inaugural lecture on ‘Judicial Reasoning in Tax Cases’ in October 2009. Four PhD theses were defended.

In June 2009 a conference was organized together with the Court of Appeal and the District Court in Arnhem on the Quality of the Administration of Justice. Also in June, researchers specializing in administrative law organized an expert meeting on current developments in administrative procedural law.

Societal impact
The CMR carried out research on behalf of the UNHCR, the European Commission, the Dutch Ministry of Justice, the Advisory Committee for Aliens’ Affairs, the Dutch Refugee Council, FORUM (Institute for Multicultural Development) and the Dutch Foundation for Legal Aid for Asylum Seekers. Consultancy services were also provided to the Council for the Judiciary, the Dutch Refugee Council and FORUM. The Centre’s publications have provided to the Council for the Judiciary, the Dutch Refugee Council, FORUM Committee for Aliens’ Affairs of the Social-Economic Council (Sociaal-Economische Raad).

Future research
The CMR will continue to participate in several projects funded by the EU, including the coordination of the Network on Free Movement of Workers for a period of four years. Prof. P.C. Muysken (socio-linguistics), Dr M. Verrips (director of the Taalstudio) and Dr K.M. Zwaan (CMR), who make up the coordination committee, will receive European Science Foundation support for organizing a preparatory workshop on Language and origin: the role of language in European asylum procedures. This exploratory workshop will take place in April 2010.

In 2010 the CMR will start a new research project, funded by DG JLS of the European Commission, on the content and the impact of compulsory elements in national integration policies. The project will compare policies, practices and data in Austria, Belgium, Denmark, Germany, Latvia, the Netherlands and the UK.

The ‘Administration of Justice’ programme will organize a conference on ‘Convergence of procedural law’ in February 2010.

Within the ‘Principles of Public Law’ programme Prof. P.P.T. Bovend’Eert – a member of the Board of Editors of ‘The Constitutional Law of the EU Member States’ – will present the initial results of a comparative study on constitutional law in 2010. A PhD project on ‘Withdrawal of administrative decisions, in a European and comparative perspective’ (Dr A.J. Bok and Prof. R.J.N. Schlössels), financed by the Netherlands Organisation for Scientific Research (NWO), will start in 2010. Furthermore, a new research field – ‘Law and Religion’ – will be introduced in 2010.

The Centre for Notarial Law
(Prof. F.W.J.M. Schols)

The Centre for Notarial Law (Dutch abbreviation ‘CNR’: Centrum voor Notarieel Recht) was established in 2008. Its key research programme focuses on Notarial Law, in particular on family property law (personal and family law, relationship property law, inheritance law and estate planning). The CNR’s main strengths lie in combining tax and civil law and the cross-fertilization between the legal practice and the academic world. Particular attention is paid to the bearing of these fields on the general law of property and to the combination of fields, for example marital property law, real-estate law
and company law. CNR researchers seek to provide a scientific foundation for notarial practice.

Research and academic education are closely connected within the CNR.

Collaboration
The Centre for Notarial Law works with ABN Amro Bank NV in the field of estate planning, and monitors the academic level of the consultancy services provided by the bank. It also works with the Dutch Foundation for Professional Education of Notaries (SBN), the Royal Notarial Association (KNB), the Association of Estate Planners in Notarial Practice (EPN), Netwerk Notarial Association and with Tilburg University as part of its course in Notarial and Fiscal Law.

Research results
The Centre for Notarial Law publishes a series called ‘Publicaties vanwege het Centrum voor Notarieel Recht’ (Kluwer Law, currently nine volumes). Prof. J.S.L.A.W.B. Roes delivered his inaugural lecture on notarial ethics and the history of notarial law. ‘Delegation of last wills to third parties’ and ‘the new inheritance tax law’ are research projects that started in 2009 and will continue in 2010.

Societal impact
The interaction between science and practice advocated by the Centre for Notarial Law is based on close ties between the CNR and legal practice. Researchers are actively involved in lectures, training and legal advice, while acting as preliminary advisors.

Researchers are lecturers (in charge) for the Stichting Beroepsopleiding Notariaat (SBN), for the estate planners of EPN (the association of estate planners in notarial law), and for the Novex (the Dutch association for executors). They are also involved in several organizations for example in the Commission Succession Law II of the Royal Notarial Association (KNB) and in the Commission Inheritance Tax law of the KNB, in the Board of the Institute for Agricultural Law in Wageningen, in the Stichting tot Bevordering der Notariële Wetenschap and in the Scientific Council and Board of the Thijmgenootschap. Researchers at the Centre are editors and editors-in-chief of major scientific and professional journals.

Future research
Current projects within the Centre will continue, including the historical development of the legal position of the surviving spouse in Dutch civil law, the exegesis of last wills, the international aspects of estate planning, the new law concerning non-liability partnerships and the developments in the legislation on marital property. In 2010 the results of an empirical study on nuptial agreements will be published.
In order to understand the complexity of societal systems and to contribute to development strategies, the main questions are:

- What are the fundamental goals, structures and behaviours of the societal system under study?
- What is the current and expected impact of interventions based on institutional, organizational and management arrangements on the goal, structure and behaviour of the societal system under study?
- How can the effectiveness, efficiency and legitimacy of these interventions be measured and evaluated?

Studying these issues leads to academic innovations in: theoretical views, explanatory models and empirical insights. The IMR’s unique multidisciplinary composition enables it to apply a variety of theoretical perspectives, including the managerial, the economic, the geographical and the political.

The IMR’s research is bundled in four programmes, which are carried out by approximately 83 FTE researchers (both tenured and non-tenured):

**Governance and Places (GaP)**
Researchers at GaP explore and evaluate the social and environmental qualities of places, from local to global, with a particular focus on issues related to spatial structure and governance. Research topics include urban and regional development, transport and water management, environmental policy, real estate development, identities and borders, and European spatial planning. The programme integrates perspectives and methods from human geography, spatial planning, environmental studies and public administration.

**Nijmegen Centre of Economics (NiCE)**
NiCE specializes in research on economic issues from a pluralistic and multidisciplinary perspective. Apart from economic theories, researchers use psychological and sociological theories. NiCE focuses on three themes: experimental and behavioural economy, the influence of culture and institutions on economic markets and accounting and finance in relation to organizational change. NiCE uses survey, longitudinal and experimental data sets.
Relational Enterprise (RE)

Researchers at RE aim to arrive at a better understanding of the way organizations are managed. The research takes an integrated approach, focusing on the relationships and networks formed among members within organizations, as well as with actors and institutions in their fields of expertise. RE researchers study these relationships in a number of interrelated domains: REALign (e.g. relationship management, partnerships and social networks); RESPONSibility (e.g. employability, social responsibility and sustainable development); REthink (e.g. managerial and organisational decision-making processes) and REcreate (e.g. social/product innovation).

Shifts in Government and Governance in a Comparative and International Perspective (SHIFTS)

This programme deals with changes in public governance and management. The main hypothesis is twofold: 1) many of the traditional mechanisms, capabilities and styles of government have not “shifted” to the extent that the leading theories suggest, and 2) a trend back to “old” forms of government is taking place.

The programme deals with four interrelated themes: relationships between government and civil society, institutional arrangements affecting citizen participation in the public domain, shifts in multilevel government and the issue of good governance. Cross-fertilization of research from public administration and political science is combined with normative and empirical approaches.

Research facilities

The IMR operates the NSM Decision Lab for experimental research based on game theory and social choice theory in order to study cooperative decision making in various empirical domains. The IMR also uses the Visa Skills Lab and an Electronic Meeting/Group Decision Room for studying group processes such as agenda setting and specifying and evaluating policy alternatives. Further, specialized national and international databases are used, including:

• GaP is building up a national database on industrial estates and industrial property prices for NICIS (the Netherlands Institute for City Innovation Studies) in close cooperation with CBS, Kadaster (the Dutch cadastral organisation) and the Ministry of Spatial Planning.
Institute for Management Research

- NiCE uses the Database Developing World (DDW), which contains socio-economic, demographic and health information on more than 10 million individuals living in over 100 developing countries. Further, the IMR economists use the Datastream International Database, Consensus Economic Survey Database, Educational Participation Database, Regional Indicator Database and Inequality of Mortality Database.
- Researchers at RE use data on mergers, acquisition and alliances from the MERIT-CATI database and Thomson Security Data as well as company-specific data from Osiris and Dun and Bradstreet. Country and sector-level data from the World Bank, United Nations and OECD are regularly consulted. RE researchers also participate in international research networks such as the Cranet network, European Manufacturing Survey, and UFIRIC to collect data on comparative human resource management, innovation among European manufacturers and corporate social responsibility.

Collaboration

The IMR participates in various Dutch research schools and invests in collaboration with partners in other national and international (applied) research networks. Some examples of new research collaborations are:
- GaP: with the International Network Programme on Border Aesthetics, which is funded by the Norwegian Research Council
- GaP: with KU Leuven and SumResearch Urban Consultancy in Brussels, to evaluate the effectiveness of the implementation of the Flanders’ structure plan on spatial planning
- NiCE: with the London School of Economics and Political Science (LSE), University of Amsterdam and the Ecole normale supérieure de Cachan (the ENS Cachan France), France, on the History of Post-War Economics
- NiCE: with the University of Melbourne on projects related to performance measurement, more specifically the adoption of innovative new systems for measuring the performance of companies
- RE: with partners from De Montfort University and Manchester Business School and the University of Sydney in a project called The Healthy Worker: a comparative study of how organizations implement national policy changes in social security and sickness absence management
- RE: with Coppead in Rio de Janeiro and the Technical University in Sao Paulo, targeting international sourcing strategies (comparison of firms in developed and emerging markets)
- RE: The Ministry for Housing funded a project on the analysis of the networks of female entrepreneurs of Turkish and Moroccan descent in the Netherlands
- RE: SenterNovem financed the project Energy transition and cooperation, in collaboration with EIM Business & Policy Research
- SHIFTS: with Crismart, a crises management research institute affiliated with the Swedish National Defence College in Stockholm, and the Swedish Institute of Foreign Affairs, on a project involving a comparison across political systems, across time and across policy areas involving 22 foreign policy crises.
- SHIFTS: The Ministry of Justice funded applied research on the Europeanization of legislation and Conditions for meta-regulation
- SHIFTS: Applied research on Citizens’ participation was funded by the Dutch Ministry of Home Affairs.

Dr Marieke van den Brink graduated cum laude with her PhD thesis ‘Behind the Scenes of Science. Gender Practices in the Recruitment and Selection of Professors in the Netherlands’.
Research results

Some noteworthy published results from IMR research:

• GaP: Dr van den Brink studied core dilemmas for Rijkswaterstaat in the process of constructing a new organizational identity over the last two decades. Her dissertation, defended in December 2009, was approved ‘Cum Laude’

• GaP: Dr Martens developed an advanced simulation model for intra-urban parking, together with Dr Benenson in Tel Aviv, Israel. The model investigates how measures to reduce the pressure on parking spaces affect the adjacent neighbourhoods. A test in Tel Aviv showed significant potential for improving parking policy.

• GaP: with the Institute for Mobility (University of Hasselt, Belgium), future transport scenarios for Flanders for 2020-2040 were elaborated by Dr Martens, in consultation with experts, stakeholders and the public.

• GaP: In cooperation with Utrecht University, the Planning Agency for the Environment and the Ministry of V&W, Dr Wiering studied the implementation of the EU’s Water Directive in various countries, showing significant differences between member states.

• NiCE: Drs Huisman and Dr Smits showed that in poor developing countries good educational facilities, in particular the presence of female teachers, are very important for the participation of young children in primary education.

• NiCE researcher Dr Smits, working with Dr Monden of Oxford University, showed that there are huge differences even in highly developed countries in the way life expectation is distributed among members of the population.

• NiCE: Drs van Hoorn and Dr Maseland (SHIFT) provided an explanation for the negative correlations between values and practices reported by the Global Leadership and Organizational Behaviour Effectiveness project: they appear to be compatible with basic micro-economic insights relating to diminishing marginal utility.

• NiCE: Prof. Vosselman analysed stable and durable relationships, such as the results of interaction between control and building trust. The study explains the interaction between accounting for control and building trust in the context of embedded agency.

• RE: Dr Horvath developed a new methodology (GVAR) measuring the dynamic effects of brand marketing (within and across categories).

• SHIFTS: The Quing (Quality in Gender and Equality Policies) research group formed by Prof. Verloo developed a research strategy for making a systematic cross-national comparison of gender equality strategies. Early results revealed that alleged cultural differences between Northern, Southern and Central-eastern European countries did not affect such strategies.

• SHIFTS researchers Prof. de Vries and Dr Lako developed new methods for measuring the effectiveness of public policy.

Awards

IMR researchers received following awards in 2009:

• Dr van den Brink received the Præmium Erasmianum 2009 – the award for the best dissertation in the social sciences and humanities in the Netherlands.

• Dr van Birgelen and Dr Furrer received Awards for Excellence from the Emerald Literati Club: Dr van Birgelen for his 2008 article in International Journal of Manpower and Dr Furrer received two awards, for articles in the Journal of Strategy and Management and the European Journal of Innovation Management.

• Dr Henseler received the Best Paper Award of the 17th International Colloquium in Relationship Marketing, Maastricht, the Netherlands.

• Dr Helderman was awarded the Van Poelje award for the best dissertation in Flemish and Dutch public administration, and Dr Mastenbroek was runner-up for this award.

• Prof. Sent won the Frans Duynstee trophy for 2009. She received an award for the best Ph.D. dissertation in Flemish and Dutch public administration, and Dr Mastenbroek was runner-up for this award.

• Prof. Van der Heijden was appointed to the Board of Trustees of the Traffic Coordination Center East Netherlands.

Societal impact

Several IMR researchers gave lectures to the general public, wrote articles in newspapers, participated in advisory committees and commented on topical issues on radio and television. Examples include:

• Prof. Leyenaar was appointed as a member of the Council for Public Administration (Raad voor het Openbaar Bestuur) and was reappointed to the Electoral Council (De Kiesraad).


• Dr Anderson was also appointed to the Curatorium for The Institute for Labour Law and Industrial Relations in the European Community at the University of Trier. And Dr Anderson was invited as a visiting expert by the Korean Ministry of Health, Welfare and Family Affairs for an International Symposium on the Economic Crisis, Social Integration and Shared Prosperity in May 2009.

• Dr van der Vleuten served as an expert on two European Citizen Summits in The Hague and Brussels in the spring of 2009.

• On the recommendation of Mrs Michèle Pappalardo, the French “Commissaire-General” for Sustainable Development, Prof. Leroy was appointed as a member of the Scientific Council of the “Service Central des Statistiques et de l’Observation” of the French Ministry for Sustainable Development.

• Prof. Van der Heijden was appointed to the Board of Trustees of the Traffic Coordination Center East Netherlands.
Key publications


Director: Prof. Rob van der Heijden

In 2001 Rob van der Heijden came to the Nijmegen School of Management as Professor of Spatial Planning Delft University of Technology, where he had been Professor of Transport Policy and Logistics since 1994. In 2008 he was appointed Vice-Dean of the Faculty alongside his role as Director of the Institute for Management Research. His teaching and research focuses on complex decision making related to spatial infrastructures and urban development. He is currently and has in the past been a member of various scientific and professional advisory boards in this field.

• Prof. Sent joined the Board of Trustees of the child focused development organization ‘Plan Nederland’. She became a regular commentator in the daily TV magazine ‘Goedemorgen Nederland’ (KRO) giving her views on economic developments in the Netherlands and abroad. She was also appointed to the Dutch Social Development Board (Raad voor Maatschappelijke Ontwikkeling)
• Profs. de Jong and Sent discussed the financial crisis in the media and in presentations for Regioverkenningen Provincie Gelderland, Bestuurlijk overleg van het Rijk van Nijmegen, Nieuwscafé de Gelderlander, Lux Nijmegen and NCW afdeling Nijmegen
• Various The IMR scientists were involved in events related to the Climate Summit in Copenhagen, for example during a Climate Night, which was organized in the Lux Cinema complex in Nijmegen
• SHIFTS organized a conference on European integration studies (December 2009), in collaboration with the Netherlands’ Institute of Government.

Future research
To enhance synergy between the research activities in these four programmes, to bundle capacity, to improve the robustness of the programmes and to further improve the visibility of the Institute’s expertise, the IMR intends to strengthen interdisciplinary collaboration around three central themes:
• responsible organizations
• territoriality and governance
• international borders and conflicts.

The contours for this collaboration will be subject to critical review during the planned mid-term evaluation of the Institute in mid-2010.

The IMR continues its efforts to increase the number of externally funded PhD positions. As a result, several new PhD projects recently started or will start in 2010. In particular:
• GaP: a postdoc and five PhD students started research in the field of City Innovation (financed by the Netherlands Institute of City Innovation Studies and various Dutch local and regional authorities)
• GaP: funding was received from the Nieuw Land Erfgoedcentrum in Lelystad for a PhD study of water management and spatial planning in the period 1970-2008 in the IJsselmeer area
• GaP: funding from NWO was received for a PhD project on the accessibility of the Randstad
• NiCE: one PhD student started research in the WOTRO research programme PopDev on the impact of reproductive health services on socio-economic development in sub-Saharan Africa
• SHIFTS: NWO provided a grant (2 PhDs and 1 postdoc) for the project on contagious social conflict: industrial conflicts as a source of strategic learning
• SHIFTS: two PhD students will start international comparative research on defence policies in cooperation with the Swedish National Defence College.
Alongside these internal projects, The IMR continues to increase the number of external PhD projects.
Nijmegen Institute for Social & Cultural Research

Researchers at the Nijmegen Institute for Social & Cultural Research (NISCO) use integrated multi-disciplinary and comparative approaches to study societal change and processes of socio-cultural participation and organization in Western and non-Western societies. The common research framework reflects complementarities in theoretical approaches, data collection, research design and data analysis. The accredited Research Masters programme in Social Cultural Science provides high-level training in theories and methods for conducting comparative research on societies. NISCO is a research institute of the Faculty of Social Sciences.

Research focuses on three main themes: inequality, cohesion and rationalization. In order to arrive at a better understanding of the dynamics of societal phenomena and processes, researchers at NISCO examine these aspects both from a historical perspective within one society, and in a comparative perspective among different societies.

The three main research themes are defined as follows:

**Inequality**
NISCO explores issues related to differences in access to and control over resources that affect peoples’ opportunities in life, such as educational level, labour-market success, media use and differences in lifestyle. Research focuses on the effect of resources on socio-economic achievement and on how variation between and within countries is affected by structural differences and national policies. Ways in which individual, family and group resources affect outcomes such as cultural and political participation, mobility and media access and use are also studied.

**Cohesion**
NISCO research describes and explains differences in social participation in formal organizations as well as in informal social networks, including families and other groups. This includes three core topics. First, developments in the relationships between social participation and both pro-social and antisocial behaviour are explored, focusing on variations among societies with different welfare-state regimes. Second, a comparative examination is made of the extent to which social groups display exclusionist attitudes and behaviour towards particular out-groups, keeping in mind the effect of economic, cultural and demographic contexts. Third, representations of social reality in mediated communication (including public awareness campaigns), and the production, reception and interpretation of these representations of social reality are studied in relation to social participation and exclusionism in societies whose democratic systems differ in terms of stability and longevity.

**Rationalization**
NISCO research compares secularization and socialization in Dutch and European societies to rationalization processes taking place in other societies. A great deal of attention is paid to belief systems and meaning derived from religion, justice and altruism and their implications for societal participation. Researchers broaden the study of secularization within Dutch society by comparing indigenous and non-indigenous denominations, taking into account the role of gender, class and ethnicity.
Awards and grants
Researchers at NISCO received major funding from the Netherlands Organisation for Scientific Research (NWO) for new integrated research programmes on relationships involving ethnic diversity in local communities (Profs. Scheepers & Kraaykamp) and for a comparative study on ethno-religious conflicts in Indonesia and the Philippines (Profs. Hüsken & Scheepers). The NWO and NCDO also support longitudinal data collection for the Family Survey Dutch population. Other substantive grants were awarded for empirical research on social mobility (Dutch Council for Societal Development), impact studies on Fair Trade (Ministry of Foreign Affairs and Solidarity) and Sharia law systems (WODC/Ministry of Justice).

Research facilities
NISCO specializes in analyzing and making available data collections, including both longitudinal – on individuals and their life courses and networks within specific social contexts (in the Netherlands as well as in several other countries) – and cross-national collections that focus on a wide range of countries. These data are considered pertinent for comparative research at this Institute, providing useful opportunities for multidisciplinary cooperation. Over the years, researchers have collected large numbers of television programmes broadcast at prime time. In 2009 a new edition of the Dutch Family Survey was completed, and the Dutch database on non-governmental development cooperation was launched (see: www.ngo-database.nl).

Collaboration
At the international level NISCO collaborates with researchers at:
- The Universities of Oxford, Southampton, Warwick, Edinburgh and the Centre for Comparative Social Surveys in London (United Kingdom)
- The Centre National de Recherche Scientifique and SciencePo Paris (France)
- The Max-Planck-Institut für Ethnologische Forschung in Halle, Westfälische Wilhelms-Universität in Münster and the Universities of Berlin, Bamberg, Frankfurt, Heidelberg and Bayreuth (Germany)
- The European University Institute in Florence and the Universities of Trento and Pavia (Italy)
- The Universities of Ghent, Antwerp and Leuven (Belgium)
- Geary Institute Dublin (Ireland)
- The University of Aarhus (Denmark)
- The Universities of Haifa and Bethlehem (Israel)
- Australian National University (Canberra, Australia)
- Harvard University, Northwestern University, Evanston (Illinois) and John Hopkins University (USA).
There is also extensive research collaboration with:

- Universidad Católica Cardenal Raúl Silva Henríquez (Chile)
- Universitas Gadjah Mada Yogyakarta (Indonesia)
- Muhimbili University of Health and Allied Sciences (Tanzania)
- Martyrs University (Uganda)
- Khon Kaen University (Thailand).

International partnerships have been established through the South Africa-Netherlands Research Programme on Alternatives in Development (SANPAD) and Edulink programmes with East African universities. NISCO staff also participate in international research networks, such as EQUALSOC (European network for research expertise on economic change, quality of life and social cohesion), European Consortium for Sociological Research (ECSR), the European Research Centre on Migration and Ethnic Relations (ERCOMER), Research Network on European Port Cities, ERANET Learning in Knowledge Society, Network of Excellence ‘Enhancing the Interest in Science in a Developing Europe’ (EISDE), International Communication Organization (ICA), International Association of Mass Communication Research (IAMCR), Development Policy Review Network and International Civil Society Forum on Conflicts (INFOCON).

NISCO researchers also participate in several international organizations such as the International Sociological Association (ISA), European Consortium for Sociological Research, Dutch Sociological Association (NSV), Dutch Anthropological Association (NVA), European Association for Development Institutes (EADI), International Initiative for Impact Evaluation (3ie), Interuniversity group on social stratification and life course research (ISOL), Association for Social Anthropology in Oceania (ASAO), Caribbean Studies Association (CSA), European Association for South-East Asian Studies (Euroseas) and the European Society for Ecological Economics (ESEE).

Members of NISCO cooperate with counterparts in other Dutch research schools, including the Research School for Resource Studies for Development (CERES), Interuniversity Centre for Social Science Theory and Methodology (ICS) and the Netherlands Organization of Communication Research (NESCOR).

Research results

The Development Studies research programme on Institutions in Development analyzes the role of national and international networks that contribute to poverty alleviation, empowerment and democratisation. A dissertation on the limited poverty focus in national choices of international non-governmental organizations (NGOs) shows that back donors and the search for externalities are major causes for the geographical concentration of NGO activities. This is confirmed in other studies that analyze the Dutch system of aid allocation to civil society organizations, options for programmatic cooperation between Northern and Southern NGOs, and the effectiveness of different types of development aid. The database on Dutch NGOs is used for analyses of the role of funding structures in allocating aid. Attention is also paid to progress in mainstreaming gender in development programmes. Data collection amongst Dutch private initiatives provides insights into the way they are perceived as new agents of development. Research on fair trade reveals that the impact on domestic welfare is rather modest, whereas organizational and behaviour effects and regional externalities are considerable. Impact studies conducted in India, Peru and Ghana reveal that outreach of primary health care,
education and sanitary service programmes goes far beyond the intended beneficiaries. New studies on reproductive health programmes in Tanzania unravel whether outreach is different for public, private and voluntary agencies.

Research conducted by the Social & Cultural Anthropology group focuses upon the power of culture and the culture of power by ethnographically studying local issues and relating them to global change. Other studies focus on identity formation in the Caribbean, the role of religion in Mediterranean cities, Maori intellectual property rights and the relevance of rituals in social life. Another programme on conflicts in Indonesia and the Philippines investigates the influence of ethno-religious identification on support for collective violence in areas of actual and potential conflict, integrating theories and insights from anthropology, sociology and religious studies.

Research on national differences in religion by members of the sociology group shows that religious attendance is strongly affected by personal and societal insecurities, by parental and national religious socialization and degree of urbanization. Hypotheses have been tested using data from 60 nations obtained from the European/World Values Surveys. Cross-cultural research on pre-industrial societies indicated that people use different thought models to explain the unknown, depending on the society’s level of subsistence technology. Sociological research uses competing hypotheses to deal with the issue as to whether ethnic diversity actually affects the social capital of citizens in European countries. The main finding is that economic inequalities as well as the national history of continuous democracy in European societies are the most important factors to explain cross-national differences in social capital. An advanced study of the effects of social mobility on antagonistic attitudes toward ethnic minorities shows that the relative influence of social origin and social destination depends on specific combinations of origin and destination. If one moves towards a more tolerant social position, the influence of social origin is negligible. On the other hand, if one is socially mobile to a less tolerant position, the impact of origin on antagonistic attitudes is substantial and may exceed the impact of the type of destination.

Research in communication science focuses on the role of mediated communication in socio-cultural and political processes. One dissertation concludes that media attention given to the far right in Germany, Belgium and the Netherlands is remarkably similar. A study on the role of ICT in sharing knowledge in organizations was also defended. This interview and diary study concluded that ICT applications were used more frequently by employees than by directors. A third dissertation was about older adults’ television use (title: Television viewing in the lives of older adults). Through interviews with older adults the study develops a theoretical model of the role that television can play for older adults in range of circumstances.

Institute for Gender Studies (IGS)
Prof. W.H.M. Jansen
www.ru.nl/genderstudies

The interdisciplinary Institute for Gender Studies (IGS) works at the crossroads of the social sciences, arts, religious studies, philosophy, medical sciences, law and management sciences. With four professors, two associate professors, five university lecturers, and seven junior researchers, IGS is the largest gender studies institute in the Netherlands.

Mission of the research programme The Dynamics of Gender, Body, Culture and Policies is to contribute to the scholarly understanding of changes in gender, gender relations, and sexuality and to make the results available to society. The research starts from the premise that gender continually shows itself to be a crucial factor in the structuring of society and culture, that gender closely intersects with other divisions in society, and impacts greatly on people’s lives. The research focuses on the dynamics of gender by studying individual and collective agents of change and the social, political and cultural constellations under which such changes occur.

Societal impact
Members of NISCO regularly advise a wide range of public and private institutes and occupy advisory positions in a variety of domains. This includes supporting international data collections (European Social Survey, European Value Survey), national data collections (CBS, DANS, NELLS, Rekenkamer, WODC, ZonMW and CBF), media data from Dutch public and commercial television institutes (such as NOS/Kijk- en Luisteronderzoek, NPS/Sesamstraat,
Key publications


Dissertations: 10
Scientific publications: 176
Professional publications: 49
NISCO researchers participated extensively in public debates and media presentations on topics such as the role of ethnic diversity and social capital in European societies (Prof. Scheepers in debate with Prof. Putnam), the future of development cooperation (Prof. Hoebink), and the role of fair trade (Prof. Ruben). Prof. Kraaykamp presented his inaugural address on Cultural Socialization and future research on the long-term effects of cultural education. Prof. Widlok presented his inaugural address on interactive and ethnographic learning about social and natural settings among the inhabitants of the Pacific region. Prof. Hoebink devoted his inaugural address – for the special chair on development cooperation – to the role of the Dutch polder model in shaping development aid programmes.

Future research
The research programmes of the Social and Cultural Anthropology and Development Studies group are integrated under three main headings: mobility and cultural encounters, pathways out of poverty, and international cooperation in transition. The first research theme focuses on understanding the role of mobility in the construction of social communities and the emergence of social conflicts in a comparative perspective. The second theme focuses on policies and processes designed to alleviate poverty and empower citizens of developing countries and regions. Special attention is given to ways of overcoming poverty thresholds, incentives for poverty reduction, and strategies for reducing risk aversion and enhancing cooperation, trust and empowerment. Current projects focus on participatory impact assessment, the role of fair trade standards, linkages between reproductive health and wealth (WOTRO/Hewlett Foundation) and interfaces between cooperatives and value chains (WOTRO Integrated Programme). The third theme addresses transitions in international cooperation arrangements. This includes changes in national patterns, in major themes and aid modalities, and new actors engaged in international cooperation. This research is funded from ongoing programmes within the Netherlands Ministry of Foreign Affairs (IS Academy), Dutch NGO’s, NCDO and DPRN, and also draws on commissioned research by Dutch and European development agencies.

The Sociology group focuses on publications containing life-course analyses and multi-level modelling on topics such as the Dutch labour market, media socialisation effects, social capital and health, abortion rules and practices, cultural capital in schooling, the composition of neighbourhoods, attitudes to children’s socialisation, and inter-ethnic prejudice and contacts. In particular, cross-national cooperation in research programmes is being extended. Results from the recently concluded Dutch Family Survey will be processed and analyzed. The recently acquired NWO programme on the relationships of ethnic diversity in local communities has been staffed.

The Communication Science group has four dissertation projects in progress. One study is about the effect of sensational television news on different audiences (as a cross-cultural phenomenon). The second study relates to stereotypes of older people and the correspondence of media portrayals with beliefs. A third project – supported by a grant from Stimuleringsfonds voor de Pers – is carried out in cooperation with the University of Leuven, and addressing the issue of how younger people in the age range from 15-25 use the news. The fourth project is a content analysis of prime-time television since 1980 in terms of the prevalence of moral values in various genres.
The Centre for Language Studies (CLS) carries out top-level research in Linguistics, Language and Speech Technology, and Communication Studies in a stimulating academic environment. Key aspects are innovation, an interdisciplinary approach, and a strong commitment to acquiring research funds, which helps strengthen the profile of research done at the Centre in the Netherlands and abroad.

There are five research programmes:

• Grammar and Cognition, combining theoretical research on language as a cognitive function with psycholinguistic research on language processing and language acquisition.
• Language in Time and Space, focusing on the comparative study of patterns of language contact, diffusion and change in a variety of different language settings and historical time-depths.
• Linguistic Information Processing, dealing with the development of computational models of language acquisition and processing, and testing these models under laboratory and real-world conditions.
• Communicative Competences, focusing on how human beings acquire and maintain an ability to communicate successfully in various contexts and modalities, and under various constraints.
• Professional Communication, which deals with the identification and explanation of cultural and linguistic factors that influence the effectiveness of documents.

Dr Asli Özyürek received a European Research Council Starting Grant entitled ‘Language in our hands: Acquisition of spatial language in deaf and hearing children’. In this project Dr Özyürek will investigate to what extent our language learning ability is specific to learning a spoken language, and to what extent it relates to communicating in any modality.

Prof. Ans van Kemenade, together with other researchers from the programme Language in Time and Space, organized the highly successful 19th International Conference on Historical Linguistics (ICHL 19) at Radboud University Nijmegen from 10-14 August 2009. The ICHL conferences are the premier forum in the world for work on historical linguistics and language change in the languages of the world.

In September ten student assistants, funded by a special Royal Netherlands Academy of Arts and Sciences (KNAW) grant, started working on the project NEWSPEAK. Within the framework of this
grant excellent Master’s students work under the supervision of senior researchers on corpus research of written language, focusing on language in the new media, such as Internet blogs, MSN and Hyves.

Nick Enfield, who was appointed Professor of Ethnolinguistics with special reference to South-East Asia, delivered his inaugural lecture on ‘Human Sociality at the Heart of Language’. Prof. Enfield received a European Research Council Starting Grant for the project ‘Human Sociality and Systems of Language Use’.

On 30 September, Professor John Searle of the University of California, Berkeley, held his audience spellbound as he spoke on ‘The Nature of Language’. This special lecture marked the official opening of the International Max Planck Research School (IMPRS) for Language Sciences, a joint initiative of the Max Planck Institute for Psycholinguistics, the Centre for Language Studies, and the Donders Institute for Brain, Cognition and Behaviour. The new research school, supported by the Max Planck Society, provides an interdisciplinary training and research programme for excellent PhD students in all aspects of language sciences.

In 2009 eleven dissertations were defended, including one cum laude: Kofi Yakpo’s ‘A Grammar of Pichi’.

**Research facilities**

CLS research is becoming more and more empirical and experimental. As a result, facilities such as experimental laboratories, experimental equipment, powerful computers and sophisticated software, as well as enriched written, spoken, and multimodal sign language databases are increasingly part of the CLS environment.

**Collaboration**

- There is long-standing collaboration with a number of groups at the Max Planck Institute for Psycholinguistics and the Donders Institute for Brain, Cognition and Behaviour.
Dr. Asli Özyürek received the prestigious Starting Independent Researcher Grant from the European Research Council for her research on ‘Language in our hands: Acquisition of spatial language in deaf and hearing children’.

- Collaboration with the Meertens Institute with respect to the Netherlands Organisation for Scientific Research (NWO)-funded research projects ‘Intonation in varieties of Dutch’ (also involving Leiden University), the ‘Dutch Bilingualism Database’ (also involving the University of Tilburg), and ‘Roots of Ethnolects’.
- The Typological Database System (also involving Utrecht University), the Surinam Creole Archive, and the Dutch Sign Language Database were established together with the University of Amsterdam.
- Collaboration with the Sint Maartenskliniek in Nijmegen and the OSST Development Centre for Speech and Language Technology in a Communication Assessment project.
- Collaboration in the FP6 ACORNS project with the Royal Institute of Technology, Stockholm, the University of Sheffield, Technical University Helsinki and the University of Leuven.
- Collaboration in the Marie Curie International Training Networks SCALE and Bayesian Biometrics for Forensics (BBfor2) programmes with IDiap Research Institute Martigny (Switzerland), RWTH Aachen (Germany), Saarland University (Germany), University of Edinburgh (UK), University of Sheffield (UK), Toshiba (UK), Philips Speech Recognition Systems/ Nuance, Forensic Sciences Services (UK), TNO (NL) and Agnitio Voice Biometrics (Spain).
- The EURYI project (Dr Miriam Ernestus) involves collaboration with the Max Planck Institute for Psycholinguistics, the University of Glasgow (Rachel Smith), LiMSI, Paris (Martine Adda Decker), Université Paris 3 (Cécile Fougeron), University of Alberta (Harald Baayen), Northwestern University, Illinois (Janet Pierrehumbert), the University of Arizona (Natasha Warner), the University of Manitoba (Kevin Russell), and the Hogeschool voor Wetenschap & Kunst (University College for Sciences and Arts) in Brussels.
- Collaboration with the University of Limpopo (South Africa), the University of Tilburg (the Netherlands) and University of Stellenbosch (South Africa) on the HACALARA project in the context of HIV/AIDS intervention programmes.

**Research results**

Dr Lotte Hogeweg finished her dissertation on the relationship between words and their meanings, which she approached from the perspectives of corpus research, language acquisition and modelling. Much of the thesis focuses on the Dutch discourse particle *wel*. This particle has many uses which seem very diverse at first sight, but are shown to have a core-meaning, namely denial of a negation. Strikingly, children first learn the stronger uses of *wel* before they acquire the weak use, despite the fact that the weaker version is much more frequently used by their parents.

Prof. Carlos Gussenhoven and his group exhaustively defined the grammar of Maastricht and both cognitive and perceptual explanations have been proposed for the ‘system gaps’ in this grammar. In perception research with English and Nigerian listeners, Nigerian English was shown to be drastically different from British English, having inalienable word melodies rather than sentence level pitch accents, despite a high degree of phonetic similarity. Persian was shown not to deaccent, but to reduce the pitch range after the focus constituent, a finding that runs counter to current descriptions of the language.

Dr Asli Özyürek, together with Dr Spencer Kelly (Hamilton USA) and Dr Eric Maris (Donders Institute), has shown that listeners are
In the Veni project ‘Avoiding the ham in hamster’ Dr Odette den Os, produced a novel memory architecture that integrates the Information Processing, coordinated by Prof. Lou Boves and Dr Els Lru. The ACORNS project, developed within the programme Linguistic Information Processing, coordinated by Prof. Lou Boves and Dr Els Lru, produced a novel memory architecture that integrates the most important aspects of biologically and psychologically inspired theories. In addition, ACORNS researchers showed how computational modelling can clarify issues in language acquisition that are difficult to investigate in behavioural experiments.

In the Veni project ‘Avoiding the ham in hamster’ Dr Odette Scharenborg completed the development of a novel model of human spoken word processing (Fine-Tracker).

In the MIDAS project Drs. Jort Gemmeke and Dr Bert Cranen extended the novel Sparse Imputation approach in such a manner that it can now handle large vocabulary continuous speech; especially for conditions in which the signal-to-noise ratio is low the novel approach outperforms existing approaches by a very large margin.

In the EURYI project ‘Acoustic reduction in European languages’ coordinated by Dr Mirjam Ernestus corpora of conversational speech in Spanish and Czech were recorded and transcribed. These corpora will be made available to the international research community. Research based on existing conversational speech corpora in Dutch and French have advanced scholars’ understanding of the structural linguistic features that affect the degree of reduction of sounds, syllables and words in spontaneous conversational speech.

Dr Suzan Verberne completed her PhD thesis on answering Why questions. She has developed a novel technique for ranking candidate answers based on structural features of the natural language questions and text passages.

In the programme Professional Communication research on differences between cultures in the use and appreciation of communication media for recruitment and for finding a job, showed that cultures differ in the media they use and that those cultural differences are related to cultural values. Surprisingly, in all countries the media HRM managers use to find personnel, differ greatly from the media people use to find jobs.

The Japanese NWO project ‘Hurdles for advanced German and Dutch learners in achieving native-like competence in Japanese’ came to an end. In two papers, Dr Keiko Yoshioka reported on how the use of the progressive depends on the type of situation in Japanese. Contrary to earlier hypotheses in the L2 literature, Dutch learners of Japanese turn out to be sensitive to this constraint, which was shown in information structure and eye movements.

Societal impact

Intercultural communication does not always proceed smoothly. Research on modality and politeness, on the different uses and acquisition of discourse particles in Dutch, on personal pronouns in the languages of the world, and on the role of animacy and space in language, may contribute to a better understanding of how language and communication work and thus help avoid miscommunication. For that purpose, Prof. Helen de Hoop and her group have published several online articles on optimal communication for a general audience.

Knowledge of information structure is the final hurdle for L2 learners in their efforts to acquire near-native competence in a global language such as English. By contrasting the information structure of present-day English with that of earlier times, when English was more like the other West Germanic languages, the NWO-funded research programme Syntax and Information Structure: Discourse Options after the loss of V2, highlights the differences between present-day Dutch/German and English, knowledge that is fed directly into the language skills courses in the English department and hence offers students concrete suggestions for improving their written English.

The Dutch Sign Language Corpus, developed by Dr Onno Crasborn and his group and published as an open access multimedia database in December 2008, has been further developed in 2009. The sign language research projects and many of the researchers were introduced to the deaf community at ‘World Deaf Day’, an annual national event that attracts many thousands of deaf people, parents of deaf children, and professionals working in deaf education. The website for the general public (www.ru.nl/gebarentaal) has been expanded.

Prof. Roeland van Hout was involved in societal organizations dedicated to dialect and regional languages and in discussions about the recognition of such languages as well as dialects and education.

Prof. Pieter Muysken participated in a committee meeting with members of the Dutch Parliament on the use of immigrant
Key publications


Dissertations: 11
Scientific publications: 230
Professional publications: 58

improved tools for patent mining. It is expected that the knowledge gained in this project can also be exploited in a range of other domains where there is a need to find information effectively and efficiently.

The CLARIN-NL projects make valuable contributions to the development of novel research methods for the Humanities. The Veteran Tapes project is a showcase for these novel research methods in the fields of History, Anthropology and Communication. In addition, making oral history resources available to the general public will have an impact on awareness of the importance of historical events in contemporary society.

In two publications, questions have been raised about the effectiveness of communication strategies in HIV/AIDS campaigns in South Africa. In one publication, the potential gains as well as the
considerable dangers of using intentionally non-explicit messages on billboards and in other mass media were identified, along with a theoretical framework that may guide empirical research which could influence the debate. In the other publication, the use and impact of slang in written mass media campaigns was studied. Again, the results of this study raise doubts about the potential benefits of such a strategy.

Studies on the differences between cultures in terms of the use and appreciation of communication media for recruitment are important for recruitment within the EU, as are studies on differences in annual reports written in English and their impact on stakeholders. For the European Commission study ‘Promoting Language Learning and Linguistic Diversity’, Dr. Marianne Starren has been asked to serve as an expert member for the Netherlands in a group studying ‘Dubbing and Subtitling Needs and Practices in the European Audiovisual Industry’ commissioned by EACEA/DG EAC/2009/01. In co-operation with SBS Luxembourg, Profs. Ton Dijkstra and d’Ydewalle are studying the potential of subtitling in film and television programmes to encourage and promote foreign language learning.

Future research
The following grants, which were obtained in 2009, will substantially strengthen research at CLS in the years ahead.

- Linking lexical databases and annotated corpora of signed Languages (SignLinC), Crasborn. CLARIN-NL. Period: Jan-Dec 2010.
- Curation of Interview Data (INTER-VIEWs), Henk van den Heuvel. CLARIN-NL. Period: Jan-Dec 2010.
- A Distributed Lemmatizer for Historical Dutch (Adelheid), Hans van Halteren. CLARIN-NL. Period: Jan-Dec 2010.
- My Pronunciation Coach (MPC). STW Valorisation Grant, Helmer Strik, Catia Cucchiarini, Liesbet Korebrits (Radboud in’to Languages), Pieter van Gelder en Bob Teurlings. (MYNT Technology). Period: 6 months in 2010. For the same project, an innovation voucher was obtained from SenterNovem and from Business Development Fonds van Stichting Gelder Kennis.
- Bayesian Biometric for Forensics (BBfor2). Marie Curie Initial Training Network, Lou Boves and David van Leeuwen.
- Language and Origin: The Role of Language in European Asylum Procedures: Exploratory Workshop of the European Science Foundation, Muysken with Verrips (De Taalstudio) and Zwaan (Centrum voor Migratierrecht at the Radboud University Nijmegen), Period: April 22-23, 2010.
Behavioural Science Institute

The Behavioural Science Institute (BSI) conducts research on the fundamental principles and processes that govern human behaviour. A distinctive feature is the BSI’s emphasis on an integrative approach to human behaviour that transcends the traditional disciplinary boundaries that characterize contemporary research in psychology and education.

In 2006 BSI – a research institute of the Faculty of Social Sciences – received its accreditation as a research school from the Royal Netherlands Academy of Arts and Sciences. The Institute offers a two-year course leading to a Research Master’s degree in Behavioural Science (www.ru.nl/master/behaviouralscience).

BSI researchers investigate issues related to the nature and development of social cognition and behaviour, executive control and automatic processes, and the dynamic interplay between biological and social-contextual factors in the development of human behaviour. Both normative behaviour and psychopathology are studied. Research paradigms include advanced experimental and quasi-experimental methods, virtual reality technology, psychophysiological measurement, behavioural and social neuroscientific methods, behavioural genetics paradigms, randomized controlled trials and intensive longitudinal designs.

BSI researchers are engaged in the following programmes:

**Cognitive processes in psychological dysfunctions**
This programme focuses on abnormal psychology through the experimental study of cognitive and biological processes. Attention, interpretation, memory, and executive functions are studied in different disorders, not only to assess their current status, but also to predict treatment success and relapse, as well as to help prevent psychological dysfunctions among individuals who are at risk.

**Developmental psychopathology**
The central theme of this programme concerns the interplay between individual characteristics (e.g., personality, expectancies, implicit associations, genes) and environmental cues and social interactions, in relation to the development of psychopathology.

**Learning and plasticity**
This programme deals with the micro-analysis of learning and cognitive plasticity. The main focus is on the learning and development of communication and cognition in normal and atypical populations. Special attention is paid to the cognitive constraints of learning a first and second language – both spoken and written – in terms of representation and control.

**Social cognition**
The main theme here is the interaction between automatic and controlled aspects of social behaviour. Several aspects of the automatic vs. controlled distinction are investigated, such as the role of conscious and unconscious processes in judgment and behaviour,
and the interaction between implicit and explicit components of attitudes, prejudice and self-esteem.

Social development
This research group studies the causes and consequences of individual differences in social behaviour at all ages, with a special focus on social behaviour and social cognition in dyads and groups. Areas of research include caregiver-child interaction and attachment, friendship, peer relations, aggression and aggression-related cognition, and sociometric and social network analysis.

Work, stress and health
This programme was established to gain a better understanding of both adaptive and maladaptive human behaviour in the context of work from a psychosocial point of view. Researchers investigate cognitive, motivational, and behavioural processes that are relevant to stress, learning and performance at work.

Awards
• Dr A. Scheres won a Vidi award from the Netherlands Organisation for Scientific Research (NWO) for her research on the interaction between executive functioning and motivation in Attention Deficit Hyperactivity Disorder.
• Dr M. Kleinjan won a Veni award from NWO for her research on gene-environment interactions and adolescent smoking experimentation.
• Dr H. Van der Vorst won a Veni award from NWO for her research on early implicit predictors of alcohol use.
• Prof. A. Cillessen won the Thesis Advisor of the Year award at Radboud University Nijmegen.
• Dr M. Strick won the 2009 ASPO Dissertation award.
• D. Anschutz MSc won the 2009 Frye Stipendium.

Research facilities
The Behavioural Science Institute has excellent research facilities. Both the scale of these facilities (over 800 m²) and their scope are exceptional in Europe.
• The Virtual Reality (VR) Lab is equipped with a sophisticated computer, utilizing high-end stereoscopic video processors, projection, and tracking systems to create immersive, threedimensional, computer generated environments. In 2008 a second VR lab has been installed.
• The two BSI mobile labs, with flexible furnishing, can be used to accommodate different experimental set ups outside university (for example, EEG recordings, computerized tests and observations of interactions between subjects). This considerably facilitates
the recruitment of young subjects (for example, children can be visited at schools).

• The Physiological Measurements laboratory houses state-of-the-art facilities for measuring neurocognitive (for example, EEG) and biochemical mechanisms involved in human behaviour. In 2009 these facilities are combined and shared with those of the Donders Center for Cognition.

• Eye-tracking equipment with a high temporal resolution (500-1250 Hz) is available for research on visual attention and eye movements. For mobile use and 3-D stimuli, two Tobii T120 Eye-trackers are available.

• A Driving Simulator is part of the BSI-lab equipment, to have an ecologically valid measurement of driving capacities and also to have the opportunity to study higher order cognitive processes.

• The observational laboratory comprises several rooms with one-way screens and multiple cameras. The rooms are child-proof, thus ideal for testing children.

• The computer laboratory consists of twenty-two identical cubicles, each equipped with a modern PC. The computer lab is the perfect place for conducting all kinds of computerized experiments (for example, experiments using reaction time paradigms). Licenses for many research-related software packages are available, including packages that make it possible to carry out on-line research.

• The Bar Lab, which is equipped with unobtrusive cameras, recording devices and a professional beer tap, is used for observation studies of social behaviour in a natural setting.

Collaboration

BSI cooperates with the following International Research Universities Network (IRUN) partners: Université de Poitiers, University of Münster, and University of Glasgow; and also with two preferential Radboud University partners: the University of North Carolina and the University of Leuven.

Researchers in Cognitive Processes in Psychological Dysfunctions have collaborations, among others, with R. Wiers and S. Bogels (Amsterdam), S. Hofmann (Boston), E. Holmes and B. Macintosh (Oxford), J. Vlaeyen (Leuven) and J. De Houwer (Ghent), C. Herman (Toronto), with the DICE (Decision, Intuition, Cognition and Emotion) group at the University of Bergen, with Maranatha University in Indonesia, with A. Glöckner (MPI Bonn), and with many mental health clinics in the Netherlands and internationally, e.g., the GGz Breburg group, GGz Nijmegen, Venray, and Salus Clinic Lindow (Germany). The Developmental Psychopathology programme started a formal collaboration with the Trimbos Institute on testing and evaluation of primary and secondary prevention of alcohol use in youths. Collaborative ventures have been started with Prof. Mitch Prinstein (University of North Carolina), Prof. James Sargent (Dartmouth Medical School), Prof. Luc Goossens (University of Leuven), Dr Isabel Granic (Hospital of Sick Children, Toronto), Prof. Peter Herman (University of Toronto), and Prof. Silvia Ciarnano (University of Torino). In the field of Learning and plasticity, collaboration continued with the Learning Research and Development Center at Pittsburgh University, with the Psychology Department of Pennsylvania State University (there was also a visiting professorship, Dr J. van Hell), with the Department of Psychology of the University of Cincinnati, with the National Technical Institute for the Deaf at Rochester and with the Max Planck Institute for Psycholinguistics in Nijmegen. Researchers within the Social Cognition programme collaborate with Prof. Vincent Zyerbyt, the Catholic University of Louvain, on an ESF-funded project on emotions. With Prof. John Bargh (Yale University), Prof. Eli Finkel (Northwestern University, Illinois) and Prof Alex
Todorov (Princeton University), collaborative ventures continued. Within the Social development programme, there are collaborative research projects with Prof. Susan Crockenberg (University of Vermont), Prof. David Kenny (University of Connecticut), and Prof. William Bukowski (Concordia University, Montreal). The Work, Stress and Health programme renewed its formal collaboration with the Work and Employment division at TNO (Dr Irene Houtman, Prof. Paulien Bongers).

Research results
Within the programme on Cognitive Processes in Psychological Dysfunctions, there were a number of studies on automatic behavioural tendencies. Automatic avoidance behaviour is a key mechanism in anxiety disorders such as spider phobia (Rinck et al., in press) and automatic approach tendencies in relation to alcohol stimuli are critical in heavy drinkers (Wiers, Rinck, et al., in press). People with both conditions can be re-trained and their severity reduced (Wiers, Rinck, et al., 2010). Moreover, the RIVERlab was used to study automatic aspects of avoidance and imitation in anxiety disorders (Rinck et al., in press; Vrijen et al., in press).

Decision making studies were extended to include mental health clinicians (Witteeman et al., 2009; Claes et al., 2009).

Within the Developmental Psychopathology programme, we demonstrated that a gene-by-environment interaction affects loneliness in adolescence: adolescents who received little support from their mothers and carried a 5-HTTLPR short allele were at increased risk for developing loneliness (van Rokel et al., 2009). Further, young children, especially boys, are susceptible to eat more snacks in front of the television when exposed to food commercials (Anschutz et al., 2009). An important but unexpected finding on media influences on smoking was that smokers’ desire to smoke was not affected when they watched smoking in movie clips (Lochbuehler et al., 2009).

Within the Learning and Plasticity programme, the neurocognitive foundation of learning was further investigated. For auditory perception, there was evidence of neural markers (Davids, et al., 2009). Another finding was that not all sounds in assimilation environments are perceived in the same way (Cho & McQueen, 2009) with no evidence for lexical or pre-lexical feedback (McQueen et al., 2009). For visual perception, the role of visual information in action planning was highlighted (Craje, et al., 2009). In the domain of school learning, a model for Dutch word decoding was created (Verhoeven & van Leeuwe, 2009), and cognitive and linguistic predictors of early literacy and arithmetic development in children with language impairment (van Daal, et al., 2009; van Weerdenburg, et al., 2009) and children with cerebral palsy (Peeters, et al., 2009; Jenkins, et al., 2009) were identified.

In the Social Development programme, Profs. Riksen-Walraven and de Weerth (2009) examined cortisol reactions in infants, parents, and professional caregivers. They found that caregiver stress at the beginning of the workday significantly reduces the quality of care. Cox et al. (2009) demonstrated the effectiveness of training visually impaired children to use visual aids. Cillessen and colleagues (2009) demonstrated that the priority attached to peer relations peaks in early adolescence. Kuin et al. (2009) demonstrated the beneficial effects of green care farms for elderly people with dementia.

Research in Social Cognition showed that expertise moderated the effectiveness of conscious and unconscious thought in decision making (Dijkstra et al., 2009). The link between body locomotion and the recruitment of mental resources was investigated, showing that avoidance movement temporarily enhances cognitive control (Koch et al., 2009). Research on mimicry revealed the fact that higher working memory loads lead to an increase in imitation (van Leeuwen et al., 2009). More applied research using conditioning techniques demonstrated the effectiveness of humour in advertising (Strick et al., 2009) and showed that male executive control suffers from mixed-sex interaction (Karrremans et al., 2009).

Within the Work, Stress and Health programme, De Bloom et al. (2009) found that a vacation from work has positive effects on health and well-being that soon fade out after work resumption. In a prospective four-wave study, it was shown that cumulative exposure to a high-strain work environment was associated with elevated levels of sleep complaints (De Lange et al., 2009). In a longitudinal study (Kompier et al., 2009), we found evidence that a positive change in employment contract was associated with better quality of working life and better psychological health.

Societal impact
- The BSI collaborates closely with the Academic Centre for Social Sciences (ACSW). This collaboration relates to joint externally funded projects on mental health-related topics conducted in concert by BSI and ACSW.
- Prof. L. Verhoeven is head of the National Language Education Centre, which was set up to improve the teaching and learning of the Dutch language and literacy at Dutch primary schools.
- Dr. T. van Strien is the university’s representative on the COTAN (Commissie Test Aangelegenheden NIP), and she is member of the Dutch Health Board (Gezondheidsraad) committee on preventing overweight and evaluating the risks of eating disorders.
- Prof. Nijman is a visiting professor at City University in London, Department of Mental Health and Learning Disabilities.
- Prof. Hosman is a Board Member of the World Consortium for Mental Health Promotion and Mental Disorder Prevention, and Chair of the Clifford Beers Foundation, an international organization that promotes mental health. He is also a visiting professor in the Faculty of Education and Rehabilitation Sciences at the University of Zagreb, Croatia.
- The research group on learning and plasticity has strong links with national institutions dedicated to working with those


Dissertations: 20
Scientific publications: 333
Professional publications: 66

with a mental handicap (Winkelsteegh, Trajectum, Pluryn, Borg), physical handicaps (VMT, BOSK, Groot Klimmendaal, Werkenrode), and sensory handicaps (KEG-Viataal, Sensis) in order to conduct both fundamental and practical studies on deaf children, children with language problems and multiply handicapped children.

• Prof. J. van Hell is member of the junior staff of the Royal Netherlands Academy of Arts and Sciences (KNAW).

• Research by Dr R. Cox with visually impaired children has helped develop tools for helping visually handicapped children in their daily lives.

• Dr R. van Baaren is collaborating with the VARA TV programme “Weet wat je koopt” (Know what you’re buying).

• Prof R. Engels received national and international media coverage for his research on the effects of portraying alcohol in movies and advertising on juvenile drinking. Prof Engels and
D. Anschutz MSc also received media attention for their study on food commercials and snacking.

- Drs H. Van der Vorst and M. Kleinjan, and Prof. R. Engels, collaborate intensively with the Trimbos Institute on prevention and intervention programmes focusing on juvenile substance use. Together they organized an international conference of the Kettil Bruun Society on adolescent binge drinking, which received considerable media attention (Drs R. Koordeman and C. van der Zwaluw).

Future research
Members of the BSI were very successful in obtaining grants from the Dutch Organisation for Health Research and Innovation (ZonMW) and NWO.

BSI is affiliated to the Donders Institute for Brain, Cognition and Behaviour. Collaboration with the Donders Center for Cognition (DCC) will be intensified, for example, through six interdisciplinary PhD projects that started in 2009. As part of the intensified research cooperation with the DCC, a joint PhD project will be established to examine the relationship between work-related chronic fatigue, cognitive deficits, and the stress-system (Drs Van der Linden, Maes and Kompier).

Ongoing research will focus on anxiety disorders and depression, eating behaviour, and clinical decision-making. New foci will be the interaction of cognitive and genetic factors in depression, the physiological and psychological indicators of health-related stress (with grants from ZonMw and the Asthma Foundation), the re-training of automatic approach tendencies and automatic attentional biases in alcohol-addicted patients, and the role of automatic processes in unwanted, impulsive behaviours.

Two Veni awards will make it possible to focus more on the precursors of alcohol use in children (H. van der Vorst) and relationship between gene-environment interactions and adolescent smoking (M. Kleinjan), and an NWO grant for research on peer influences and alcohol use.

The study of language and communication will be extended with PhD projects in the following cognitive domains: language, literacy, numeracy, and perception and motor abilities in both typically and atypically developing populations. Two international scholars will be appointed to support this research: Prof. Charles Perfetti from the Learning Research and Development Center of the University of Pittsburgh (BSI appointment) and Prof. Laurie Feldman from the Psychology Department of the University at Albany (KNAW appointment).

A new wave of the Nijmegen Longitudinal Study (Principal Investigator: Prof. Riksen-Walraven) will take place in 2010 with young adolescents followed since 1998 as they progress from elementary to secondary school. New studies will begin on the precursors of eating disorders in adolescent girls, and on coordinated action among 2-5 year-old children. New research will begin on the neuropsychology of ADHD children (Vidi award, Dr Scheres).

New RCT projects will start with grants from ZonMw for testing a home-based programme designed to prevent alcohol use by children, the effectiveness of an on-line drinking test for young people, nicotine-replacement therapy for smoking adolescents and a smoking cessation programme for parents.
Donders Institute for Brain, Cognition and Behaviour

Cognitive Neuroscience is one of the key research fields at Radboud University Nijmegen and the Radboud University Nijmegen Medical Centre. The research focuses on cognition and behaviour in humans as well as on the neuronal substrate, including the genetic, molecular and cellular processes that underlie cognition and behaviour: this emphasises the broad spectrum of research ‘from Molecule to Man’.

Understanding the structure and function of the brain requires a highly interdisciplinary approach. To strengthen collaboration and to increase its visibility, both nationally and internationally, all research in cognitive neuroscience on the Nijmegen campus has been integrated in the Donders Institute for Brain, Cognition and Behaviour. Building on strong past collaborations, this Institute has the critical mass to provide scope for new cutting-edge research ideas and projects.

The Donders Institute for Brain, Cognition and Behaviour includes researchers from the Centres for Cognition, Cognitive Neuroimaging, and Neuroscience, who work in close collaboration with colleagues from the world-renowned Max Planck Institute for Psycholinguistics, the Behavioural Science Institute and the Centre for Language Studies. With over four hundred researchers, the institute combines leading scientists in a unique centre of expertise, encouraging them to excel in this field at the national and international level.

Research themes

The research activities are concentrated around four major themes whose content was developed by the research leaders in a bottom-up process. These themes are:

1. Language and Communication
The objective is to determine how core language operations are grounded in – or related to – other domains of cognition, such as perception, action, memory, communication (social interaction) and how the human language facility is rooted in the neurobiological and genetic infrastructure that makes the human brain ‘language-ready’. Subthemes included multilingualism, gesture and sign language, (contextual) flexibility of comprehension and production, individual variability (language processing across the lives of people with different sociological and linguistic backgrounds) and the neurobiological and genetic infrastructure of language and communication.

2. Perception, Action, and Control
The objective here is to study the basic sensorimotor aspects as well as the cognitive, contextual and social components of perception-action coupling, and their clinical implications and relevance for
Robotics. Research methods include theoretical analysis, psychophysical and behavioural studies, neurophysiological techniques, neuroimaging, clinical and pharmacological interventions, and developmental and genetic approaches. Subthemes are sensorimotor integration (studying how sensory processing and motor performance interact), intention and control (research on the cognitive, motivational and emotional regulation of perception and action), and social interaction (studying the mechanisms supporting our ability to perceive and react to the actions of others).

3 Learning, Memory & Plasticity

The mechanistic underpinnings and behavioural consequences of long-term changes in neural structure and function are studied using genetic, molecular and cellular methods, animal models, as well as human neuroimaging and cognitive neuropsychology.

• Development: Determinants, mechanisms, and consequences of normal and abnormal development are studied. Examples include neurogenetics and molecular studies of brain development and child psychiatry.

• Adaptation to external challenges: Vulnerability factors and neurobiological mechanism determining behavioural and clinical consequences of external challenges such as stress are studied.

• Adaptation to internal challenges: Researchers study the mechanisms and consequences of brain damage in general and in aging, stroke, and neurodegeneration in particular.

4 Brain networks and neuronal communication

This research theme centres on brain networks ranging from the smallest scale – communication between individual neurons – up to the largest scale: communication between different brain areas and the outside world. The Principal Investigator (PI) groups combine developing new techniques for electrophysiological and anatomical measurements of connectivity and activation with data analysis and the experimental application of these techniques, within the context of studies of cognition in humans, non-human primates and rodents. Computational modelling is an important component, as it integrates multi-level experimental data in order to develop a clearer understanding of cognitive processes.

Activities in 2009

• In collaboration with the Max Planck Institute for Psycholinguistics a lecture series called the ‘Donders Lectures’ was organized. In the 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, ranging from neuroscience to psychology and linguistics.

• A symposium entitled ‘The Donders Institute Proudly Presents’ on 30 July provided an overview of research in progress within the institute.

• The Donders Graduate School for Cognitive Neuroscience has been established to connect the educational part of the Research Master’s programme in Cognitive Neuroscience (coordinated by the Faculty of Social Sciences) with the PhD projects carried out at the Donders Institute. In August the Institute received a grant from (NWO) to set up the graduate school.

• Joint meetings have been organized involving all researchers across the Institute to create a better focus and stronger collaboration between the centres.

Future activities

• In order to strengthen collaboration with other research institutes, a system of Research Fellows will be introduced.

• An innovation lab for spin-off companies based on work at the Institute will be established. This will be made available to start-up companies where there are strong links with the research carried out at the Institute.

• Researchers within the Institute will strengthen the collaboration with other institutes on campus, such as the Institute for Molecules and Materials and the Nijmegen Centre for Molecular Life Sciences within the imaging platform ‘Molecule-2-Man’.
The Donders Centre for Cognition (DCC) is one of the three centres of the Donders Institute for Brain, Cognition and Behaviour. At DCC, scientists from a range of disciplines jointly study the psychological, formal and neurobiological principles of information processing in biological and artificial cognitive systems. The Royal Netherlands Academy of Arts and Sciences (KNAW) renewed DCC’s accreditation in December 2007 and the centre continues to play a central role in the University’s research focus on Cognitive Neuroscience.

Psycholinguistics
(Head: Prof. Herbert Schriefers)
Psycholinguistics is the study of the cognitive processes and representations underlying the use of language in various contexts. The context can be narrow, as when language is processed in interaction with other mental or brain faculties (attention, emotion, and intention) or broader, as in dialogue and in life-long social development. The research programme covers speaking, reading, and listening, at the level of the word, sentence and discourse. Various research techniques are applied, including reaction time studies, eye-tracking, neuro-imaging, and computational modelling.

Members of the department of Psycholinguistics contribute to the Donders theme ‘Language and Communication’: Recently, Prof. J. McQueen became speaker of this theme, which is divided into three subthemes: Contextual flexibility, Multilingualism, and Individual Variability. Two members of this department coordinate research within the subtheme ‘Contextual flexibility’ and ‘Multilingualism’.

Action, Intention and Motor control (AIM)
(Head: Prof. Harold Bekkering)
The objective of this research theme is to advance the study of the basic sensorimotor aspects as well as the cognitive, contextual and social components of perception-action coupling. Research methods include clinical and behavioural studies, neurophysiological and neuroimaging techniques, developmental and genetic approaches, and computational modeling.

All of the members of the AIM division of DCC participate in the Donders theme Perception, Action and Control (PAC). Dr. Pieter Medendorp is speaker of the PAC theme. The research domain contains all three subthemes of PAC: Sensorimotor Integration, Intention and Control and Social Interaction.
Biological Psychology  
(Head: Prof. Markus Ullsperger)  
The aim of research at the Biological Psychology department is to bridge the gap between cognitive and systemic neuroscience on the one hand and basic neuroscience on the other. The methodological spectrum is very broad ranging from animal research via behavioural, EEG and neuroimaging studies in healthy participants to studies in selected groups of neurological and psychiatric patients. The research focuses on sensory processes, performance monitoring and cognitive control, learning, pain processing and epilepsy.

This department made significant contributions to research in cognitive control within PAC. Behavioral research related to the theme Learning, Memory and Plasticity links the themes LMP and PAC. Members of this department made important contributions to the themes Learning, Memory and Plasticity and Brain Networks and Neuronal Communication.

Neuropsychology and Rehabilitation Psychology  
(Head: Prof. Roy Kessels)  
Research within the department of Neuropsychology and Rehabilitation Psychology focuses on the interplay between executive control, learning and memory using patient-centered studies or aging individuals in combination with structural and functional neuroimaging methods. Research on the ways in which working memory functions in relation to medial temporal lobe memory systems (episodic memory) is an important research line. Furthermore plasticity – learning and rehabilitation – is investigated. The focus here is on learning processes in brain-injured patients and older adults (e.g. discrimination learning, acquisition of skills), often in relation to clinical applications in neuropsychological rehabilitation (e.g. patients with neglect, dysexecutive syndrome, post-stroke fatigue).

Research at the Neuropsychology and Rehabilitation Psychology department is integrated within the themes Perception, Action and Control (PAC) and Learning, Memory and Plasticity (LMP).

Cognitive Artificial Intelligence  
(Head: Prof. Peter Desain)  
The research focus here is on human cognition and communication and cooperation, the environment and artificial systems. There are two main themes.  
• Brain Computer Interfaces, in which a direct link between mental activity and computer is exploited, e.g. to allow fully paralysed patients to communicate and control devices. This theme contributes to the theme Brain Networks and Neuronal Communication.
Dr Janneke Lommertzen successfully defended her PhD thesis (published in the Donders Series) ‘Visuomotor Coupling at Different Levels of Complexity’. Dr Lommertzen has a degree in Kinesiology.

Research facilities
DCC researchers have access to the brain-imaging facilities of DCCN (fMRI, MEG and EEG) and the following in-house facilities:
- a baby-lab including a Tobii eye-tracker and a 48-channel active EEG set-up
- a vestibular sled with combined EEG apparatus (96 channels) and motion-tracking devices
- several EEG/ERP laboratories for measuring brain activity during cognitive tasks and online processing in Brain-Computer Interfacing
- laboratories with 2D and 3D motion-tracking systems for measuring movements and trajectories
- ‘reach-in’ 3D-visualisation and force-feedback machinery
- a cognitive artificial intelligence laboratory, which is used to analyse human-computer interaction
- a laboratory and studio for research on auditory perception and music cognition
- several laboratories for behavioural studies using visual/auditory stimuli
- a biochemical laboratory for identifying brain substances.

Awards and acknowledgements
- A Vidi grant for Dr C. Fiebach’s project ‘Cognitive and neural mechanisms of affective working memory’
- Prof. R. Kessels was elected as a member of the scientific advisory board of the Federation of European Neuropsychological Societies
- Prof. R. Kessels is a member of the board of directors of the Dutch Neuropsychological Society (NVN)
- Prof. L. Fassoti is a member of the scientific advisory board of the Netherlands Brain Foundation (Hersenstichting)
- Prof. L. Fassoti is Visiting Professor at the Université d’Angers, France
- An STW valorization grant for developing BCI technology to help ALS patients, applicant Prof. P. Desain.

Collaboration
The DCC collaborates with the following institutions from the preferential partners of Radboud University International Research Universities Network (IRUN):
- Institute of Psychology, Jagiellonian University Kraków, Poland: PhD project ‘Endogenous and exogenous factors in absence epilepsy’
- Westfälische Wilhelms-Universität Münster, Germany, MEG project on performance monitoring and cortical folding pattern of medial frontal cortex
- Katholieke Universiteit Leuven, Belgium: Perceptual Organisation

The DCC is also engaged in structural collaboration with many other academic institutions, including the following:
- Vincent van Gogh Institute for Psychiatry in Venray (departments of Neuropsychiatry and Korsakoff clinic) for studies on social cognitive neuropsychiatry and memory
- Sint Maartenskliniek (division rehabilitation): for studies on rehabilitation psychology
- Universität Oldenburg, Germany: for studies on discrimination learning and false memories
- University Medical Center Utrecht (dpt. of Neurology): for studies on working memory and discrimination learning in Alzheimer patients
Researchers in Psycholinguistics clarified how listeners are continually learning about speech and how they can be flexible but at the same time stable in their comprehension across listening situations. They also stressed the importance of attention and monitoring, inhibition and interference in language performance in reading, object naming, and when one retrieves the names of non-verbal objects that surround us in daily life. Other research delved into the formation of new meanings, and the linkage of meaning to emotion in monolinguals and bilinguals. The development of the mental lexicon in children with different language backgrounds and serious hearing problems (e.g. having Cochlear Implants) was also investigated. Multilingual research found that foreign subtitles help but native-language subtitles harm foreign speech perception by bilingual film viewers.

In 2009 the research of the AIM group focused on the relationship between cognition and action. Using behavioural and neuroimaging techniques, important progress was made in topics such as goal-setting, error monitoring, spatial updating, movement planning, agency, perceptual organization, mental imagery, and number processing. Between-trial behavioural adjustments were related to the valence of the behavioural consequences. Considerable research effort was put into scrutinizing the neurocognitive mechanisms underlying joint action, in particular the processes in relation to the Mirror Neuron System (MNS), motor simulation, coordination, and tacit communication. In order to elucidate mechanisms of joint movement coordination we investigated how dyads perform isometric force production tasks and could reveal how subjects rely on feedback and feed forward mechanisms to coordinate their shared motor activities. Special attention was paid to the interaction of language with perceptuomotor processes in human cooperative tasks, thus involving the expertise of Psycholinguistics division.

Research results

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The Biological psychology department made important progress in the field of cognitive control, particularly in the understanding the function of the posterior medial frontal cortex (pMFC), a key player in performance monitoring. It appears to track the history of recent action outcomes, to update the value of the action at hand, and to initiate appropriate adjustments. Imaging genetics studies and pharmacological challenges have unraveled further roles of the neurotransmitter dopamine in performance monitoring and cognitive control. Neuroimaging studies revealed that the pMFC not only interacts with other frontal brain areas but also initiates top-down control enabling task-specific and fine-tuned adjustments in perception. Longitudinal studies in patients undergoing deep brain stimulation for substance abuse and Tourette's syndrome show a gradual plastic change leading to a normalization of performance monitoring functions.

Further behavioural research in humans focuses on associative, attentional, and representational issues of discrimination learning and set-shifting. This research line will be coupled with the above-described cognitive control research in order to study long-term cognitive adjustments incited by signals of the performance monitoring system.

Within the Neuropsychology and Rehabilitation Psychology department it was demonstrated that error detection is independent of reward and generalizes beyond our own actions, highlighting its role in optimizing performance in both individual and joint action. Research in this department also showed that the medial temporal lobe is activated during associative working memory tasks, implicating the strict distinction between working memory and episodic memory systems can be questioned.

Many of the studies of the Cognitive Artificial Intelligence department are experimental, sometimes by means of simulation and introduction of formal techniques from signal processing, machine learning and information theory; some studies work on the theoretical underpinnings and build on mathematical logic and conceptual analysis. A new insight is that – contrary to what was formerly believed – the systematicity of thought can be explained using a neural network architecture of mind. Large steps have been made on the professional advancement of the BCI team, introducing state of the art Machine Learning techniques to increase reliability of single trial detection in EEG. A novel method to decompose EEG signals based on the internal structure of the stimuli has been proposed and successfully tested.
Key publications


Dissertations: 10
Scientific publications: 166
Professional publications: 33
Societal impact
DCC researchers contribute to the dissemination of fundamental research and its technological and educational applications via teaching programmes, public conferences and the media.

DCC scientists presented their research on Dutch television and radio (e.g. Dr R. van Lier and drs. M. Vergeer presented their ‘visual illusion’ on Noorderlicht TV’, Dr M. Jongsma was interviewed for the ‘Giel Beelen’ radio show, Dr R.van Lier acted as an expert in the ‘National Science Quiz’). Also internationally DCC scientists claim attention with interviews in newspapers and popular magazines (Prof. M. Ullsperger in ‘Stuttgarter Zeitung’, Prof. J. Mc.Queen in ‘Der Spiegel’ and in Swedish and Danish radiobroadcasts). Particularly the Neuropsychology and Rehabilitation Psychology department is active in education of the general public and patients (i.e. LUX Research night, Hersenstichting publieksdag, ISAO donorendag).

Together with Philips the Cognitive Artificial Intelligence department took the initiative to found an ICT Innovation platform for Brain and Cognition. This platform is currently extended to encompass a broad range of partners. Within the BrainGain consortium research results are being transformed into commercial products with the help of both small and large industrial partners. RE-phrase, a spin-off has put chat-by-click technology and an innovative product called ‘E-coaches’ for Autism on the market.

Future research
The launch of the Donders Institute for Brain, Cognition and Behaviour in September 2008 meant a strengthening of the multidisciplinary approach of studying the structure and function of the brain in relation to goal directed behaviour.

In line with the research themes of the Donders Institute, the DCC’s research will keep on examining the functional architecture of cognitive systems in relation to applied research areas, such as Brain-Computer Interfaces, Neuropsychology and cognitive robotics.

Research in 2010 will be strengthened by new grants gained in 2009, for example, the NWO Vidi grant for Dr C. Fiebach project ‘Cognitive and neural mechanisms of affective working memory’. Other ongoing projects are a Vici-project (Prof. H. Bekkering), three Veni’s (Dr S. Ruschemeijer, Dr K. Lemhöfer and Dr E. de Bruijn), Vidi project of prof. Dr. R. Kessels, several open competition projects funded by NWO, as well as the NWO Mozaiek scholarship for Inti Brazil’s project ‘Psychopathy, errors and the brain’. Also the establishment of a chair for contextual neuropsychology in collaboration with the Vincent van Gogh Institute for Psychiatry, will further enhance research within DCC.

Furthermore the DCC will develop initiatives to increase the proportion of external funding within the FP7 framework. Also efforts will be made to increase the number of externally funded PhD’s to strengthen the research basis.

Being a basic science institute with an open eye for relevant applied studies and research is the DCC’s main aim for the near future.
The Donders Centre for Cognitive Neuroimaging (DCCN) was established to conduct basic and applied research in cognitive neuroscience, (i.e. human and animal cognition, as viewed from the perspective of the brain). Much of the recent rapid progress in this field is driven by the development of complex neuroimaging techniques for the in-vivo scanning of activity in the human brain – an area in which the DCCN plays a leading role.

Research at the DCCN focuses on central cognitive functions. The aim is to unravel these complex cognitive functions and understand how they are represented in the brain. This is done by identifying the networks of brain areas that are vital to each of these functions, and determining the role of – and interactions – between regions. In order to achieve this, it is also necessary to understand how neurons make networks and how networks carry out cognitive functions – in other words, how to get from neurons to cognition. The Centre aims to establish how the different brain areas coordinate their activity with very high temporal accuracy in order to enable human and animal cognition.

Another important aspect of the research is improving the imaging methods themselves, by optimally combining imaging techniques with high spatial (fMRI) and high temporal (MEG, TMS and EEG) resolution (i.e. multimodal imaging) and by developing advanced data analysis tools to extract relevant information from the highly complex signals which these imaging systems provide. In recent years, some aspects of both the cognitive and the methodological research have been combined in projects centred on the theme brain-computer interface, where both a deep understanding of brain functioning and technical excellence are required.

Since 1 September, 2008 all research at DCCN has been incorporated in the Donders Institute for Brain, Cognition and Behaviour. Within the Centre research is organized in ten research groups, each headed by a Principal Investigator (PI). All the research is embedded in one of the four major research themes of the Institute.

Two of the research groups work within the Language and Communication theme:

*Neurocognition of language* (in association with the Max-Planck-Institute for Psycholinguistics, PI Prof. P. Hagoort)

This group studies the neural basis of reading, speaking and listening. It is probing the genetic infrastructure of language by investigating brain functioning in subjects with polymorphisms for language-relevant phenotypes and endophenotypes.

Discoveries in 2009 included determining the influence of mood states on core aspects of language processing. We found that reading hand action words activated the left premotor cortex in right-handed people and the right premotor cortex in left-handed people. Additional research was carried out to extend the Memory Unification and Control model that this group developed. Theory
of Mind areas are used to understand indirect speech acts. New research investigated the process of speaking with fMRI and key aspects of language processing use the same neuronal infrastructure. However, contrary to the popular Mirror Neuron view, we found no evidence for the use of the motor cortex during language comprehension.

Language and multilingualism (in association with the Max-Planck-Institute for Psycholinguistics, PI Dr P. Indefrey)
This group investigates the organization of the multilingual brain – in particular how learning a second language reorganizes language areas in the brain. Experiments have been designed to establish whether between-language meaning activation is observed when bilinguals are listening to first language sentences. In another series of experiments the exact time course of processing stages in second language word production is examined in order to better understand the peculiarities of second language production and collect the data needed to construct bilingual processing models.

Four of the research groups focus on the theme Perception, Action and Control:

Intention and action (in association with the Donders Centre for Cognition, PI Dr I. Toni)
This group explores ways in which perception translates into action and investigates the brain circuitry that makes human action possible. In 2009, it was shown that action selection depends on the history of actions recently selected. This finding is particularly relevant for understanding clinical features of Parkinson Disease, namely the difficulties that these patients have in starting a movement. Furthermore, it was found that, contrary to currently popular accounts, our communicative abilities are distinct from both sensorimotor processes and linguistic abilities. This work correlate closely with the topics studied within the Perception, action, and control theme, as well as in the Language and communication theme.

Prediction and attention (Dr F. de Lange)
This group studies how perception and cognition is shaped by prediction, and how this process interacts with attention. Research has focused on contrasting several stages at which expectation could influence perceptual decision making. fMRI studies, in which spatial and featural predictability were manipulated, indicate that predictability modulates activity in early perceptual areas, independent of attention.
Decision neuroscience (in association with the Behavioural Science Institute, PI Dr A. Sanfey)
This group investigates individual and interactive decision-making by combining the methods of behavioural experiments, functional neuroimaging, and economic models. Research focuses on the cognitive and neural systems that underlie social decision-making. The group has investigated the degree to which affective factors such as trust, guilt and feelings of fairness can alter our interactive choices and judgments, in contrast to ‘rational’ models of behaviour. Results have demonstrated that prior knowledge about what is expected in a social exchange can radically change our decisions, even in the face of learning that these expectations are not valid. The neural processing of these expectations is localized and assessed brain activation and behavioural responses when there are deviations from these prior beliefs.

Cognitive Control (in association with the department of Psychiatry at the Radboud-UMC, PI Dr R. Cools)
This group investigates the neurochemical mechanisms of the motivational and cognitive control of decision making. The work focuses on the role of fronto-striatal circuitry and its neuro-modulation by dopamine and serotonin in health and disease, with the ultimate translational aim of understanding the neurochemical mechanisms underlying a variety of neurological and neuropsychiatric disorders. The group has been successful in setting up pharmacological fMRI protocols to study the role of dopamine in healthy volunteers, patients with Parkinson’s disease and in patients with ADHD. Results demonstrate the critical role of dopamine in motivation, cognition – and their interaction – and researchers are beginning to elucidate its neural mechanism of action.

Three of the research groups focus on the theme Brain, Networks and Neuronal Communication:

Neuronal coherence (in association with the Faculty of Science at the Radboud-University, PI Prof. P. Fries)
This group investigates the mechanisms and functions of neuronal synchronization. The working hypothesis is that functional interactions among groups of neurons are subserved by rhythmic synchronization. This research focuses on rhythmic neuronal synchronization, the functions that it might serve and the mechanisms through which it might subserve these functions. The Communication Through Coherence (CTC) hypothesis was put forward, stating that the specific pattern of interactions among neuronal groups is governed by the specific pattern of synchronization. Experimental evidence in support of this hypothesis was provided.

Neuronal oscillations (Dr O. Jensen)
This group studies how neuronal oscillations shape the functional architecture of the working brain in the context of perception and memory tasks. Data are acquired and analyzed from animals and humans using intracranial recordings, EEG and MEG. Numerous MEG studies carried out by the group indicate that oscillatory
activity plays an important role in shaping the functional architecture of the brain: activity in the gamma band (30–80 Hz) reflects neuronal processing, while alpha band activity reflects disengagement of task-irrelevant areas. This disengagement serves to direct the information flow through the brain. These principles have emerged from studies on memory, attention and perception. Recently it was demonstrated that these signals can be used to control brain-computer interfaces. This provides a new tool for investigating cognitive processing as a function of brain state.

MR techniques in brain function (Prof. D. Norris)
This group improves and develops methods for MR imaging, such as Diffusion Tensor Imaging and high-resolution fMRI, and develops methods for multimodal imaging (e.g. combining EEG and fMRI). Progress was made in measuring layer-specific activation within the cortex, using the 7 T system in Essen. Previously developed multi-echo techniques were combined with layer-specific activation to show how the signal from deeper cortical layers has a different signature to that of superficial vessels. A new field of research that involves segmenting brain regions on the basis of connectivity profiles has delivered promising results.

Awards and acknowledgements
• Dr F. de Lange and Dr M. Roberts received a Veni grant.
• Prof. G. Fernández received an NWO research grant together with colleagues at the Free University of Amsterdam.
• Dr O. Jensen obtained a FES grant in collaboration with researchers at Utrecht University.
• Dr O. Jensen received a Vici grant.
• A university team composed of members of the MR Techniques in Brain Function group came equal first in the Pittsburgh brain competition 2009.
• Dr F. de Lange was awarded the 2007-2009 Dutch Psychonomic Society dissertation award.
• Dr R. Cools received a Human Frontiers Science Program grant in collaboration with Kansai Medical University Japan and New York University.

Research facilities
• three MR scanners – dedicated to research at 1.5, 3, and 7 Tesla – for measuring structural anatomy and functional brain activity with high spatial resolution
• a whole-head, 257-channel MEG system for measuring neuronal activity with high temporal and good spatial resolution
• two EEG laboratories, with 128 channel recording options, for measuring the synchronous electrical activity of large ensembles of neurons
• a dedicated 32-channel EEG system for measuring EEG in the MR scanners
• two behavioural laboratories
• integrated stimulus presentation facilities for auditory and visual presentation as well as activities such as somatosensory stimulation
• a computer infrastructure with centralized storage management and central computation power
• a facility for awake monkey neurophysiology, allowing simultaneous recording from 256 sites across the brain
• a laboratory for Transcranial Magnetic Stimulation (TMS)

Collaboration
The DCCN is a research centre at Radboud University Nijmegen that includes participation by researchers at the universities of Leiden, Maastricht, and Twente as well as the Radboud University Medical Centre and the Max Planck Institute for Psycholinguistics in Nijmegen.
• The DCCN collaborates with the following preferred partners of Radboud University Nijmegen:
  • The University of Duisburg-Essen, Germany (operating of a joint research centre for high-field MR imaging in Essen)
  • The University of Zürich, Switzerland, for studies on computational neuroscience.
The DCCN is also engaged in structural collaboration with many other academic institutions, including:
• Utrecht University
• Erasmus University
• University of Bonn, Germany
• Heinrich-Heine-Universität, Düsseldorf, Germany
• University of Bielefeld, Germany
• Ernst-Strüngmann-Institute, Frankfurt, Germany
• University of California, Berkeley, USA
• Columbia University, New York, USA
• University of Arizona, Tucson, USA
• University of Oxford, UK
• Norwegian University of Science and Technology, Norway
• Unicog U562, Gif/Yvette, France
• University of Trento, Italy

Societal impact
Researchers at DCCN contribute to a better understanding of the nervous system through dissemination of expertise and knowledge to both the scientific community and the general public. An annual series of courses entitled ‘The cognitive neuroscience tool-kit’ attracts students and researchers from all over Europe. An advanced analysis software package for use in analyzing MEG and EEG data has been developed and made available to the neuroscience community.

Staff at the DCCN gave numerous lectures to the general public, appeared in the Illusion public event organised by the NWO, and arranged a number of tours for high schools. Several researchers contributed to the scientific pages of regional, national and international newspapers and appeared on TV and in radio shows including appearances on the BBC and CNN. In February, the EU Commissioner for Science and Research, Janez Potocnik, visited the centre where he was given an overview of current research and witnessed a live experiment involving MR scanners.
Future research

Neurocognition of language
Future work will focus on language production, bilingualism and structural and functional changes related to it. Moreover, language behaviour will be studied in conversational setting in a Virtual Reality environment.

Intention and action
Currently work involving two main lines of research: targeting instrumental and communicative actions will continue. Experiments are planned to study the mechanisms that integrate visuospatial and perceptual information in a ‘motor plan’ and to study the cerebral and computational mechanisms that support the generation of human communicative actions.

Key publications


Dissertations: 6
Scientific publications: 124
Neuronal coherence
Having established that selective synchronization does indeed result in selection interactions among neuronal groups, the next step will be to test whether this mechanism is used during normal cognitive functioning. Specifically, tasks will be used in which cognitive top-down control alters the brain-wide pattern of interactions to discover whether this is achieved by altering synchronization patterns.

Neuronal oscillations
The brain will be investigated as a network in cognitive tasks using newly developed cross-frequency analysis techniques. This will be done using a multimodal approach combining EEG with TMS and fMRI. Brain-computer interfaces will be used to investigate the role of oscillatory brain states on perception and memory online.

Prediction and attention
The aim here is to characterise the information carried by different regions during perceptual inference, as well as their integration, using multivariate classification in fMRI. In MEG experiments we aim to temporally dissociate effects of predictability and attention during auditory perception.

Decision neuroscience
Future studies will explore social interactive decision-making, by investigating how prior expectations are formed, to what degree they are influenced by experience, and precisely which individual differences may underlie responses to fairness and trust. Explorations of the neuroscience of individual decision-making have started, in particular examining the response to uncertainty and risk in consumer decisions, and the neural antecedents of decision conflict.

Cognitive control
Assessments will be made as to whether and how the effects of dopamine differ from those of serotonin and whether they can be predicted by individual genetic variation.

Cognitive neurology and memory
The effects of stress and steroid hormones on specific brain operations that underlie mood regulation, stress perception and memory will be studied. Moreover, an attempt will be made to identify a mechanistic account of the effects of stress on memory and mental health, incorporating three dimensions in a fully integrated approach: pharmacology, genetics and neural processes.

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The human brain is an adaptive self-organizing system, whose potential for adaptation – which is rooted in the genetic profile – is expressed through interaction with the environment. Research on animals and human beings at the Donders Centre for Neuroscience (DCN) takes place at various levels: that of genes, biomolecules, neurons, networks of neurons, and the behaviour of the whole organism.

The DCN operates at all of these levels, bringing together multi-disciplinary basic and clinical research groups from the Faculty of Science and the Radboud University Nijmegen Medical Centre. Researchers use their expertise and skills to train students, researchers, physicians, specialists and professionals who are active in the field of neuroscience, while also applying knowledge and expertise in clinical practice. The strength of the centre lies in the way it combines a broad repertoire of skills, experimental facilities, and expertise from the molecular level to the behavioural level for basic research on cognitive neuroscience. The range includes firstly investigating the neuronal processes involved in attention, action, perception, adaptation, memory and emotion – as well as applied clinical research with a focus on diagnosis and therapy, secondly exploring techniques for use in normal and pathological cognitive dysfunction, and thirdly understanding the pathophysiology and aetiology of psychiatric and neurological syndromes.

Since 1 September 2008 all of the research at the Centre for Neuroscience has been incorporated in the Donders Institute for Brain, Cognition and Behaviour. Researchers at the DCN participate in all four themes of the Donders Institute (see also page 66).

Awards and acknowledgements

• Dr N. Lambregts-Rommelse received a Veni grant entitled ‘Hunting for pleiotropic genes for attention-deficit/hyperactivity disorder and autism’.
• Prof. J. Bruhn received a Vidi grant for ‘Detection of attempted movements for the prevention of intraoperative consciousness using an on-line electroencephalographic system’.
• Prof. G. Fernández received a research grant from the Netherlands Organisation for Scientific Research (NWO), together with Dr D. Posthuma of the Free University of Amsterdam, for their work on ‘Imaging genetics of intelligence: towards a neurobiological understanding of intelligence’.
• Prof. J. Buitelaar and Dr B. Franke received a grant from the Dutch organisation for health research and innovation (ZonMw) for work on the addiction programme: ‘Substance Abuse Disorders in Adolescence and Young Adulthood: A Follow-
up Study of an ADHD Cohort. In Search of Clinical, Cognitive and Genetic Risk Factors’.

• Two grants for research on aggression and psychopathy were awarded to Prof. J. Buitelaar: 1) Brain & Cognition FES Program ‘Agressie beter beheersen’ (Together with Dr R. Verkes) and 2) an FP7 grant on ‘Paediatric European Risperidone Studies (PERS) in Conduct Disorder’.

• Prof. E. Roubos, Dr T. Kozicz and Dr J. Homberg received a NWO-ALW grant for their work on ‘Serotonin transporter gene polymorphism by adverse life events interaction: an anatomical and behavioural approach towards the understanding of nature-nurture interaction in the psychobiology of depression’.

• Prof. P. Tiesinga was awarded a NWO grant in the Computational Life Science programme entitled ‘Reverse physiology of the cortical microcircuit’.

• Prof. G. Martens received a TI Pharma grant for a project entitled ‘Novel susceptibility pathways and drug targets for psychosis’.

• Dr J. Homberg received a ZonMw-NIDA Grant together with Dr G. Koob (of the Scripps Research Institute, USA) to study the interaction between serotonin and CRF in cocaine addiction.

• Dr H. van Bokhoven received three grants in 2009; 1) from the National Foundation for Ectodermal Dysplasias for a project entitled ‘Genome-wide Identification of p63 target genes in Ectodermal Dystrophy’, 2) Hersenstichting Nederland for ‘Functional cloning of genes involved in neuronal migration disorders’ and the 3) the Prinses Beatrix Fund for a project on ‘Identification of the genetic and functional basis of the alpha-dystroglycanopathies: from families to genes and back’.

• Dr B. van de Warrenberg received a grant from the Hersenstichting to study ‘Cerebral plasticity in cervical dystonia’.

• Dr I. Tendolkar and Dr R. Esselink were awarded a starting grant from the Dutch Parkinson Foundation to setup a psychosocial network for Parkinson’s patients in collaboration with MijnZorgNet.

• M. Wilhelmus (Department of Neurology) received the 2009 Brain Research Young Investigator Awards for a paper entitled ‘Small heat shock proteins inhibit amyloid-β-protein aggregation and cerebrovascular amyloid-β-protein toxicity’. 
Prof. B. Bloem received the Radboud Penning for outstanding services to the Radboud University Nijmegen Medical Centre.

Dr A. Aschrafi (Departments of Human Genetics and Cognitive Neuroscience) was awarded a RUNMC Fellowship of 2009 to start a five-year tenure track on the expression and function of synaptic miRNAs.

Research facilities

The DCN has unique research facilities and access to various cohorts of patients for studies of diseases such as Alzheimer, ALS and Parkinson. It also has access to large samples of genetically hearing-impaired families, families with age-related hearing impairment and clinical otosclerosis, and to a large number of genetically visually impaired families and populations with age-related macula degeneration. In addition, the centre has access to advanced equipment for virtual reality stimulation, genomics and proteomics facilities, and to advanced neuroimaging facilities, such as the fMRI equipment at the Donders Centre for Cognitive Neuroimaging.

The fully equipped Radboud Transcranial Magnetic Stimulation (TMS) Laboratory and the Nijmegen Gait and Balance Unit are used for ground-breaking research on human motor control. In addition, non-invasive high-density EMG systems with up to 130 channels per muscle, ultrasound facilities for neuromuscular diagnostics and EEG recording facilities up to 64 channels are available to explore the role of the peripheral motor system in the coordinating movement. There is a 3D virtual reality stimulus generator and a vestibular chair for research on visuo-vestibular interaction. For research on auditory perception (single-unit recordings in the auditory cortex) and sensori-motor integration (multisensory integration, eye-head coordination, sound localization studies with human beings and electrophysiological recordings with head-unrestrained macaques), the DCN runs three fully equipped laboratories to perform high-level behavioural sensori-motor experiments. The Centre also has neuropsychological test facilities and a Near Infrared Spectroscopy (NIRS) lab.

There are two movement laboratories with state-of-the-art equipment for studying postural control and gait. This includes a multidirectional balance perturbation platform, recently built with financial support of the NWO that is unique in the world. The ‘Radboud Falls Simulator’ is able to deliver extremely destabilizing multidirectional balance perturbations for use in studying human postural control at the limits of stability.

In addition to the standard equipment, there are also advanced laboratory facilities for morphology, electron microscopy, cell physiology, electrophysiology, pharmacology, isotopes and molecular biology such as quantitative PCR, proteomics facilities, Xenopus transgenesis facility, cell-tissue culture and animal models (Xenopus, Drosophila, mice, rat, monkey). Specifically for behavioural experiments with rats there are rewarding/aversive conditioned place preference tests, water maze tests and forced swim tests. For mice there are eight phenotyper cages available in which behaviour can be monitored using a video-based complete observation system.

The DCN also houses a fully equipped lab for slice electrophysiology including patch-clamp recordings, micro-electrode recording arrays, UV-flash photolysis of caged compounds, fluorescence recording and equipment for post-mortem tracing in brain slices.

Dr Glenn Dumont’s PhD project focused on unravelling the psychological and physiological effects of combining the drugs ecstasy, alcohol and cannabis. His dissertation was published in the Donders Series.
For research within informatics the DCN has a database of primate brain connectivity (www.cocomac.org) and a computer lab for neuro-imaging analysis, including spatial normalization, cortical thickness measurements, graph-theoretic measures and multivariate analysis techniques. A PC cluster is available for fast parallel computations.

Collaboration

Local
Besides collaboration within the Donders Institute, researchers at the DCN also cooperate with several research institutes on campus including IGMD, NCEBP, NCMLS, IMM and ICIS.

National
• Erasmus University Rotterdam/ErMC
• Free University Amsterdam / VUMC
• Leiden University (Medical Centre)
• Maastricht University/AZM
• Twente University
• University of Amsterdam/ AMC / NIN
• Utrecht University, UMCU and Hubrecht Lab

International
• University of Würzburg, Würzburg, Germany
• Univ. Paris Descartes, Paris, France
• Technical Univ. Denmark, Copenhagen, Denmark
• University of Birmingham, UK
• University of Southampton, UK
• University College London, UK
• University of Oxford, UK
• Karolinska Institutet Stockholm, Sweden
• Weizmann Institute of Science, Rehovot, Israel
• Northwestern University, Evanston, USA
• SUNY Upstate Medical University, Syracuse, New York, USA
• University of California, Berkeley, USA
• University of Southern California, Los Angeles, USA
• Tufts University, Medford, USA
• The Scripps Research Institute, la Jolla, USA
• Salk Institute, La Jolla, USA
• University of Rochester, NY, USA
• University Pittsburgh Medical Center, PA, USA
• State University of New York at Stony Brook, NY, USA
• Baylor College of Medicine, Salt Lake City, USA
• Yale University Medical School, New Haven, USA

Preferred partners of Radboud University Nijmegen
• Catholic University of Leuven, Belgium
• Universitat de Barcelona, Spain
• University of Glasgow, Glasgow, United Kingdom
• Péter Pázmány Catholic University, Budapest, Hungary
• Università degli Studi di Siena, Italy
• Universität Zürich, Zürich, Switzerland
• Universität Duisburg-Essen, Essen, Germany
• University of Iowa, USA
• University of North Carolina at Chapel Hill, Chapel Hill, USA.

Results

Theme 1. Language and Communication
Breakthroughs in autism research
Prof. J. Buitelaar and his colleagues examined the neural correlates of the integration of voice-based inferences about speaker’s age, gender or social background, with sentence content in adults with autism spectrum disorder (ASD) and matched control participants. The ASD group showed increased activation in right inferior frontal gyrus for speaker-incongruent sentences compared to speaker-congruent sentences. This suggests that pragmatic language problems in ASD are not restricted to high-level inferential processes, but involve the most basic aspects of pragmatic language processing.

Theme 2. Perception, Action and Control
The falls prevention programme in daily practice
Dr Weerdesteyn and Prof. Geurts demonstrated for the first time that the specific Nijmegen falls prevention programme, for which efficacy had previously been demonstrated in a Randomized Controlled Trial (RCT), maintained its effectiveness in reducing the number of falls among the elderly after implementation in daily clinical practice.

Parkinson care: solutions for today, innovations for tomorrow
The ParkinsonNet continues to expand, currently including 64 regional networks. The results of a large multicenter RCT that evaluated the merits of the ParkinsonNet concept were published in the prestigious journal Lancet Neurology. In 2009 ZonMw awarded its Pearl Status to this national concept developed by Dr M. Munneke and Prof. B. Bloem.

Oscillatory brain activity
Brain activity often reveals oscillations in particular rhythms. One of these rhythms is the gamma rhythm (35-80 Hz). The group led by Prof. S. Gielen has shown that encoding a neural signal by a gamma frequency makes that signal more powerful. If a neuron receives several inputs, the neuron will selectively respond to the signal with the larger gamma modulation and will ignore all other inputs. This is particularly important in selective attention, when attention is being paid to one of many objects in a scene in order to analyze a particular object accurately by ignoring other (irrelevant) objects.

Multisensory Integration
Prof. van Opstal and colleagues succeeded in measuring head-unrestrained gaze-orienting responses to audiovisual targets in
Key publications


monkeys using a newly developed electromagnetic measuring technique. In human beings they demonstrated that the brain continuously monitors subtle changes and statistics of complex audiovisual environments, in order to programme fast, accurate orienting responses of the eyes and head.

**Theme 3. Learning, Memory and Plasticity**

**Novel gene for motor disorder**
Dr H. Kremer and Dr J. Schelhaas were involved in the discovery of a novel gene for a motor neuron disease, which was published in *Nature Genetics*. The gene encodes a transient receptor potential (TRP) channel. The impact of this discovery for patient care is currently being evaluated.

**Finding genes for the brain**
In an effort to find genes involved in brain development, whether functional or malfunctional, Dr B. Franke and Prof. G. Fernández performed a genome-wide search for such genes using the volume of memory and emotion-related subcortical brain structures (such as hippocampus and amygdala) measured in the brains of 600 healthy individuals. This approach identified multiple genes that had earlier been thought to be involved in psychiatric and neurodegenerative disorders.

**Stress and feeding control**
The midbrain Edinger-Westphal nucleus (EW) produces stress and eating-controlling neuropeptides. The group led by Prof. E. Roubos showed that the EW is rhythmically active, that maternal separation sex-specifically affects the EW and that fasting inhibits the EW. The latter finding indicates that the nucleus co-ordinates stress adaptation and feeding. These insights open new avenues for treating major depression and eating disorders.

**Lessons from animal studies**
The group led by Dr Homberg has revealed that the unique dopamine D1 receptor mutant rat has a constitutive active receptor that causes impaired reactivity to external stimuli, which can be restored with dopamine agonists. They also found that the serotonin transporter knockout rat, which models the human serotonin transporter polymorphism, is strongly influenced by environmental stimuli, acts without thinking, but adapts well to environmental changes. These findings may help elucidate individual differences in human behaviour.

**Genes found responsible for ataxias**
Dr H. Scheffer and colleagues have provided a proof of principle for the diagnostic approach using gene capture followed by next generation sequencing (NGS). For this, the researchers captured seven genes involved in recessive ataxias. All mutations known to be present could be identified. This approach will open up complete new strategies for molecular diagnostics of genetically heterogeneous disorders in neurology.
New breakthroughs in genome sequencing
Dr H. Van Bokhoven and colleagues, benefiting from recent revolutionary improvement in the capacity and throughput of genomic sequencing, sequenced all of the X chromosomal genes in a large cohort of patients with suspected X-linked intellectual disability. This has revealed several new causative genes, and surprisingly, demonstrated that DNA variants that introduce premature stop codons in genes are harmless polymorphisms.

Finding new CSF biomarkers
In collaboration with Schering Plough Research Institute (New Jersey, USA), Dr M. Verbeek and Prof. M. Olde Rikkert developed a method for sampling continuous cerebrospinal fluid (CSF) to characterize amyloid peptides, tau proteins and other potential biomarkers in healthy elderly subjects and patients with Alzheimer’s Disease. These studies will make investigating the diurnal fluctuation of CSF biomarkers possible over a 36-hour period.

Theme 4. Brain Networks and Neuronal Communication
How to control movement?
The novel method for stochastic control that was developed by Prof. B. Kappen and colleagues at DCN in 2005, was shown by the robotics group led by Dr Stephan Schaal at the University of Southern California to significantly outperform all other state of the art reinforcement learning methods for an autonomously walking dog in 2009. A video (search for ‘little dog usc’) can be found on YouTube. This approach is currently being extended to other robot platforms in Dr Schaal’s laboratory.

Visual processing modulates alpha and gamma oscillations
Prof. P. Tiesinga developed a large-scale computational model for studying visual processing in terms of networks of spiking neurons. Simulations of this model showed that during visual processing the power in the gamma (30-80 Hz) frequency band increased, whereas that in the alpha (~10Hz) band decreased, thus reproducing experimental measurements. This model is the first step towards understanding the role of oscillations in mediating communication between brain areas.

Societal impact

Media appearances
- Dr B. Franke gave a press conference on the genetics of adult ADHD at the European College of Neuropsychopharmacology Meeting in Istanbul.
- Prof. B. Bloem appeared frequently in the media, including on national radio (e.g. on the programme Casa Luna) and on national television (e.g. EenVandaag).
- Prof. S. Gielen also appeared in the TV programme EenVandaag.
- Prof. M. Olde Rikkert gave several interviews for Dutch newspapers such as NRC and radio interviews on behalf of the Alzheimer Centre Nijmegen concerning new drug developments and a nutritional intervention.
- The VPRO programme ‘Noorderlicht’ visited Prof. J. Van Opstal’s lab to make recordings of ongoing auditory plasticity experiments (‘owl ears’).

Scientific boards and committees
- Prof A. Geurts became vice-president of the Dutch Society for Neurorehabilitation and was an active member of the programme committee of the 2nd stimulation programme on rehabilitation research of the Netherlands Organisation for Health Research and Development (ZonMw).
- Prof. E. Roubos is chairman of the Zon-Mw Programme Electromagnetic Fields and Health, and a member of the National Platform Electromagnetic Fields and Health.
- Prof B. Bloem was appointed as a board member of ZonMw, became president of the International Society for Postural and Gait Research and a member of the European Section Executive Committee of the Movement Disorder Society.
- Dr M. Verbeek was a member of the Expert Group In vitro Diagnostics for variant Creutzfeldt-Jakob’s Disease (Inspectie voor de Gezondheidszorg).
- Dr H. Scheffer was appointed Chairman of VKGL (Vereniging Klinische Genetische Laboratoriumdiagnostiek), lid DB Klinisch Genetisch Centrum Nijmegen.
- Dr I. Tendolkar was elected as a board member of the Dutch Psychiatric Association, focusing on research and clinical development related to psychosomatic medicine.
- Dr H. Van Bokhoven was a member of the Horizon programme of the Netherlands Genomics Initiative and sat on the Editorial Advisory Board of the ‘Encyclopedia of Life Sciences’ (ELS; John Wiley & Sons), section Genetics & Molecular Biology (2008-).
- Dr B. Van de Warrenburg became a member of the medical advisory boards of the Dutch Society for Dystonia patients, the Dutch Organisation for Hereditary Spastic Paraplegia/Primary Lateral Sclerosis patients and the Dutch Society of Ataxia patients.
- Dr V. Weerdesteyn was elected as a board member of the International Society for Postural and Gait Research.

Economic, societal valorization and regional involvement
Prof. B. Bloem founded and became director of MijnZorgNet BV, a spin-off company of the Radboud University Nijmegen Medical Centre that was established to act as a service provider for patient-centred and collaborative care.

The Promedas medical diagnostic advisory system co-developed by Prof. B. Kappen was tested at the division of internal medicine of the UMC Utrecht. The system, which was made available to about 150 physicians, was used on average 1200 times per month. The system will be implemented and tested in other academic hospitals in 2010.
Director: Prof. Stan Gielen

Stan Gielen has been a Full Professor of Biophysics since 1988 with appointments in the Faculty of Science and at the Radboud University Nijmegen Medical Centre. He is an expert in neuronal information processing, focusing on cognition as an emergent property of the brain and on various applications in Artificial Intelligence. Prof. Gielen is a member of the Editorial Board of several scientific journals. In 2007 he was awarded a Knight-hood in the Order of the Netherlands Lion.

The version 1 Bonaparte expert system for missing person identification, which is based on DNA data, developed by Prof. B. Kappen and colleagues, was given a positive evaluation by the Dutch Forensic Institute. The system will be employed and used in daily practice in 2010.

The fundamental research data of the Department of Cellular Animal Physiology (headed by Prof. E. Roubos) – focusing on the basal mechanisms of adaptation in animals and man – had a profound impact and received strong support in the biomedical and social area; together with the Department of Anaesthesiology (RUNMC) and Merck (Oss) collaborative projects were established to evaluate the role of neural and endocrine adaptation systems in the genesis of chronic neuropathic pain, feeding disorders, depression and suicidal behaviour.

Future research

The newly formed research group Molecular Neurobiology is an integral part of the theme Learning, Memory and Plasticity team. This research group will link DCN with NCMLS, thus further strengthening collaboration within the RUNMC Departments Human Genetics and Cognitive Neuroscience.

Neuronal Communication by establishing close links to both ICIS (Prof. T. Heskes) and IMAPP (Prof. F. Redig).

There are opportunities for the Donders Institute within the M2M Platform. The DCN aims to develop new brain-imaging techniques for molecular and cellular processes linked to experience of optical imaging in the NanoLab of the IMM.

In 2010 DCN will further strengthen contacts with regional partners, including collaboration with companies such as Danone and Merck.
Institute for Genetic and Metabolic Diseases

At the Institute for Genetic and Metabolic Diseases (IGMD) scientists from a range of disciplines engage in research on genetic and metabolic diseases, using a bench-to-bedside approach. Within the Institute’s nine inter-related research themes, fundamental, applied and clinical researchers work closely together to answer specific, patient-related research questions that are designed to reduce the incidence of mortality, as well as the severity and duration of morbidity resulting from genetic and metabolic diseases. The intention is to elucidate the pathophysiology of specific diseases, develop novel diagnostic methods and develop innovative forms of treatment.

**Research themes**

*Functional imaging*
Functional imaging and monitoring is of vital importance for the diagnosis, treatment and follow-up of patients. The Functional Imaging Group aims to develop and clinically evaluate innovative, non-invasive functional imaging and monitoring techniques such as 2D and 3D Echography, NMR spectroscopy, Near Infrared Spectroscopy (NIRS) and radioisotope imaging (PET and SPECT). The ultimate goal is timely detection of tissue damage in early life as well as in adults and the aging population.

*Molecular gastro-enterology and hepatology*
This research programme was set up to establish a comprehensive understanding of human gastrointestinal diseases at the molecular level, with the ultimate goal of discovering novel paradigms for effectively treating patients. The main focus is on polycystic liver disease, an autosomal dominant disorder. Although this is a rare disorder, it provides a unique opportunity to study human cystogenesis. Researchers in this translational programme aim to identify key intracellular signalling pathways in PCLD in order to find potential therapeutic targets that can be tested in clinical trials. The other research lines include identifying genetic aspects of chronic pancreatitis and the molecular pathology of inflammatory bowel diseases.

*Genomic disorders and inherited multi-system disorder*
Genetic factors are important in most human diseases and traits. This group focuses on finding such genes in order to provide better patient care. Topics include mental retardation, congenital abnormalities, psychiatric disorders, brain development and individual responses to treatment due to pharmacogenetic factors.

*Glycosylation disorders*
This research focuses on the complex biosynthetic and catabolic pathways of glycans in health and disease with a clinical and
biochemical emphasis on Congenital Disorders of Glycosylation (CDG). Glycosylation is a biochemical process of post-synthetic modification that occurs in most proteins and in all cell-types. In parallel with developing novel analytic techniques, the research group applies a broad range of biochemical, genetic and cell biological methods in order to identify new disease entities, improve current diagnostics and better understand pathophysiological mechanisms. These aspects are of crucial importance for developing future therapeutic strategies.

Healthy aging / healthy living

Remarkable advances in medicine have allowed humans to live to quite unprecedented ages: average human life expectancy has increased from 45 years at the beginning of the 20th century to over 75 years at the beginning of the 21st century. Understanding the process of healthy ageing, as well as the role of exercise and activity in senescence, is the main topic of this research programme that covers human in-vivo approaches down to the genetic level. Living longer, however, does not necessarily mean living better. The metabolic syndrome, the central infirmity of the 21st century, is one of the major focuses of this research programme. Risk factors that contribute to the metabolic syndrome such as dyslipidemia, hypertension and insulin sensitivity are studied both separately and combined in patients with multiple risk factors. The overall goal is to improve the health – and/or vitality – of individuals as they age.

Hormonal regulation

The research within this group focuses on adrenal diseases, especially pheochromocytoma/paraganglioma, congenital adrenal hyperplasia, primary aldosteronism and hyper- and hypocortisolism. Patient care and research on adrenal diseases are the raison d’être of the recently established Radboud Adrenal Centre (RAC).

Iron metabolism

This research is designed to arrive at a full understanding of iron metabolism, in particular the identification and characterization

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of novel factors that mediate dysregulation of iron homeostasis in some of the world’s most prevalent diseases, including anaemia related to chronic kidney disease, rheumatic diseases, hereditary haemochromatosis, iron loading anaemia’s, bacterial and malarial infections, cardiovascular disease and mild non-hereditary hepatic iron overload associated with alcohol abuse, hepatitis C and the metabolic syndrome. Among the most recent achievements is developing a mass spectrometry assay for the recently discovered iron regulatory hormone peptide hepcidin that is currently the subject of several translational studies.

Mitochondrial medicine
Within this group fundamental and applied studies ranging ‘from molecule to man’ are carried out under the guidance of scientists with a clinical, cell biological or bio-chemical background. The information gathered is used to develop new forms of treatment for diseases and adverse-health conditions in which the mitochondrial energy capacity is reduced. Defects of the human oxidative phosphorylation system are among the most frequently encountered inborn errors of metabolism and the study of patients with these devastating disorders has revealed important information about the role that mitochondria play in the normal process of ageing and in neurodegenerative diseases such as Parkinson.

Renal disorder
The kidneys play an essential role in several processes in our body including volume and osmo-regulation, electrolyte balance, and the excretion of metabolites and drugs. Within this theme the regulation of the physiological development of the kidney is studied in order to better understand the pathogenesis of kidney disorders, to diagnose and ultimately cure or prevent them. These disorders include acquired and inherited forms of kidney diseases. The research projects are carried out on the genetic (gene defects, polymorphisms), molecular (transport proteins), and cellular (glomerular and epithelial cells) level. The results of fundamental and clinical research are integrated.

Research facilities
IGMD research and patient care requires an excellent laboratory infrastructure. State-of-the-art technology platforms are at the heart of this infrastructure, offering unique research opportunities. These include a DNA sequencing facility, genome scanning facility, expression array facility, proteomics facility and a metabolomics and glycomics facility. These platforms are the building blocks used to successfully apply genomics, proteomics and metabolomics approaches and to bring the data together in a holistic systems biology approach to genetic and metabolic disease. The technology platforms are largely hosted by the Department of Human Genetics and by the Laboratory of Genetic, Metabolic and Endocrine Disorders. For researchers it is a challenge to make use of these facilities in their work and to incorporate this high-tech infrastructure in grant applications.

Collaboration
There is frequent and fruitful collaboration with researchers from the other research institutes at the University and the Radboud
Bert van den Heuvel, Joost Hoenderop and Roos Masereeuw received a research grant from the Biomedical Materials Program to develop a biological kidney support device (Biokid) in cooperation with the technical universities of Twente and Eindhoven and UMC Groningen.

The Dutch Scientific Organization has awarded a grant to Dr Dirk J. Lefeber (Laboratory for Paediatrics and Neurology) entitled “High-resolution glycoprofiling in human medicine” for innovative nanoLC- mass-spectrometry equipment. This technology represents a major extension of the current infrastructure and enables highly sensitive and detailed fingerprinting of many different glycan classes such as those present on proteins and lipids in body fluids or cells. Dirk also received a grant, together with Dr Hans van Bokhoven, from the Princes Beatrix Foundation for their research on alpha-dystroglycanopathies.

Prof. Cees Tack received a grant from the European Foundation for the Study of Diabetes for his research on the effect of interleukin-1 receptor antagonist on insulin secretion in first degree relatives of patients with type 2 diabetes.

Prof. Jan Smeitink received a grant from the Energy4All Foundation for his project on Treatment of mitochondrial disease.

Dr Joost Hoenderop has been selected as a Young Academy member of the Royal Netherlands Academy of Arts and Sciences (KNAW). A committee, whose members are appointed by the Young and the Royal Academy’s Board, selects new candidates who are nominated by Dutch Universities and Medical Centres. Dr Hoenderop is Principal Investigator at the department of Physiology and he supervises an international research team that is working on the molecular physiology of the mineral balance.

Awards
Prof. René Bindels received the Homer W. Smith Award from the American Society of Nephrology. The Homer Smith Award is awarded annually to an individual who has made an outstanding contribution to nephrology. In 2009 René Bindels also received the Robert F. Pitts and the Carl W. Gottschalk Lectureship in Kyoto and New Orleans, respectively. This hat trick in awarded international research prizes underlines the top position of kidney research at the Radboud University Nijmegen Medical Centre.

Dr Roos Masereeuw was awarded the DPS Schering Plough Pharmacology prize for her innovative research on the regulation of drug transporters in renal damage and repair.

Several young IGMD researchers received Young Investigator awards and poster prizes from various learned societies.

Research results
IGMD researchers received prestigious grants from ZonMw, NWO/ALW, the Dutch Kidney Foundation, STW and the Dutch Heart Foundation, as well as from the European Framework Programmes.

Kolff grants of the Dutch Kidney Foundation were for Heleen Arts MSc (Human genetics) and Dr Joris Robben (Physiology).
Key publications


Dissertations: 14
Scientific publications: 521
Patents: 2
Dr Geert Wanten was elected as chairman of NESPEN, the Netherlands Society for Parenteral and Enteral Nutrition.’

Prof. Joost Drenth was appointed deputy editor of the Nederlands Tijdschrift voor Geneeskunde. He was also elected a member of the assembly of the United European Gastroenterology Federation (UEGF).

Dr Henri Timmers was appointed chair of the international Pheochromocytoma and Paraganglioma Research Support Organization (PRESSOR).

**Future research**

The priority is to ensure genuine cooperation among researchers working on the themes and activities identified by the task forces.

The research focus in Functional Imaging is on multi-modality imaging for cardiac and cerebral applications, in order to identify vulnerable plaque and diabetic patients; the group will work on developing and characterizing novel tracers for beta-cell imaging in animal models of diabetes.

In 2010 the Molecular gastro-enterology and hepatology group aims to start two randomised clinical trials focusing on polycystic liver disease. They are genotyping a new mouse model for polycystic liver disease in order to facilitate the study of the pathogenetic mechanism that leads to polycystic liver disease and use it as a model for studying the effect of pharmacological interventions designed to reduce or prevent polycystic livers. The ultimate aim is to reduce the burden of polycystic liver disease.

Healthy Aging research focuses on the mechanisms involved in chronic diseases caused by inactivity. The ultimate aim of the Mitochondrial Medicine group is to make a substantial contribution to developing a treatment for mitochondrial disease.

The Hormonal Regulation group focuses its research on the adrenal diseases pheochromocytoma/paraganglioma and congenital adrenal hyperplasia with the aim of better understanding the molecular mechanisms underlying these diseases and improving therapy.

In the field of Iron Metabolism new insights into mitochondrial iron homeostasis, soluble hemojuvelin and hepcidin will be translated into novel diagnostic assays and therapeutic strategies that can be implemented in the clinic.

The goal of research on renal disorders is to further strengthen the group’s international research position in this field and to become the top national reference centre for patients with these disorders. The group is also working on the use of pharmacological chaperones for the treatment of certain genetic tubular disorders.

The ultimate aim of the Mitochondrial Medicine group is to make a substantial contribution to finding a cure for mitochondrial and related diseases.

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**Director: Prof. Jan Smeitink**

Prof. Jan Smeitink has been Head of the Department of Metabolic and Endocrine Disorders at the University Children’s Hospital of the Radboud University Medical Centre since 1996. In 1997 he set up the Nijmegen Centre for Mitochondrial Disorders, which is internationally recognized as a centre of excellence for patient care, diagnostics and research of patients suffering from disturbances in the mitochondrial energy metabolism. In 2001 he became an Extraordinary Professor in Mitochondrial Disease and in 2006 a Full Professor in Mitochondrial Medicine. In 2006 he was appointed for six years as Foreign Adjunct Professor at the Karolinska Institutet, Stockholm, Sweden. In August 2006 he received the Princes Beatrix Foundation Jubilee Award from Queen Beatrix of the Netherlands for his research on mitochondrial medicine. April 2009 he set up the Centre for Systems Biology and Bioenergetics.
The Research Institute for Oncology aims to advance innovation in translational research in oncology and to reduce the morbidity and mortality of cancer. Researchers from several disciplines unravel the pathology of tumours, develop new diagnostics and therapies, and improve patient care.

The Institute was founded in 2008 as one of six research institutes of the Radboud University Nijmegen Medical Centre to enhance coordination and strengthen research in oncology and oncology-related topics. Built on the tradition and strong reputation of existing research groups, the Institute operates in close association with the clinical service for patients with cancer under the umbrella of the Radboud University Centre for Oncology (RUCO).

Research is organized in five themes, the basic principles of which are:

- Research is patient-centred and related to patient care
- Research is arranged in themes, which are multidisciplinary and offer extra value when compared to existing structures
- Close cooperation with the other University research institutes, such as NCMLS and NCEBP, is very important.

The five themes of the Institute are:

**Hereditary cancer and cancer-related syndromes**

This theme contains research programmes that investigate the cause and early detection of hereditary and other cancer-related syndromes and develop improved detection methods for specific forms of hereditary cancer, plus studies on health care and psychosocial aspects.

Subthemes:

- Genetic causes and mechanisms
- Recognition, prevention and treatment of hereditary cancer
- Patient empowerment, psychosocial care, quality of care and ethical dilemmas.
Age-related aspects of cancer
Cancer has several aspects that differ per age group. This theme investigates the cause of cancer in the young, the age-related pathology of tumours and its consequences, the need for specific approaches for special age groups, including pharmacology, developing programmes for early clinical trials in children, and adapting treatments for the elderly.

Subthemes:
• Pediatric oncology
• AYAs (Adolescents and Young Adults) and cancer
• The older adult.

Translational research
Advances in the understanding of the biology and genetics of cancer have in recent years led to the development and implementation of novel diagnostic, prognostic and therapeutic approaches. (A paradigm is the discovery of the Philadelphia translocation in chronic myeloid leukaemia (CML), the subsequent identification of the bcr and abl (fusion) genes as being involved in this translocation, the notion that this gene fusion leads to constitutive tyrosine kinase activation, and that this activation is essential for its transformative activity. This information has subsequently been employed for the identification of a specific tyrosine kinase inhibitor (Gleevec/Imatinib) that acts as an effective and now well-established treatment for this and other, related, diseases. Since then, several novel targeted agents have been developed, tested and approved for pre-clinical and clinical testing). Research within this theme is designed to integrate state-of-the-art genetic and genomic information, tumour imaging and phenotyping including invasive and metastatic properties, with novel targeted treatment options.
such as epigenetic, metabolic and immunologic (vaccine-based) approaches, up to the level of (pre) clinical trials. Research within this theme closely interacts with that done within the other RUCO themes.

Subthemes:
- Genomics and epidemiology
- Diagnosis and staging
- Pre-clinical testing
- Targeted therapies
- Clinical implementation.

Quality of care
Health care aspects include Quality-of-Life, cost effectiveness, clinical decision making and implementation-related issues which are largely covered by the NCEBP. In this theme the new knowledge and tools that are being derived from this type of research are used to improve care for cancer patients.

Subthemes:
- Behavioural medicine
- Decision making
- Quality of care

Aetiology, screening and detection
This theme includes all research on genetic and lifestyle causes for the non-Mendelian forms of cancer and the role of such factors in prognosis. A second focus is on the efficacy and effectiveness of policies for cancer screening (general population) and routine follow-up (clinical population).

Subthemes:
- The development, early evaluation and diagnostic and prognostic efficacy of biomarkers in everyday clinical practice
- The development, evaluation and diagnostic and prognostic efficacy of imaging techniques in everyday clinical practice
- Aetiology.

Research facilities
In addition, the Institute supports technological and other platforms which are crucial to its research and which generally also serve other research institutes, such as the microscopy centre, functional imaging, medical technology assessment, genomics and proteomics, bioinformatics and biostatistics.

The following multi-institutional platforms are supported:
- Imaging
- High-throughput genomics
- Proteomics
- Unit for clinical application of new drugs
- Unit for psychosocial research tools
- Biostatistics
- Microscopy centre
- Central Animal Facility
- Bio-informatics
- Centre for minimal invasive treatment (Mitec).

Collaboration
Scientists at the Institute are actively involved in a range of national and international research networks, participating in the following organizations:
with an inhibitor of blood vessel formation had a negative result. Showing that adding an inhibitor of growth factors to treatment was wrong. A large national study coordinated by Prof. Kees Punt – pharmaceuticals that are each effective against colorectal cancer – Clinical research led to a series of important findings in 2009. Research results

Dr. Roland Kuiper received a Vidi grant for a research project entitled ‘Heritable epimutations: a new paradigm in colorectal cancer predisposition’ and Dr Katarina Wolf received a Vidi grant for her project ‘Re-visiting proteases in cancer’. Dr. Tom Scheenen received a ERC starting grant for his research project ‘Exploring the aggressiveness of prostate cancer to enable an individualized treatment approach’. Prof. Nicoline Hoogerbrugge and Dr Rosella Hermens received a KWF grant for a project entitled ‘Implementation of guidelines on hereditary or familial colorectal cancer risk calculation and risk communication’. Prof. Wim Oyen received a ZonMw Agiko clinical research grant on behalf of Dennis Vriend for the project ‘Tailoring Cancer Therapy by Imaging of Glucose Metabolism’. In addition, grants were received from the KiKa foundation, the Quality of Life Foundation, and Pink Ribbon. Furthermore, many studies are carried out with funding from and/or in collaboration with industrial companies.

Awards and acknowledgements

The Institute is very successful in acquiring competitive research funds from the Dutch Cancer Society (KWF) and the Netherlands Organisation for Scientific Research (NWO). Projects funded by KWF and NWO are carried out within all themes. A few examples:

- Dr Roland Kuiper received a Vidi grant for a research project entitled ‘Heritable epimutations: a new paradigm in colorectal cancer predisposition’ and Dr Katarina Wolf received a Vidi grant for her project ‘Re-visiting proteases in cancer’.
- Dr. Tom Scheenen received a ERC starting grant for his research project ‘Exploring the aggressiveness of prostate cancer to enable an individualized treatment approach’.
- Prof. Nicoline Hoogerbrugge and Dr Rosella Hermens received a KWF grant for a project entitled ‘Implementation of guidelines on hereditary or familial colorectal cancer risk calculation and risk communication’.
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- In addition, grants were received from the KiKa foundation, the Quality of Life Foundation, and Pink Ribbon. Furthermore, many studies are carried out with funding from and/or in collaboration with industrial companies.

Research results

Clinical research led to a series of important findings in 2009. The idea that a treatment with several new drugs at the same time – pharmaceuticals that are each effective against colorectal cancer – was wrong. A large national study coordinated by Prof. Kees Punt showed that adding an inhibitor of growth factors to treatment with an inhibitor of blood vessel formation had a negative result. Dr Peter Bult, pathologist, showed that the search for isolated tumour cells in lymph nodes is relevant to women with breast cancer. A European group around Prof. Theo de Witte reported an improved treatment of acute myeloid leukaemia.

Early detection of cancer is increasingly important. Dr Bert Siebers showed that a patient friendly way of taking and processing smears of the cervix is reliable. Research on the genetic characteristics of cancer is an important field. Dr Marjolijn Ligtberg discovered an entirely new mechanism that is responsible for a hereditary form of colorectal cancer. The group led by Dr Joop Jansen proved that the tumour cells of patients with myelodysplastic syndrome have TET2 gene mutations. Professor Bart Kiemeney linked genetic changes in the germ line to an increased risk for prostate cancer and basal cell carcinoma.

Societal impact

Cancer – a major health problem in developed countries – has an enormous physical and mental impact on patients and their families. Improving prevention, diagnosis and therapy as well as psycho-social assistance are important for the wellbeing of society as a whole. Researchers at the Institute are members of various national and international advisory boards.

Future research

The research focus on hereditary cancer involves all aspects of hereditary cancer but in selected diseases: renal cancer and breast cancer and colorectal cancer – research on cancer in children will focus on detecting pathways of leukemogenesis in ALL (acute lymphoblastic leukaemia) that may be targets for novel treatment approaches; detecting variants in genes relevant for (cytostatic) drug metabolism – affecting the outcome and toxicity of conventional chemotherapy – and optimising immunotherapy in children with cancer.

Areas of research in AYA include genetics, epidemiology, pharmacokinetics, predictive factors, late effects of treatment psychosocial and quality-of-life issues. In translational research researchers strive to create new insights into:

- cancer-related target genes and pathways
- associations between genetic variants and cancer susceptibility, prognosis and therapy response
- diagnosis through molecular analyses, including possibilities for personalized therapy
- the efficacy of functional imaging in relation to diagnosis, prognosis and therapy
- the mechanisms underlying invasion and metastasis
- novel molecular markers for imaging
- the efficacy of novel metabolic and epigenetic drugs for therapy and novel vaccine-based therapeutic strategies.


In quality of care, researchers will follow patients from the beginning of cancer care in order to link physician-reported outcomes to patient-reported outcomes and quality indicators. Then it will be possible to identify relevant factors affecting behaviour and care and to identify their influence on illness and survival.

In screening detection and aetiology researchers strive to collect new evidence on:

- The efficacy and effectiveness of
  - diagnostic and prognostic biomarkers for cancer
  - diagnostic and prognostic imaging modalities for cancer
  - cancer screening in the general population
  - routine follow-up policies for cancer patients
- Constitutional and lifestyle/environmental risk factors affecting cancer
The Nijmegen Institute for Infection, Inflammation and Immunity (N4i) brings together strong research groups that focus on infectious diseases, inflammation and immunity – areas that are intimately connected. N4i’s ambition is to achieve national and international leadership in research in these areas. This research, which is inspired by observations at the bedside, is designed to improve the diagnosis, treatment and prognosis of patients with infection, inflammatory and immunological disorders.

The Institute’s research is structured within five overarching themes that link Infection, Inflammation and Immunity.

1. The pathogenesis of the inflammatory response
Although infectious agents are the prime causes for inflammation, any tissue damage will evoke an inflammatory response. Research within this theme will yield new insights into the pathogenesis of many diseases. Issues that are addressed include:
• the recognition of pathogens by the host
• inflammasome activation and cytokine responses
• the mediator response in sepsis and other serious bacterial and viral infections
• mechanisms of tissue damage
• the inflammatory response in chronic obstructive pulmonary disease (COPD) and its effect on muscle weakness
• developing highly sensitive and specific molecular imaging tools in infection and non-infectious inflammation.

2. Invasive mycoses and compromised host
Within this theme invasive fungal infections are studied in relation to sophisticated medical treatments given to immunocompromised and frail patients. Research focuses on understanding host defence mechanisms, in particular:
• Fungal recognition, host defence mechanisms, and immunogenetics in the pathophysiology of invasive mycoses
• Signal transduction, the interaction between innate and specific immunity, and the role of host cell receptors (e.g. Toll-like receptors)
• Mucosal barrier injury and the pathogenesis of invasive infection
• Developing immunotherapeutic options for treating invasive mycoses
• Epidemiology and management of invasive fungal infections in Europe
• Advanced diagnostics of invasive mycoses, including antigen detection, molecular diagnostics and imaging.
3. Poverty-related infectious diseases
In developing countries infectious diseases are still a major cause of mortality. Poverty is a pivotal factor for vulnerability to infections such as tuberculosis, HIV and malaria. Within this theme the following topics are addressed:
- the pathogenesis of malaria and developing vaccines for malaria
- innate host defence against Mycobacterium tuberculosis and the role of mycobacterial genotypes
- optimal diagnosis and treatment of tuberculosis (TB), with a focus on complicated TB
- evidence-based prevention and treatment of HIV/AIDS in the context of intravenous drug use
- optimal anti-HIV and anti-TB treatment in resource-poor settings and in children

4. Mechanisms and modulation of inflammation and infection
Research on the inflammatory response is designed to arrive at new insights into the pathogenesis of infectious diseases and non-infectious inflammatory disorders. Within this theme investigations focus on:
- immunotherapy for systemic fungal infections
- new immunostimulatory drug treatments
- vaccines for pneumococci and Plasmodium falciparum
- the therapeutic effects of TLR-4 antagonism
- therapies designed to preserve mucosal integrity after aggressive chemotherapy
- the severity of psoriatic phenotypes and response to treatment
- outcome parameters for assessing inflammation and response to treatment
5. Auto-immunity and transplantation biology
Research on auto-immunity focuses on initiating the immune response, damage to various tissues and optimising treatment. To achieve this, the following topics are studied:
- the phenotypes of auto-immune diseases of the skin
- the course of chronic inflammatory rheumatic diseases and response to treatment
- the initiation of the autoimmune response, the mechanisms of tissue damage, and optimal treatment strategies in Systemic Lupus Erythematosus (SLE)
- the development of biomarkers to monitor immune status and immunosuppressive treatment efficacy
- immunological tolerance after transplantation and transfusion, as well as in relation to infection and autoimmunity
- use of dendritic cells, regulatory T cells and NK cells for auto-immune diseases and transplant-related immunotherapy.

Research facilities
N4i is a centre of excellence for clinical translational research that combines research at the bedside with that at the bench – and vice versa. The core components of the Institute are clinical departments (General Internal Medicine, Paediatrics, Nephrology, Dermatology, Rheumatology, Haematology, Pulmonary diseases, Intensive Care Medicine and Nuclear Medicine) and dedicated research laboratories (those directly connected to the clinical departments as well as the laboratories Medical Microbiology, Clinical Pharmacy, Blood Transfusion and Transplantation Immunology and Tumour Immunology). The Institute makes use of the facilities of the Radboud University Nijmegen Medical Centre, i.e. the Animal Laboratory (CDL), the Microscopic Imaging Centre (light microscopy, electron microscopy, digital imaging, atomic force microscopy, flow cytometry, FRET and FRAP as well as in-vivo NMR facilities for animals and humans (7 Tesla), the Micro-array Facility Nijmegen, the Nijmegen Proteomics Facility (2D electrophoresis, SELDI-TOF, MALDI-TOF, MALDI-LTQ and nano-LC LTQ-FT MS, the Centre for Molecular and Biomolecular Informatics, the Clinical Research Centre Nijmegen and the GMP facility.

Collaboration
The research at N4i takes place within international and national research networks that focus on infection, inflammation and immunity. Apart from collaborations with outstanding laboratories in the western world, research at N4i also has fruitful partnerships with institutes in developing countries, in particular in Tanzania (KCMC, Moshi) and Indonesia (Eijkman Institute, the Universities of Indonesia and Bandung).

Between November 2009 and May 2010 Charles Dinarello, Professor of Infectious Diseases at the University of Colorado, Denver, was appointed KNAW visiting professor at N4i. He is a world leader in cytokine research, especially interleukin-1, interleukin-18 and interleukin 32, IL-1F7 and anti-cytokine strategies in inflammatory disorders.

International research partners include:
- University of Colorado, USA
- University of Aberdeen, UK
- University of Barcelona, Spain
A major discovery was the finding of a deficiency of the dectin-1 receptor in patients with recurrent fungal infections of the skin, nails and vagina. Dectin-1 recognizes beta-glucan, one of the sugars on the surface of the fungus Candida albicans. This finding not only provides insight in why these nasty infections may arise, but also opens up new approaches to treatment (Ferwerda et al NEJM).

Recent studies have demonstrated that a protein platform called the inflammasome is crucial for activating the proinflammatory cytokine interleukin-1beta (IL-1beta). In turn, IL-1beta – one of the main mediators of inflammation – and plays a central role in autoinflammatory diseases such as familial Mediterranean fever, hyper IgD syndrome, gout and type 2 diabetes. Netea and others achieved an important breakthrough in understanding the function of the inflammasome, by describing separate inflammasome activation pathways in different cell populations. This opens the door for the design of tailored therapies for various diseases in which IL-1beta plays an important role.

In a large collaboration study Prof. Schalkwijk and others found a link between the deletion of late cornified envelope (LCE) genes LCE3B/C and psoriasis in populations from Spain, Italy, the Netherlands and the USA. These findings suggest that this deletion compromises the repair of disruption of the skin, which in turn might lead to penetration of environmental stimuli through the skin. In the Dutch cohort an interaction between the deletion with HLA-Cw6, a major psoriasis risk factor, was found. Collectively these genetic variations could explain the inflammatory response in psoriasis.

An important advance was made in malaria research. Prof. Sauerwein’s group demonstrated that protection against malaria can be achieved in human volunteers that were immunized by bites of a low number of malaria infected mosquitoes whilst taking chloroquine prophylaxis.

**Societal impact**

Infectious diseases are the main reason for morbidity and mortality around the world and the focus of many aspects of the programme, such as poverty-related infection. Inflammation and immunity not only underlie infectious diseases but also play a major role in other diseases that are studied within the framework of N4i. Researchers are actively involved in national and international organizations such as the KNAW, the Young Academy of KNAW, Academia Europaea, European Academic Scientific Advisory Council (EASAC), Health Council of the Netherlands, the Centre for Infectious Disease Control (Cib at RIVM), ZonMw committees, European and Developing Countries Clinical Trial Partnership, Dutch Working Party on Antibiotic Policy (SWAB), ESCMID, the Dutch Working Party on SLE and several other professional societies.
Key publications


Dissertations: 26
Scientific publications: 474
Patents: 1
Future research

By bringing together researchers to work on infection, inflammation and immunity, the critical mass for research in these fields increased considerably in 2009. N4i provides a platform for cross-fertilization in multidisciplinary research.

Areas for collaborative research in future are:

- The role of pattern recognition and inflammasome activation in infection and inflammation disorders
- Natural immunity to infection in the evolution of mankind
- Resistance to antifungal drugs and its implications for clinical medicine
- Exploring the pathophysiology of major pathogens (pneumococci, staphylococci, malaria parasites and others) and developing vaccines
- Modulating inflammatory and immunological responses using humoral and cellular tools (e.g. regulatory T cells)
- Exploring the role of epithelial barriers in disease (e.g. psoriasis and atopic mucosal damage)
- Exploring the correlates of protection in poverty-related infections
- The role of apoptosis-induced auto-antigen modifications on the initiation of autoimmunity.
Every discovery in medical science should ultimately be applied in clinical practice. How such a discovery finds a way into clinical practice, however, is a science in itself. And that is exactly the field of research the NCEBP specializes in. Three questions are central to this research: Are the findings resulting from laboratory research or laboratory animal research also applicable to human patients? Does applying them lead to a reduction in sickness or mortality? And if so, how do you introduce them as a structural part of the daily activities of medics, allied healthcare workers and nurses? These are the questions that are being asked in the fight against serious diseases such as cancer, chronic pulmonary disease, cardiovascular disease and dementia.

The NCEBP conducts research that is designed to help individual patients and patient populations, and in a preventative sense also healthy populations. The NCEBP is often involved in the development and evaluation of guidelines and protocols, both nationally and internationally. But the NCEBP is also involved in a broader sense, in all manner of policy issues relating to healthcare, thus bridging the gap between science and society.

**Molecular epidemiology (Prof. Bart Kiemeney)**

Epidemiology is usually understood to involve studying lifestyle as a risk factor for disease, but the scope of the discipline is actually much broader. In the theme ‘Molecular epidemiology’, the main focus is on identifying molecular/metabolic and genetic determinants for disease and disease outcome. Most of the research targets various types of cancer, but other multifactorial diseases, e.g. autoimmune diseases and iron metabolism disorders, are studied where there are overlapping specific mechanistic pathways (e.g. the 1-carbon metabolism) or overlapping research methodologies (e.g. whole genome genetic association analyses). Aetiological issues are covered, but also issues related to diagnostic, prognostic and intervention research.

**Evaluation of complex medical interventions (Prof. Gert Jan van der Wilt)**

Healthcare interventions may be complex in various ways. They may be technically complex, demanding considerable delivery skills. They may comprise multiple components (including contextual factors), each contributing critically to achieving the desired end-point. Finally, they may be complex in terms of their effects, which can be multiple and varied, difficult to measure, and differentially distributed over time. These types of complexity pose considerable challenges to the valid evaluation of healthcare interventions.
Within this theme methodologies are developed and tested that are appropriate when evaluating complex interventions.

**Implementation science (Dr Michel Wensing)**
This theme focuses on improving healthcare practice, with a specific focus on primary care. It includes developing and evaluating performance indicators, interventions to achieve sustainable change, and the factors associated with changes in performance. Research fields include the education of health professionals, pharmaceutical patient care, out-of-hours care, structured chronic care and patient safety.

**Quality of hospital and integrated care (Dr Hub Wollersheim)**
Research within this theme is designed to measure and improve the quality and safety of patient care in hospitals, home care and nursing homes. In addition, handovers between these three settings or handovers with general practice are studied. Research covers clinical patient care across a wide range of diseases. It involves developing and evaluating quality indicators and effective implementation strategies, including integrated care systems.

**Healthcare ethics (Prof. Evert van Leeuwen)**
Healthcare ethics involves studying the ethical aspects of change processes. On a philosophical level, a conceptual analysis is made of theories and concepts that underlie the processes of change. Together these studies make it possible to evaluate existing care in the light of changing norms and values, and they contribute to improving decision-making and the quality of care.

**Quality of nursing and allied healthcare (Prof. Theo van Achterberg)**
Research on nursing and allied healthcare sciences is a relatively young field. Challenges include searching for scientific evidence
The ’Radboud Fall Simulator’ is used by Prof. Sander Geurts for his research on sensorimotor problems and fatigue. Prof. Geurts specializes in physical rehabilitation.

Effective primary care and public health (Prof. Chris van Weel)
This research theme was established to support healthcare in the primary care population. The main challenges are promoting and preserving the health and functioning of ageing populations. Healthcare must be provided for all patient groups in the community (regardless of health problems, gender, and age or social class) while combining a variety of approaches: health promotion, disease prevention, diagnosing and treating diseases, rehabilitation, supporting patients and palliative care.

Psychological determinants of chronic illness (Dr Andrea Evers)
The focus of research here is on improving diagnostics and the treatment of patients with chronic somatic illnesses, in particular with regard to the psychological determinants and consequences of somatic conditions. There are two linked sections: ’Psychological factors in chronic somatic illnesses’ and ’Cognitive dysfunction’. Both focus on the psychological and neuro-psychological risk factors, consequences, diagnostics and treatments of these conditions in adults and children, finally contributing to improving the quality of care for those suffering from these conditions.

Mental health (Prof. Anne Speckens)
The aim of this research is to study the determinants, prevalence, prognostic significance and treatment of mental health problems from a patient-centred perspective. The theme focuses in particular on mood disorders, somatoform disorders, partner violence, Attention Deficit/Hyperactivity Disorder (ADHD) and Autistic Spectrum Disorders (ASD). Many projects involve a developmental perspective and the study of the precursors, longitudinal course, and age-related manifestations of these disorders. In addition, the implementation, effectiveness and cost-effectiveness of innovative therapeutic interventions are studied.

Sensorimotor problems and fatigue (Prof. Sander Geurts)
Many neurological, orthopaedic and oncological diseases affect movement ability and physical fitness and may cause excessive fatigue. Through analyzing motor control and physical activity as well as their interaction with cognitive and emotional characteristics, this research is designed to disentangle the generic determinants from disease-specific determinants of movement disability, reduced physical fitness and fatigue. Both mechanistic and clinical research questions are addressed. In this way, functional assessment and rehabilitation strategies can be improved for many conditions, resulting in a better perception of health and quality of life.

Nijmegen Alzheimer Centre (Prof. Myrro Vernooij-Dassen)
The Nijmegen Alzheimer Centre (NAC) focuses on developing and evaluating support programmes in order to directly improve the quality of care and quality of life for people with dementia, as well as for their families. Efficiency studies of these programmes are carried out to contribute to high-quality care at an affordable price. In addition, NAC contributes to fundamental knowledge on Alzheimer’s disease.

Human reproduction (Prof. Jan Kremer)
Human reproduction is a research topic that is booming, due to the increase in demand, growing awareness of prevention, diagnostic and therapeutic possibilities, and available evidence. Patients and society keep track of these developments and have relevant questions about the aetiology and prevention of reproductive and develop-
mental disorders, as well as about the safety, effectiveness, and patient-centeredness of reproductive and obstetric care. This research theme is designed to provide answers to these questions.

Infectious diseases and international health (Dr André van der Ven)
The main goal within this theme is to improve health in both low and high income countries by developing an evidence base for decision-making. The research activities are integrated, combining clinical, public health and economic disciplines whereby basic research in the Netherlands is often combined with translational research, including working in other countries. Research activities focus on 1) poverty-related diseases, 2) public health and health systems in developing countries, and 3) general infectious diseases, while at the same time building capacity designed to establish centres of excellence in certain low-income countries.

Cardiovascular diseases (Dr Gerard Rongen)
The main aim within this theme to achieve greater understanding of the pathogenesis of cardiovascular disease in order to improve evidence-based cardiovascular healthcare and to train young talented investigators in cardiovascular research. The focus is on the mechanisms and consequences of vascular injury. This theme covers the first two steps of translating fundamental research into clinical practice. This involves human in vivo proof-of-concept studies and studies from concept to evidence-based medicine. The genetic and metabolic causes of atherosclerosis and thrombosis – and of their risk factors – are investigated. Regulation of vascular tone in health and disease is an important research topic.

Awards and acknowledgements
• The EPA project received the 2009 award of the European Health Forum Bad Gastein.
• Dr Maud Graff received the NCEBP award 2009, the Catharina Pijls award 2009 and the Astrid Kinebanian ergotherapy award 2009 for best dissertation.
• Dr Jaco Burgers received the Harkness fellowship.
• Dr Martin Munneke and Prof. Bas Bloem received a ZonMw Pearl for the ParkinsonNet project.
• Dr Monique van Eijken received the Anna Reynvaan prize (AMC) for best scientific publication in the field of nursing sciences.
• Prof. Ria Nijhuis-van der Sanden and her research team received the Dutch Open Health 2.0 Challenge Award for the research project ‘Choose to Move’.
• Prof. Jan Kremer received the Freya award 2009 for the most patient-centred IVF centre.
• Richard Lopata, MSc, received the Student Paper Award ITEC 2009 and the Student Award BME 2009.
• Mark van Geffen, MSc, received the Young Investigators Award, ISTH 2009 Boston for best oral presentation.
• Prof. Richard Grol received the Radboud bronze award (Radboudpenning in brons) for his life-time achievements at the University.

Research facilities
Within the NCEBP, databases, ICT networks, registries and clinical research facilities are of the utmost importance because of its research focus on clinical and population studies. Important examples of these facilities are listed below.
• Academic networks of general practitioner sites, nursing homes, municipality health services and dental care sites. Registries relate in particular to COPD and asthma, cancer, Parkinson’s disease, Prader Willi Syndrome and patients with neuromuscular diseases.
• Innovative ICT applications designs to improve patient care in Parkinson’s disease, people with psychological disorders and intravital fertilisation.
• Databases and biobanks of general population samples (The Nijmegen Biomedical Study), or of specific patient groups, e.g. congenital malformations, cancer and poverty-related infections in Indonesia and Tanzania, or of patients with macular degeneration in close collaboration with University of Cologne, Germany (EUGENDA).
• The NCEBP has access to a clinical research centre comprising a wide variety of human in vivo models including the multidirectional balance perturbation platform the ‘Radboud Falls Simulator’, which is used to study human postural control at the limits of stability. This platform is unique worldwide.

Collaboration
• In close collaboration with the University of Twente, the Radboud University Nijmegen Medical Centre has initiated the Minimal Invasive Technology expert Centre (MITeC). In particular, evaluating innovations (evidence-based medicine trials, health technology assessment) within this MITeC will be part of the NCEBP.
• Radboud University Nijmegen Medical Centre takes part in a national biobank initiative from the Dutch Federation of University Medical Centres (NFU). The purpose of this ‘String of Pearls Initiative’ (PSI) is to create a research infrastructure for future studies on genetic and other determinants, diagnosis and the prognosis of eight selected diseases.
• Within the fields of primary care and public health, the NCEBP intensively collaborates with the Ministry of Health, Welfare and Sport, the National Institute for Public Health and the Environment (RIVM), and the National Health Services Research Centre (NIVEL).
• International: The NCEBP also collaborates with research centres outside the Netherlands, in particular with University centres all over the world (in particular the IRUN partner: the University of Münster), but also with the European Union/ECDC, the World Health Organization, UNESCO, the Center on Birth Defects and Developmental Disabilities and foreign Centres for Disease Control and Prevention.
Evidence-Based Practice

1(5), 329-37. Annals of Internal Medicine, 15

abnormality in primary aldosteronism. Differentiate unilateral from bilateral adrenal

Systematic review: diagnostic procedures to


Dissertations: 62
Scientific publications: 1046
Patents: 1

Nijmegen Centre for Evidence-Based Practice

Key publications


Dissertations: 62
Scientific publications: 1046
Patents: 1
Within the field of cardiovascular diseases the NCEBP has finished several human in vivo studies on the mechanism of action of statin therapy, on the renin-angiotensin-aldosterone system, and on ischemia-reperfusion injury.

Societal impact
NCEBP researchers have made a significant contribution to national and international guidelines and reports of societal or scientific institutes or committees, such as the international Commonwealth, the RIVM, the Ministry of Public Health, Welfare and Sport, the Netherlands Organisation for Health Research and Development, the HARM-Wrestling Expert Group, the European Academy of Nursing Science, the WONCA, the National Expert Committee on Perinatal Mortality, the National Committee for the Modernization of Obstetric Care Indication list, the ARBO services International Society for Postural and Gait Research and the Dutch Society for Neurorehabilitation.

Future research
The Vidi grants that were awarded in 2009 to NCEBP researchers provide an important basis for future research:

- Within the field of cardiovascular diseases the NCEBP has finished several human in vivo studies on the mechanism of action of statin therapy, on the renin-angiotensin-aldosterone system, and on ischemia-reperfusion injury.

Societal impact
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Future research
The Vidi grants that were awarded in 2009 to NCEBP researchers provide an important basis for future research:

- The role of expectancies (placebo effects) in the immune and endocrine systems and for the outcome of medical treatments (Dr Andrea Evers).
- The co-evolution of host and bacterial genotypes in tuberculosis in Indonesia (Dr Reinout van Crevel).

Apart from these topics, prominent research areas over the next few years will be prevention, patient centricity, e-health, implementation science, patient and hospital safety, disease management, innovation in care, caries in dental care and pharmacogenetics.
The Nijmegen Centre for Molecular Life Sciences (NCMLS) seeks to achieve greater insight into the complexity of living cells in order to obtain comprehensive knowledge of both normal and pathological processes. NCMLS pursues its goals in the interests of curiosity-driven research and education. The NCMLS aims to advance innovation in translational research, based on integrating diverse areas of scientific expertise within the molecular and medical sciences.

The NCMLS is a leading multidisciplinary research school that is accredited by the Royal Netherlands Academy of Arts and Sciences (KNAW) and operates within the domain of molecular mechanisms of disease and particularly in the fields of molecular medicine, cell biology and translational research. The NCMLS accommodates research groups from both the Radboud University Nijmegen Medical Centre and the Faculty of Science. Research takes place within three main themes, in keeping with the Centre’s mission to move towards ‘understanding the cellular basis of disease.’ These are: (1) Infection, immunity & tissue regeneration; (2) Metabolism, transport & motion; and (3) Cell growth & differentiation.

**Theme 1: Infection, immunity and tissue repair (Prof. G. Adema)**

Infection and autoimmunity (Prof. J. Schalkwijk), Immune regulation (Prof. G. Adema), and Tissue engineering and pathology (Dr A. van Kuppevelt)

The immune system has the dual task of eliminating pathogens and eradicating incipient tumours, while preventing auto-reactive responses harmful to the host. In maintaining this balance, there is a complex interplay between immune and tissue cells and many stimulatory and inhibitory circuits that operate simultaneously. Outcomes are further shaped by genetic and environmental factors. Deregulation of this intricate balance is associated with human diseases ranging from inflammatory and autoimmune disorders to cancer, infection and transplantation disorders. In each case, prolonged deregulation can initiate a cascade of events, ultimately leading to tissue damage and destruction. The aim of tissue engineering research is to repair or replace damaged tissues by implanting ‘smart’ synthetic bio-matrices or stem cells. Immune control is intrinsically involved both in tissue acceptance and in preventing autoimmune attacks on engineered tissues.

A multidisciplinary approach is taken to defining the molecular basis of immune regulatory circuits, events that trigger or fuel immune-related disorders and infectious diseases, and tissue pathology and regeneration as well as stem cell behaviour and differentiation.
We therefore consider it not surprising that there are close links at many levels between the different Theme 2 topics. Metabolites such as ATP and NAD(P)(H) produced in key pathways such as glycolysis and mitochondrial respiration are consumed as fuel or needed as co-factors for ion-transport ATPases, drug-transporters and the acto-myosin motor and sliding machinery involved in organelle dynamics and cell movements. Forms of renal disease, cardiomyopathy, and brain and muscle disorders are caused by defects in the production or assembly of ATPases, water channels, or the mitochondrial OXPHOS machinery. Often defects in metabolic signalling are also involved. Defects in the structure and/or functioning of cilia (hair-like protrusions on epithelial cells with signalling abilities) have recently been identified as important causes of renal disease, often in combination with blindness, deafness and brain disorders and these are also important topics within Theme 2.
The fate of all cells lies in the fine balance between growth and differentiation. If this balance is disturbed, uncontrolled growth and deregulated cellular development can lead to disease. Studying the processes that underlie growth and differentiation is pivotal to a basic understanding of the causes of many diseases and malfunctions.

Multi-level analysis is used to study the blueprint of all cellular decisions and a functional genomics approach is pursued that ranges from deciphering the genome in terms of actively transcribed genes under defined cellular circumstances (such as normal differentiation versus unregulated proliferation) to specific disease-linked genomic studies. Since the single cell cannot be viewed in isolation from its cellular surroundings, decisions within the cell need to be linked to external cues and constraints, and the translation of this approach within cells is at the core of research on signalling networks. In order to understand the molecules that convey the information packaged in the functional genomic blueprint as well as the signals from the cellular outside world, it is also necessary to gain a better understanding of the protein structure and design of these molecules that finally convey the growth and differentiation decisions. Valuable insights can be gained from investigating a specific differentiation programme and neural development is studied as a special case.

Awards and prizes

- Rene Bindels (Department of Physiology) received the Radboud Award for his individual merits as an excellent researcher, his contributions to education and his broad commitment to the UMC. In 2009, Prof. Bindels won three prestigious international awards in Physiology, an unprecedented achievement.
- Carl W. Gottschalk Distinguished Lecturer of the American Physiological Society Renal Section for 2009.
- Robert Franklin Pitts Lecturer 2009 from the International Union of Physiological Sciences (IUPS).
- Homer W. Smith award from the American Society of Nephrology
- Jos van der Meer (Department of General Internal Medicine) was elected to the Academy of Europe.
- Joost Hoenderop (Department of Physiology) was elected Young Academy member of KNAW.
- Roos Masereeuw (Department of Pharmacology & Toxicology) was awarded the DPS Schering-Plough Pharmacology Prize.
- John Jansen was named as Honorary Professor at Sichuan University, China.
- Joost Drenth (Department of Gastroenterology) was elected Deputy Editor of the Dutch Journal of Medicine.
- Jenny van der Wijst (Department of Physiology), Maaike van den Heuvel (Biorganic Chemistry) and Lilyanne Grevers (Department of Rheumatology) each won the Frye Stipendium.
- Alessandra Cambi (Department of Tumour Immunology) received a MEERVOUD subsidy for her project, which was entitled 'Prostaglandin receptors EP2 and EP4: nano-scale membrane organization, dynamics and cross-talk.'
**Research facilities**

These are grouped in the following categories:

**Animal models**

Medical research is ultimately about whether or not results can be applied effectively in humans. Animal models are therefore of great importance to molecular life scientists engaged in biomedical research. The NCMLS has excellent links to the Central Animal Facility (CDL), which provides expert advice and access to facilities for animal testing and has several disease-related models available, for example for arthritis, cancer, kidney disease, tissue engineering, heart transplantation, neural disorders, metabolic disorders, osteoporosis, haematopoiesis, fungal and bacterial septicaemia, and malaria (*P. falciparum*).

**Molecular imaging**

Imaging at the sub-cellular and cellular level is an essential tool for molecular life scientists. The Microscopic Imaging Centre (MIC) at the NCMLS is a state-of-the-art facility for imaging biological specimens that uses light microscopy (bright-field, confocal and fluorescence), conventional scanning and transmission electron microscopy, and sophisticated digital imaging. The facility offers access to other techniques such as Atomic Force Microscopy Flow cytometry, FRET and FRAP. Access to magnetic resonance facilities for in vivo NMR and MRI of animals and humans (7 Tesla) are also available.

**Translational research (cellular therapy)**

A GMP facility with clean rooms is available for innovative translational research projects. Current projects include immunotherapeutic cell therapy, stem cell transplantation and gene therapy. In 1997 the Departments of Tumour Immunology, Medical Oncology and Haematology collectively started applying dendritic cell-based anti-cancer vaccines in melanoma patients. To date, more than 250 patients have been treated with this experimental form of therapy.

**Genomics**

DNA sequencing and micro-array technology for gene expression profiling are fast becoming standard laboratory tools. The Microarray Facility in Nijmegen is one of the core facilities of the Radboud University Medical Centre. The department also harbours a sequencing facility and a genotyping facility. The Facility focuses on multiple applications such as expression profiling, genomic copy number profiling (array CGH) and high-density SNP profiling.

**Proteomics**

The growing availability of genomic sequence information, together with improvements in protein characterization by mass spectrometry, has had an enormous impact on protein research. To exploit these opportunities the Nijmegen Proteomics Facility (NPF) was established in 2004. This state-of-the-art facility offers fundamental technological tools in proteomics research and makes them available for academic and industrial researchers, both within and outside the Radboud University Medical Centre. Available equipment includes 2D-electrophoresis, SELDI-TOF and mass spectrometry (MALDI-TOF, MALDI-FT and nano-LC FT MS).

**Bioinformatics**

The Centre for Molecular and Biomolecular Informatics (CMBI), which is the Dutch National Centre for Computational Molecular Sciences, is housed on the ground floor of the NCMLS research tower. The institute pursues a rigorous research programme, with topics ranging from computational small-molecule chemistry to bioinformatics. The Centre’s facilities, databases and software packages are available to external scientists and there is a help desk for those who use the service facility. Currently, the CMBI is primarily involved in bioinformatics research and in maintaining a data and software infrastructure to help scientists improve bioinformatics and/or computational small-molecule research.

**Collaboration**

NCMLS researchers collaborate at the local, national and international level. The research school is allied with the Institute for Molecules and Materials (IMM) and the Donders Institute for Brain, Cognition and Behaviour (DI-BCB), providing a solid platform for integrating chemical synthesis, nanoscience and neuroscience with molecular life sciences. Furthermore, incorporating the Centre for Molecular and Biomolecular Informatics (CMBI) within the NCMLS...
Key publications


Selected research results

- The BioMedical Materials programme (BMM) approved a joint proposal to develop a biological kidney support device (BioKid). Project leaders, Bert van den Heuvel (Paediatrics), Joost Hoenderop (Physiology) and Roos Masereeuw (Pharmacology and Toxicology), will collaborate with academic partners from UMC Groningen, the Technical Universities of Eindhoven and Twente, the Dutch Kidney Foundation, and with the companies PharmaCell and SupraPolix.

- The BMM programme approved a joint proposal to develop a system for totally replacing the meniscus with an implant. In this project researchers will develop a biostable meniscus implant to functionally restore damaged meniscus. Project leader, Pieter Buma (Orthopaedics) will collaborate with academic partners from UMC Groningen and the Technical University in Eindhoven and with the companies Baat Medical Engineering, Biomet and DSM.

- The BMM programme approved a joint proposal (BONE-IP) to develop bone implants (i.e. bone substitutes and bone implant coatings) with improved biological capacity: the materials thus developed should actively promote the formation of bone tissue. Project leaders, John Jansen (Dentistry) and Jeroen van den Beucken will cooperate with all major players in the Dutch R&D landscape and companies involved in the commercialization of bone implants, i.e. UMC Utrecht, Erasmus MC, UTwente, Xpand, Biocomp, CAM, EMCM/aap, Solmates and FT Innovations.

- Joost Hoenderop and René Bindels received a TOP grant from ZonMW to study new magnesiotropic genes in health and disease.
Nijmegen Centre for Molecular Life Sciences

• Patrick Zeeuwen of the Department of Dermatology was awarded a Horizon Breakthrough grant from the NGI for his project, which was entitled ‘A new concept for the pathogenesis of psoriasis: Lessons from genetics and functional genomics.’
• Johan van der Vlag (Nephrology Research Laboratory) obtained a grant from the Dutch Kidney Foundation to continue his studies on the molecular mechanisms leading to proteinuria.
• Luuk Hilbrands (Nephrology) and Irma Joosten (Medical Immunology) obtained a grant from the Dutch Kidney Foundation to continue their studies on the effect of immunosuppressive drugs on the alloreponse after organ transplantation.
• Dr Peter van der Kraan (Rheumatology) has received a TOP grant for his project, which was entitled ‘Age-related changes in TGF-beta signalling as a cause for osteoarthritis’.
• Dr Harry Dolstra (Department of Laboratory Medicine) was awarded a ZonMW grant for his work in the Translational Adult Stem cell (TAS) research programme.

Societal impact
NCMLS plays an important role in improving our understanding of the molecular mechanisms of disease. Various members and affiliated members of the NCMLS are funded by national and international patient-oriented non-profit organizations, such as the Kidney Foundation, Dutch Cancer Society, the Diabetic Foundation, and the Rheumatoid Arthritis Foundation. In addition, several NCMLS members have advisory functions or are board members within these organizations. Clinical groups (led by Profs. Berden, Netea, Punt, de Witte, Knoers, Kullberg and Smeitink), interact on a daily basis with patients and their relatives at the Radboud University Medical Centre, have close ties with patient organizations and are involved in public and strategic policy.

Since 2007, NCMLS has organised annual international ‘New Frontiers’ symposia, each covering a specific topic within one of the thematic areas of NCMLS. Last year’s symposium, which was entitled ‘Pattern Recognition Receptors: seeing the enemy’ (5-6 November 2009), attracted a record number of visitors from across Europe, Asia and America. In total, more than 400 people scientists and clinicians came to Nijmegen for fruitful discussions on the latest immunological research.

The societal importance of Molecular Life Sciences-related research is emphasized in the NCMLS graduate education programmes (both MMD and PhD) and throughout the research school. Researchers at the NCMLS study molecular mechanisms that control essential functions of the cell and explore ways in which malfunctioning can lead to life-threatening disorders. Training researchers in this field is of great importance to society, since they will form the next generation of scientists and biotechnology entrepreneurs, who will continue the search for new drugs and develop novel treatments.

Future research
The following Veni and Vidi grants, which were awarded to members of NCMLS, form the basis for important future research.
• Roland Kuiper (Department of Human Genetics) received a Vidi award for his study of heritable epimutations.
• Katarina Wolf (Department of Cell Biology) received a Vidi award for research into tumour invasion and metastasis.
• Rob Collin (Department of Human Genetics) received a Veni award for developing novel therapeutic strategies for inherited blindness.
• Marcel Coolen (Department of Molecular Biology) received a Veni award for RNA-Directed Epigenetic Remodelling. Epigenetics plays a major role in cancer development.
• Richard Notebaart (CMBI) received a Veni award for systems-level analysis of evolutionary adaptation.

Theme 1: Infection, Immunity and Tissue Repair
Fundamental research within this theme relates to the elucidation of regulatory circuits and their deregulation in diseases. Many diseases with a high societal burden are studied, including chronic inflammatory disorders, infectious diseases, transplantation and cancer. Future fundamental research will focus on the role of dendritic cells, regulatory T-cells and other haematopoietic cells in adaptive immunity, as well as the contribution of resident tissue-specific cells (e.g. epithelial cells, synovial cells, chondrocytes) in innate immune processes. Current knowledge about these cell types and developments in stem cells will help us redefine and expand our knowledge of cellular regulatory circuits and differentiation routes. In addition to developing and applying novel tools for diagnosis and tissue pathology, the knowledge is gained will lead to new experimental treatments.

Theme 2: Metabolism, transport and motion
Research within this theme covers both fundamental and translational issues. New opportunities will allow (i) further integration of novel microscopy-imaging platforms and MR tools into experimental in vitro and in vivo studies, (ii) the development of biosensors or cell lines for screening and diagnostic purposes, (iii) the development of a new methodology for modulating cell processes by chemical rather than biological means, and (iv) new high-content diagnostic methods for characterising cellular metabolic-physiological states. Patients with metabolic or genetic diseases such as muscle, neurological disorders and kidney problems will ultimately profit from the availability of new procedures for preventing disease and novel agents that can help stabilize or enhance their health.
**Director: Prof. Carl Figdor**

Carl Figdor has been Full Professor of Cell Biophysics at the University of Twente since 1992, and a Full Professor Immunology at Radboud University Nijmegen since 1994. From 1984 to 1994 he was a staff member at the Netherlands Cancer Institute. His research focuses on the immune system and its ability to resist cancer. He specializes in the role of dendritic cells in immune responses. In 2006 he received the Spinoza prize from NWO - the most prestigious science prize in the Netherlands. In 2008 he was elected as member of the Royal Netherlands Academy of Arts and Sciences (KNAW).

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**Theme 3: Cell growth and differentiation**

The research carried out within this theme focuses on the molecular basis of cell behaviour in the context of health and disease. Basic and clinical research are combined in an attempt to decipher the molecular pathways that underlie the functioning of the central nervous system under normal and pathological conditions, while elucidating the pathways that control the processes of proliferation and differentiation in physiology and pathology, especially cancer. The range of research activities in theme 3a, Functional Genomics, has resulted in the development of novel diagnostic tools such as DNA micro-arrays, software development and improved recognition of hereditary cancer syndromes. Other new tools of great general interest such as ChIP-seq will be widely implemented to explore disease, the aetiology and functional consequences of key nuclear factors. Research in sub-theme 3b will continue to exploit the potential of organic chemistry to modify, design and mimic proteins and their building blocks in order to modulate and analyze their activities and properties in the cellular environment.
The Institute for Water and Wetland Research (IWWR) encourages interdisciplinary cooperation between scientists engaged in microbiology, animal, plant and environmental sciences. The institute aims to integrate these disciplines and to stimulate joint research in order to enhance our understanding of interactions between plants, animals, and micro-organisms, their interactions with the environment, and to find solutions to a variety of problems arising from these interactions.

The research at the IWWR is carried out by complementary, closely interacting research groups, which study the mechanism of adaptation of cells, organisms and ecosystems to stress. Research in most departments spans a considerable area within each field, notwithstanding the focused research goals, providing excellent opportunities for interdisciplinary collaboration. There are two main programmes: Ecological research and Gene-environment research.

The availability – or excess – of water will be the main global environmental problem in the 21st century. Water shortage is likely to increase in many parts of the world, while many flood plains will experience increased chances of flooding in particular seasons. In addition, poor water quality is challenging human populations and natural ecosystems alike. Organisms and ecosystems are adapted to specific water regimes, but changes in water quantity and quality result in stress responses. Research at IWWR focuses on water, wetland and associated terrestrial systems in which there is considerable variation in environmental conditions, both in space and time, and from the gene to the population level. The specific relationships between the organisms living in these fluctuating environments – as well as the regulatory mechanisms used to maintain homeostasis – are studied under both natural and experimental conditions.

Ecological research programme
Traditionally the stress response and adaptation of ecosystems played a central role in most of the research carried out at the IWWR. There are groups working on plant and animal ecology, aquatic ecology and environmental sciences.

A major scientific innovation has been achieved by linking and extending the ecological research to the genomic level. In this way the fundamental principles of stress and adaptation to changing aquatic environments can be studied at all levels of biological organization. This fundamental knowledge produces predictions about how systems respond to environmental change, forming the basis for novel applications in ecosystem management and water purification.

Gene-environment research programme
In the research on Gene-environment interactions, a link is made between ecosystems and the genomic level, with a focus on individuals, populations and communities. Molecular and genomic tools have revolutionized ecology in the last ten years, providing unprecedented insight in for example (microbial) community composition and functioning and evolutionary and ecological history of species and populations.
Research groups at the IWWR are at the forefront of developing and applying the latest genomic techniques in order to unravel the inherent genetic constraints and opportunities of ecosystems, in particular in their responses to changes in water quantity and quality. The research comprises all major biotic components of ecosystems, micro-organisms as well as plants and animals. In this research, adaptations and stress responses of organisms are also studied in the context of molecular and physiological regulatory mechanisms, in both plants and animals. This research provides fundamental knowledge on how and why individuals respond to environmental stressors the way they do, and identifies the ecological and evolutionary opportunities for and constraints on adaptation.

**Research facilities**

The IWWR has eight departments, all with state-of-the-art modern laboratory facilities in the new Huygens Building, and a central analytical service. The equipment used includes:

- State-of-the-art light microscopy and electron microscopy facilities for detailed analysis of the ultrastructure of microorganisms, animals and plants
- Extensive molecular biological facilities such as quantitative RT PCR, RNA interference and in-situ hybridisation techniques for analysis of single cells till complex ecosystems
- Extensive culture facilities for microbes, plants, fish and amphibians
- PHYTOTRON – a unique national research facility for detailed ecological research on sub-surface processes such as root formation under varying oxygen conditions.
- The Solanacaea collection and green houses are part of the IWWR large scale facilities.

**Collaboration**

Research is conducted in close collaboration with over hundred national and international research groups, research institutes, companies and governmental organizations. These include the Institute for Society and Information systems (ISIS), Center for Wetland Ecology (CWE), the Darwin Center for Biogeology, the Netherlands Center for River Studies (NCR), the Graduate School Experimental Plant Sciences (EPS), the Graduate School Functional Ecology (FE), the Research School for Socio-Economic and Natural Sciences of the Environment (SENSE), various environmental biotechnology companies, various water boards, the Joint Genome Institute (Walnut creek, USA) and Genoscope - the French National Sequencing Center (Evry, France).
Research results

In 2009 the IWWR was externally assessed according to the national Standard Evaluation Protocol in 2009. The international assessment committee was greatly impressed by the coherent research programme, the management of the institute and the enthusiasm and skills of the researchers. Following most recommendations, the IWWR and the faculty have made an implementation plan to further improve the research with respect to focus and mass. As a result of the assessment, an additional full professor in Ecogenomics and two assistant professors have been hired.

The Experimental Plant Ecologists at the IWWR developed a new modular concept for plant foraging behaviour, in which detailed studies on the molecular regulation of plant responses have been linked to the responses of and fitness benefits for the whole plant. The nature, degree and impact of variations in factors influenced by flooding were investigated for several model species. In South-African savannas the interplay between competition for water and nutrients was deciphered and its impact on tree establishment investigated.

The research of the animal ecologists concentrated on the nursery function of mangroves and sea grass beds for coral reef fish and new clues as to how fish find their nurseries were discovered in the past year. A second topic that was addressed was bio-invasions, and important answers with respect to the displacement of native species by invaders were found.

Ecologists at the IWWR discovered that even low atmospheric nitrogen deposition levels (5 kg/ha yr) lead to large changes in the endangered vegetation of acidic coastal dunes in Europe, in contrast with the critical loads previously set for this type of ecosystems (15-20 kg/ha yr). A further promising result was the fact that anammox was discovered in peatland sediments loaded with nitrogen. An important biogeochemical coupling was found at the landscape scale between nitrogen pollution in uplands and phosphate pollution in wetlands, bridged by sulphur transformations. The effects of elevated carbon dioxide levels – due to climate change – on the competition between esocetid and elodeid plant species were investigated and it appeared that a doubling of carbon dioxide will lead to a complete shift in vegetation. Furthermore stressors and feedbacks in temperate sea-grass ecosystems were studied and a self-organized patterning in sea grasses along a depth gradient of an intertidal ecosystem was discovered.

A new ecological theory on the home ranges of individuals and geographic ranges of species was integrated by environmental scientists at the IWWR with empirical evidence, which shows that organism size and trophic level are the main determinants. Contributing to fundamental principles governing the distribution of species, practical applications for reserve areas in nature management were implemented in decision-support systems.

The marine nitrogen cycle was investigated in the Peruvian Oxygen minimum zone by the microbiologists at the IWWR and showed an unexpected link between nitrate reduction to ammonium and anammox. The genome, transcriptome and proteome of the several novel microbes were elucidated using pyro- and illumina sequencing and advanced mass spectrometry. A novel division ring in anammox bacteria was visualized by advance electron microscopy.
The interactions of Corticotropin-Releasing Factor (CRF) and its soluble receptors with binding protein were studied in collaboration with the Salk Institute, LaJolla, CA USA, producing a wealth of insights into structure-function relationships. Furthermore, cortisol receptor profiles in the carp were analysed under control and stress conditions. The role of leptin in zebrafish was studied by cloning leptin and its receptor genes. The recombinant proteins were used for bioassays.

Plant biologists at the IWWR investigated the molecular adaptation of Solana dulcamara in response to several different environmental stressors.

Geneticists at the IWWR identified a new gene that is involved in organ fusion of Petunia. In Arabidopsis this function is redundantly encoded by two distantly related WOX genes, a homeobox-such as family of genes. Intriguingly, in Petunia and maize, the function is encoded by one or the other of these genes. In addition, the relation between chromosome structure and meiotic recombination frequency was investigated.

Plant scientists at the IWWR established the fact that cross-talk between the hormones GA and AUX regulated fruit initiation and between GA and cytokinin, which was related to plant stress resistance. Furthermore, the role of auxin in Petunia and maize was investigated. In Petunia this function is redundantly encoded by two distantly related WOX genes, a homeobox-such as family of genes. In maize, the function is encoded by one or the other of these genes. Intriguingly, in Petunia and maize, the function is encoded by one or the other of these genes. In addition, the relation between chromosome structure and meiotic recombination frequency was investigated.

A patent application on the modulation of ABA sensitivity was filed in collaboration with the seed company Nunhems and work on S. dulcamara in collaboration with AGRICO (Bant) led to the development of a spin-off company in Poland.

The research on bittersweet (Solanum dulcamara) will be expanded in the near future as it will become a model system for investigating the basis for plant adaptation to different environments, such as dry dunes and wetlands. In a joint collaborative operation all of the plant scientists at the IWWR extended the collection of S. dulcamara from various ecosystems in the Netherlands and Europe. This will form the basis for sending the adaptation of S. dulcamara with molecular-genetic and eco-physiological tools.

Awards and new grants

Awards
Marco Visser won an essay prize for his MSc thesis. Hans de Kroon became a Research Associate at the Smithsonian Tropical Research Institute. Laura van Niftrik received a Veni grant. Michiel Vandenbussche received a CNRS fellowship and Joop Schaminee won the Prins Bernhard Cultuurfonds prijs voor Natuurbehoud.

New grants and PhD projects
• 2009-2013 PhD ALW grant / Marloes Hendriks
• 2009-2010 Postdoc British Council grant / Alex Dumbrell
• 2009 2010 Visiting professor Fulbright grant / Lisa Donovan
• 2009-2012 PhD NCSF grant marine anammox / Jia Yan
• 2009-2013 PhD ALW grant proteome of anammox / Naomi de Almeida
• 2009-2013 PhD N cycle diversity / Maartje van Kessel
• 2009-2013 PhD Ecology of anammox / Mathilde le Roy
• 2009-2011 Diversity of N cycle bacteria / Katharina Ettwig
• 2009-2010 Postdoc NCSF Diversity of anammox grant / Boalan Hu
• 2009-2013 PhD CAS KNW grant Diversity of damo and anammox in Chinese wetlands / Baoli Zhu
• 2009-2012 Postdoc DARWIN marine N cycle
• 2009-2012 PhD ALW grant / Klaas Heijmans
• 2009-2013 PhD EU grant / Antoine Ederveen
• 2009-2011 TTIGG grant / Michiel Vandenbussche and Kitty Vijverberg
• 2009-2013 PhD NWO/LNV grant / vacancies
• 2009-2011 PhD Norwegian Research Council vacancy

Societal impact
Most of the research at the IWWR is fundamental, but it also has many strategic and applied aspects. The ecological research closely relates to major environmental problems including climate change, pollution, and eutrophication, and their effects on biodiversity, soil quality and water quality. For this reason, much of this research has been commissioned by policy makers, nature managers and water managers.

Experts in Experimental Plant Ecology are currently studying important plant traits and investigating the difference that they make to the responses of populations, communities and ecosystems. The knowledge they build up is applied in a number of applications, ranging from changes in plant distributions in response to climate-induced changes in flooding regimes, improving crop yield in water-limited agriculture, and tree-grass balance in dry savannas.

Biological invasions are currently occurring all over the world at an increasing rate, causing much damage to native biodiversity and economies, for example through biofouling. Studies on the nursery function of sea-grass beds and mangroves are important for coastal conservation as well as sustainable fisheries and tourism.

The discovery and distribution of anammox bacteria in the oceans has made a significant impact on current models of the global nitrogen and carbon cycles that are used by oceanographers and was the basis for further expeditions to study various marine ecosystems. Furthermore, two new wastewater treatment plants based on the anammox concept were built to remove ammonia from industrial waste streams more cost-effectively.
The research in the animal physiology group is relevant to understanding stress parameters for fish in aquaculture. They participate in an EU COST Action, where aquaculturists from all over Europe form a network that will formulate the best possible conditions for animal welfare in aquaculture. The consortium is preparing guidelines for fish handling for in Europe and beyond. In the public-private SMARTMIX consortium substantial progress was made in developing transgenic fish in which bone-forming cells are tagged with fluorescent dyes. Zebrafish scales with the associated bone forming cells will be prepared for high throughput screening of drug libraries.

While the most direct application of the Institute’s floral mutagenesis programme can be found in the ornamentals industry, the Petunia system and in particular the transposable element insertion technology is used by several companies to identify candidate genes for traits such as drought – or cold tolerance or resistance against specific diseases such as Botrytis. These systems are also used to identify mutants in maize.

Future research
In 2010 the Institute will focus even more on gene-environment interactions and ecogenomics. For this purpose a joint proposal of all the plant groups was submitted. The plant ecologists at the IWWR will continue their research on the ecological and evolutionary significance of adaptive traits, with particular emphasis on the properties of plants that are responsible for their success. New plans are being developed for scaling up knowledge on traits and individuals to include the resilience of populations and communities in response to climate change. Both West European grasslands and the tropical rainforest are studied and novel modelling techniques are employed to achieve these goals.
Future research in ecology will focus more on interdisciplinary research on the biogeochemical interactions between micro- and macrobiology, the role of internal biogeochemical processes on water quality, and on the effects of global change on different ecosystem types. Microbiologists at the IWWR will continue to investigate the role of anaerobic ammonium oxidation in marine waters and sediments as well as in soils. Together with researchers at the NIOZ and Utrecht University, the role of aerobic and anaerobic ammonium-oxidizing microorganisms in past and present oceanic nitrogen cycle will be studied, using unique ladderane lipids as biomarkers and proxies. Furthermore, the fate of methane in various wetland and volcanic ecosystems will be assessed, using stable isotopes as well as molecular and environmental genomic methods.

Several EU-funded projects that will take effect in 2010 will make it possible to continue with developing and implementing a consistent framework for assessing the impacts on human health and ecosystems in a life-cycle assessment context. Likewise, the fate, exposure and effects of nano-materials will be investigated in various externally financed projects.

Physiologists at the IWWR will participate in a SMARTMIX consortium to study zebra fish and their genome as a model for stress and bone (osteoporosis) physiology and related drug development. Plant researchers will focus on the involvement of microRNA in floral organ definition and on the relationship between chromosome structure and recombination frequencies. Insertion libraries containing 150,000 transposon insertions will be made available to interested parties. The researchers will also develop a new model system: Solanum dulcamare and perform a whole-transcriptome analysis.

In 2010, experimental plant ecologists, environmental biologists and microbiologist at the IWWR will extend their use of the new Nijmegen phytotron for advanced studies of underground processes under control conditions. This will combine observations of the detailed responses of the roots and their microbial community with whole plant responses in realistic settings.
Institute for Molecules and Materials

The Institute for Molecules and Materials (IMM) aims to conduct research and train undergraduate and graduate students in functional molecular structures and materials. There is a strong emphasis on understanding and controlling complexity in order to design new functionality in these systems.

In physics, chemistry and biochemistry the desire to understand complexity in systems is spurred by the wish to manipulate their functionality. In recent decades scientists have approached the problem of complexity from two perspectives.

On the one hand the goal of achieving an advanced understanding of complexity leads to the study of the smallest building blocks, using them incrementally to build larger and larger systems. In this way the structure and functionality of atomic nuclei, atoms, and (small) molecules have been investigated and analyzed. Combined experimental and theoretical efforts have resulted in a broad knowledge of the behaviour of these systems.

On the other hand continuous efforts are made to understand macroscopic systems with well-known properties or to analyze the constituents of a large system that has been investigated extensively as a whole. Examples include many-body problems in physics and exploration of systems in life sciences on a cellular and subcellular scale.

One of the major challenges ahead is to unravel the complexity and better understand functionality in the area where these two directions meet, namely the field of nanoscience, an interdisciplinary field on the interface between biology, chemistry and physics. This research is undertaken by 20 groups organized along three main themes: 1) Design, synthesis, and growth, 2) Spectroscopy and characterization, and 3) Theory and simulation. The main objectives relate to three fundamental questions:

- **What are the fundamental properties of electron-correlated systems?** Attempts to understand intriguing phenomena in electron-correlated materials such as ultrafast magnetization dynamics, the electronic properties of oxidic and graphene materials, and the fractional quantum Hall effect are currently at the forefront of condensed matter research.

- **How does self-organization of complex systems work?** An advanced understanding of self-organization in complex molecules and nano-sized materials is of great significance, since it creates a bridge between the domain of relatively well-understood atoms and small molecules and more complex macromolecular and supramolecular structures.
Staff

Prof. J.G.J. van den Brink (e)
Prof. L.M.C. Buydens (o)
Prof. A. Fasolino (p)
Prof. A.J. van Gool (e)
Prof. R.A. de Groot (o)
Prof. P.H.H. Hermkens (e)
Prof. J.C.M. van Hest (o)
Prof. M.I. Katsnelson (o)
Prof. A.P.M. Kentgens (o)
Prof. J.C. Maan (o)
Prof. W.L. Meerts (e)
Prof. E.W. Meijer (e)
Prof. G.J.M. Meijer (e)
Prof. J.J. ter Meulen (o)
Prof. R.J.M. Nolte (o)
Prof. D.H. Parker (o)
Prof. G.J.M. Pruijn (o)
Prof. T.H.M. Rasing (o)
Prof. A.E. Rowan (o)
Prof. F.G.M. Russel (e)
Prof. F.P.J.T Rutjes (o)
Prof. S.E. Speller (o)
Prof. E. Vlieg (o)
Prof. J. de Vlieg (e)

Prof. M.I.J. Vrakking (e)
Prof. G.W. Vuister (p)
Prof. W. van de Water (e)
Prof. S.S. Wijmenga (o)
Prof. W.J. van der Zande (o)

Tenured

Full Professors 9.7 FTE
Associate Professors 4.1 FTE
Assistant Professors 8.5 FTE
Researchers 1.8 FTE

Non-tenured

Researchers 42.1 FTE
Doctoral candidates 84.5 FTE

• What are the fundamental properties of biomolecular systems, especially those that play an important role in biology-driven problems?

The answer to many unsolved problems in cellular and sub-cellular systems lies in the behaviour and interplay of individual biomolecules and bio-macromolecules. With its unique infrastructure and expertise, the IMM is ideally suited to tackle some of these most pressing issues in this area of nanoscience. It is therefore the ambition of the Institute to act as a key player in all of the fields described above.

Research facilities

The IMM houses a number of national and international research centres:

• High Field Magnet Laboratory (HFML). Continuous magnetic fields of 33 Tesla (45 Tesla in 2012) and pulsed fields up to 60 Tesla are used in combination with low temperature and spectroscopy equipment.

• European Large Scale Facility for high-resolution liquid NMR, with a number of instruments including 600-MHz and 800-MHz machines.

• Solid-state NMR Facility for advanced material science, with a new wide-bore 850-MHz machine.

• Scanning Probe laboratory, where molecules and materials can be investigated and manipulated at nanometre and sub-nanometre scales using a broad range of STM and AFM techniques.

• Laser Laboratories, in which high-resolution spectroscopy is carried out on molecules and materials using ultra-short timescales.

• Velocity map imaging laboratory for the study of uni- and bimolecular dynamical processes with complete quantum state characterization.

• European Life Science Trace Gas Exchange Facility for the detection of very small amounts of gas in the life sciences and atmospheric applications.

• Thin Film Growth Laboratory, where materials and thin films are grown with atomic precision.

• FLARE: a Free Electron Laser for research using THz radiation (under construction, operational in 2012)

• FOM centre for Computational Materials Sciences, where computational methods are used to assist in the understanding and design of materials.
In addition, the Institute has state-of-the-art facilities for carrying out advanced synthesis and analyses: instruments for synthesis under extremely high pressure, equipment for combinatorial synthesis, a peptide synthesis laboratory, mass spectrometers, high-pressure liquid chromatography facilities, and X-ray diffractometers.

Collaboration

There are many collaborative initiatives between IMM research groups and research groups at universities and institutions around the world. Among other collaborations, the Institute works closely with partner universities in the International Research Universities Network (IRUN), which aims to further improve the quality of research and teaching at the universities involved. Within the network, the exchange of researchers, lectures, and students will be encouraged and facilitated. This may lead to joint curriculum development and joint degree programmes for Master’s students and PhD candidates. IMM currently collaborates with groups from Münster, Duisburg/Essen, and Barcelona.

Collaboration with other universities includes work with the Catholic University of Leuven in Belgium on single molecule spectroscopy (the group led by Profs. J. Hofkens and F.C. de Schryver). This collaboration involves the exchange of PhD students and post-docs and the use of the special laser equipment at the two locations, leading to successful joint publications.

The section Molecular and Biophysics collaborates with the Institut für Physikalische Chemie of the Heinrich Heine University in Düsseldorf, which has led to a number of joint publications in highly ranked journals. There are also strong links between the IMM and the Fritz Haber Institute of the Max Planck Society in Berlin Germany (Director Prof. Gerard Meijer), and the Fraunhofer Institut für Mikroelektronische Schaltungen, Duisburg. Currently, collaboration between the IMM and the Duisburg/Essen centre for nano-integration CENIDE is being formalized.

There is also collaboration between the IMM and the Ioffe Institute in St. Petersburg, Russia. This includes joint projects with shared PhD students that have led to a number of highly-ranked publications. Likewise, there is close collaboration with the Jozef Stefan Institute in Ljubljana in Slovenia.

Many of the groups at the IMM participate in EU projects with other European partners, which is very rewarding both in strengthening research contacts and training PhD students and post-docs. Three members IMM (Profs. R. de Groot, R. Nolte, and L. Meerts) hold part-time professorships at other universities in the Netherlands.
Research results
Below is a summary of the results achieved in 2009 in the three main research themes at the institute.

Electron-correlated systems
Prof. de Groot and colleagues have studied the low overvoltage, and thus high efficiency, of ruthenium-dioxide electrodes for electrolysis of water into hydrogen and oxygen. The surface of ruthenium-dioxide itself reveals paramagnetic moments, enabling mechanisms for the evolution of magnetic oxygen without violating conservation of angular momentum.

The group led by Prof. Katsnelson has made calculations of the topology and shape of self-assembled vesicles, i.e. nanometre-sized structures of large aromatic molecules. Self-assembly of molecules with flat aromatic cores into a curved surface cannot take place without creating topological defects. It is concluded that high magnetic fields can lead to a topological transformation of single vesicles into double bubbles.

At the High Field Magnet Laboratory headed by Prof. Maan the kinetics of the temperature induced aggregation of macrocyclical molecules were investigated using magnetic field induced birefringence. This technique is sensitive to the degree of molecular order of an entire aggregate. Three consecutive stages in the aggregation process of the macrocycle system were found, each with its own typical time scale: disordered objects, ordered fibres and a network.

The team led by Prof. Rasing has discovered a second novel mechanism for magnetization reorientation using sub-picosecond laser pulses. Under the impact of the laser pulse, the magnetization of a ferromagnetic thin film first collapses and then reappears in the direction defined by the polarization of the pulse. Using this method, magnetic information was recorded by a sub-picosecond laser pulse and read out by a second pulse within 30 picoseconds.

In the NanoLab (led by Prof. Speller) electron transport through a carbon monoxide molecule was studied, using mechanical controllable break-junctions of gold in non-polar liquids. For the first time it was possible to reliably and reproducibly determine the conductance of a single molecule in a liquid.

Solid samples with nanolitre volume have been studied by NMR spectroscopy in the group led by Prof. Kentgens. The Micro Magic Angle Spinning method combines high resolution with superior sensitivity. It was demonstrated that this method can determine quadrupolar tensor orientations in microcrystals.

Self-organizing systems
The group led by Hageman and Schermer worked on solar cells with world record efficiencies. Efficiency can significantly be increased with III-V semiconductors that make it possible to integrate several sub-cells using different parts of the solar spectrum. Using the Epitaxial Lift-Off etch process, thin-film GaAs solar cells were produced with efficiencies up to 26.1%.

Prof. Vlieg and his group – in collaboration with other IMM groups – have optimized a method for deracemising mixtures of left and right-handed molecules. It was demonstrated that circularly polarized light can determine the handedness of the final state. Since such polarized light was also present at the formation of the Earth, this is a possible scenario for the homochirality of life.

Prof. Nolte and colleagues have started a programme using the capsid (i.e. the empty shell) of the Cowpea chlorotic mottle virus as a nano-sized reaction vessel. A procedure was developed for attaching the guest protein or enzyme to the capsid protein dimers prior to assembly. This new strategy is currently being used to encapsulate different types of enzymes into viral capsids, thus creating multi-enzyme nanoreactors.

Groenenboom and his colleagues studied the vibration-rotation-spin states of the OH-HCl complex using ab initio calculations. A coupled diabatic electronic state approach was developed that takes into account the non-adiabatic effects and spin-orbit coupling and the spectroscopic properties were predicted.

Harren and colleagues were involved in airborne measurements of ethene from industrial sources. A laser photo-acoustic instrument was developed and used for aircraft measurements of ethene produced by industrial sources nearby Houston. The results suggest that rapid ozone formation regularly takes place in such industrial plumes.

The groups led by Profs. Parker and Ter Meulen reported on the extraction of quantitative information from telescopes such as the Herschel Space Observatory. Extraction crucially depends on the microscopic properties of water in collision with hydrogen and helium. Advanced velocity map imaging measurements of rotational inelastic collisions of water with hydrogen and helium and state-of-the-art theoretical calculations are found to be in excellent agreement.

Prof. van der Zande and his team are designing and building a Free Electron Laser for research using THz radiation (FLARE). Part of the FLARE radiation will be delivered to the High Field Magnet Laboratory so that optical experiments in high magnetic fields between 30 and 45 Tesla become possible.

Biomolecular systems
Prof. van Hest and his colleagues have discovered a method for introducing permeability in the membrane of polymersomes based
Institute for Molecules and Materials

Key publications


on a sugar-responsive solubility change of polystyrene boronic acid. Modified boronic acid-polymers and block copolymers can be useful for developing bioreactors, drug-delivery vehicles, and sensors responsive to physiologically relevant glucose concentrations.

In the group led by Prof. Pruijn the formation of unique hetero-oligomers from small heat shock proteins was studied in detail. In cells, these proteins are assembled in homo- or hetero-oligomeric structures, which can contain from two to about 50 subunits. Preliminary data suggest that some of these proteins are unique in the sense that they do not form oligomeric complexes with other family members, but a relatively well-defined complex instead.

Prof. Rutjes and colleagues worked on fast efficient modification of enzymes, proteins and other biomolecules, a technique which is of great importance in chemical biology. They have developed copper-free click chemistry for efficient enzyme PEGylation and demonstrated its bio-applicability.

The team led by Prof. Buydens investigated the misalignment of chromatograms from liquid chromatography-mass spectrometers, which is a major problem in analytical chemistry. Several improvements were made to an existing alignment algorithm called parametric time warping, thus extending its alignment capabilities to proteomic data.

The regulation of the sodium/calcium exchanger in cardiomyocytes was studied in the group led by Prof. Vuister. Two cytosolic calcium binding domains regulate activation of the exchanger, but little was known about the mechanism. Using NMR, isothermal titration calorimetry and small-angle X-ray scattering, a model for the regulation of this exchanger was developed.

Finally, in the group led by Prof. Wijmenga methodologies for segmental and selective isotope labelling of large RNAs and DNAs were developed for NMR structural studies. These methodologies open the way for atomic resolution studies of the structure and dynamics of large RNAs and DNAs within the context of their natural functionally active complexes.

**Awards and grants**

In 2009 Prof. Huck won a prestigious advanced grant from the European Research Council for further extension of his work. Other grants awarded in 2009 include three NWO ECHOs for Prof. D.H. Parker, Dr F. van Delft, and Dr D. Lowik. Former IMM PhD students Dr W. Noorduin and Dr E. Schwartz each received an NWO Rubicon subsidy for a post-doc position at a top institute abroad. The groups led by Profs. Rasing and Maan received several prestigious FOM Project grants.


Institute for Molecules and Materials

Societal impact
One aim of the IMM is to valorize research results and thus establish spin-off companies and filing of patents is encouraged. Life science processes and material applications inspire much of the research and most groups are engaged in extensive collaboration with industrial partners. The IMM has formal cooperative arrangements with all major companies in the Netherlands, including DSM, Philips, Organon, Solvay, Unilever and AkzoNobel.

Maintaining large infrastructure at the IMM has resulted in long-standing business relations with technology-oriented medium-sized enterprises near Nijmegen. Spin-off companies have created hundreds of jobs in and around Nijmegen. The partnership with nanoscience centre CENIDE in Duisburg/Essen has led to an increased influx of knowledge workers in the region and a burgeoning student population.

Another important initiative is the ‘Innovation Lab’, where aspiring researchers can start commercializing innovative research results. They have access to technical and scientific support as well as business training and coaching. Financial support for the Innovation Lab comes from the University and NWO. Budding entrepreneurs are also expected to attract their own funding.

IMM’s outreach to small and medium-sized enterprises is further exemplified in the NanoLab, which was established to facilitate knowledge transfer between the university and industry. Companies can make use of a training unit as well as five research units that focus on biomedicine, nano-electronics, nano-chemistry, nano-optics, and nano-materials. A wide range of applications are supported through the availability of a range of Scanning Tunnelling (STM) and Atomic Force (AFM) microscopes as well as other research facilities.

Another important line of research that has clear significance for society is the study of materials science. Combined experimental and theoretical efforts helped to create an advanced understanding of novel systems that can be directly linked to applications in the semiconductor industry and in electronics. The manipulation of spins with ultrafast light or extremely high magnetic fields, directly addressing the issue of data storage on hard drives, is one example. The development of thin film solar cells with the highest possible efficiency is another. In 2009 the University established a joint venture with a British company called f2e devices for producing thin-film solar cells for concentrator systems and space applications.

Finally, there is active and close collaboration with NCMLS on developing novel tailor-made molecular and macromolecular and biomacromolecular systems for monitoring and addressing personal health issues. This involves applying real-time NMR and scanning-probe imaging techniques to identified species, targeted drug-delivery systems, and diagnostics on a nanometre-scale with the development of molecular sensors and markers. Non-invasive diagnostic tools are also being developed, including the ‘breath test’, which allows researchers to analyze the trace gas constituents of human breath for diagnostic purposes.

IMM scientists sit on various national and international advisory boards, committees and journal editorial boards (including those of such prestigious journals as Science). Apart from these activities in the scientific domain, many leading IMM scientists are actively involved in the public debate on a variety of topics.

Future research
Future research within the Institute will take place within three broadly defined research themes comprising of physics and chemistry. These tackle the following questions: 1) How can we understand the exciting, yet unresolved, issues in correlated-electron systems and nano-sized materials? 2) What is the science behind the self-assembly of complex molecules? And 3) What are the unique properties of biomolecules which can explain the way they function in cellular systems?

An important challenge for the years ahead is provided by a 26 million euro grant from the national investment in large infrastructure (NWO-BIG) in 2006. This grant was awarded to enable the IMM to set up the Nijmegen Center for Advanced Spectroscopy (NCAS). By joining the High Field Magnet Laboratory (HFML), NanoLab facilities, the NMR Laboratories, and the laser facilities into a single coordinated infrastructure, a research infrastructure of international standing is being established. In addition, a Free Electron Laser for research using Terahertz radiation (FLARE) is being built next to the HFML. This will create unique opportunities for studying magnetic excitations in inorganic and organic molecules, as well as low energy spectroscopy (far-infrared) on molecular clusters and large molecules and biomolecules. Finally, a new hybrid 45 Tesla magnet is being built for the HFML, which will provide new research opportunities with cutting-edge technology.

On 1 January 2010 Prof. Wilhelm Huck succeeded Prof. Roeland Nolte as professor of Physical Organic Chemistry within the IMM. In the coming period Prof. Huck will establish a new IMM research group that will focus on creating and studying microreactor droplets, which our produced using microfluidic techniques. One major research goal is to encapsulate single cells within these droplets in order to control their chemical environment and to study the effect of the environment on the chemical processes that occur within the cellular matrix. This investigation will lead to a better fundamental insight of cell metabolism, which will also be very valuable for medical science.
When the 2009-2016 Sector plan ‘Nijmegen Profiling in Chemistry and Physics’ is approved (mid-2010), a number of exciting new initiatives will start in chemical biology and advanced spectroscopy of functional molecules and materials. The focus on chemical biology puts chemistry back into a leading position in groundbreaking research at the interface between chemistry and biology. To achieve this goal, interactions between the participating groups will be strengthened and a new complementary research line bridging the organic chemistry and biochemistry groups will be established. The aim in relation to physics is to strengthen research capacity by using the unique IMM facilities – the High Field Magnet Laboratory (HFML) and the Nijmegen Centre for Advanced Spectroscopy (NCAS) – to study low-dimensional systems and for carrying out terahertz spectroscopy on strongly correlated systems.

In close collaboration with the Nijmegen Centre for Molecular Life Sciences (NCMLS/UMC) researchers at IMM have formed a Chemical Biology cluster, in order to further exploit the combined knowledge in organic chemistry and apply it to biochemical, biological, and medical problems. Together with NCMLS research groups and industrial pharmaceutical partners this promising research line will enhance our understanding of complex molecules and will make it possible to synthesize molecules with specific physical, chemical and pharmaceutical properties.

Increasingly, groups at the IMM are collaborating across the boundaries between chemistry, physics, and biology, and those between theoretical and experimental science. The key to the future of science is interdisciplinary research and the IMM is fully equipped to tackle the challenges that lie ahead.
Institute for Mathematics, Astrophysics and Particle Physics

The Institute for Mathematics, Astrophysics and Particle Physics (IMAPP) carries out fundamental research in mathematics, high-energy physics and high-energy astrophysics, with a special eye on interdisciplinary topics. The overarching research theme is the origin and evolution of the universe and its underlying mathematical structures. The institute is also actively engaged in outreach.

Mathematics
This subject centres on three interdisciplinary themes: mathematical physics, algebra and logic, and applied stochastics. There are well-established links between these themes, computer science and physics. The traditional areas algebra, logic, analysis, geometry and stochastics are studied within these themes.

Astrophysics
This department concentrates on two areas of research in high-energy astrophysics: astroparticle physics and compact objects. The main goals are to unravel the sources of the highest-energy particles in the universe, and to understand the physics of the surroundings of black holes, neutron stars and white dwarfs, and the evolution of white dwarf binaries as important sources of gravitational waves. The approach is both observational as well as and theoretical.

High-energy physics
This group carries out and analyzes experiments in the field of elementary particle physics at the smallest distance and highest mass scales that are attainable. This entails both accelerator-based and cosmic ray detection experiments and the theoretical foundation of elementary particle interactions. There is a particular focus on electro-weak symmetry breaking and the Higgs boson, in an attempt to gain more insight into the structure of vacuum.

Awards
• Prof. Kuijpers was knighted in the Order of the Netherlands Lion
• Prof. De Jong won the National Academic Year Prize 2009
• Drs. Niessen received a Shell Stipend for theoretical physics and won the DRSTP symposium poster prize
• Drs. M. Caspers won the GQT MSc thesis prize
• Dr Hu and Dr James received a NWO Rubicon award
In 2009 the X-Shooter spectrograph was attached to the UT2 telescope of the Very Large Telescope (VLT) on the Paranal mountain in Chile. The X-Shooter – the best spectrograph worldwide and a key instrument on the VLT – was partly built at Radboud University Nijmegen.

**Staff**

- Prof. C.C. Aerts (e)
- Prof. C. Dominik (e)
- Prof. H.D.E. Falcke (p)
- Prof. D. Froidevaux (e)
- Prof. M. Gehrke (o)
- Prof. N. de Groot (o)
- Prof. P.J. Groot (o)
- Prof. G.J. Heckman (o)
- Prof. W.H. Hundsdorfer (e)
- Prof. S.J. de Jong (o)
- Prof. F.J. Keune (o)
- Prof. R.H.P. Kleiss (o)
- Prof. H.T. Koelink (o)
- Prof. J.M.E. Kuipers (o)
- Prof. N.P. Landsman (o)
- Prof. A.N.J.J. Schellekens (e)
- Prof. J.H.M. Steenbrink (o)
- Prof. M.C.A. van Zuijlen (o)

**Tenured**

- Full Professors: 4.4 FTE
- Associate Professors: 2.8 FTE
- Assistant Professors: 2.8 FTE

**Non-tenured**

- Researchers: 10.4 FTE
- Doctoral candidates: 20.3 FTE

- Dr James won the Bragg Medal for best physics thesis in Australia
- Dr Hu and Dr De Bondt were awarded PhDs cum laude.

**Research facilities**

Experimental groups make use of leading national and international astronomical and astroparticle observatories (ESO, La Palma, LOFAR, LOPES, HST, Kascade-Grande and Pierre Auger) and high-energy particle accelerators (LEP, LHC and Tevatron). The LHC produced its first particle collisions in 2009. The Institute itself houses two optical telescopes and a radio interferometer, which are used for educational activities and to encourage public participation. The Institute has ‘computing farms’ for both astrophysics and particle physics. It also makes use of the faculty’s mechanical and electronics’ workshops and the facilities of the Amsterdam-based National Institute for Nuclear and High-Energy Physics (Nikhef).

**Collaboration**

Mathematicians based in Nijmegen are involved in the NWO mathematics clusters DIAMANT (Discrete, Interactive & Algorithmic Mathematics, Algebra & Number Theory) and GQT (Geometry and Quantum Theory). Mathematical physicists at the IMAPP make a leading contribution to GQT.

The elementary particle physics group – a partner in the Nikhef – is associated with the European Laboratory for Particle Physics (CERN in Switzerland) and the Fermi National Accelerator Laboratory (FNAL in the USA). There is intensive collaboration involving the particle physics theory group with KEK, RIKEN, Tokyo Hosei and Osaka EC University in Japan, Demokritos in Greece and the University of Granada in Spain. Astronomical research is carried out within the framework of the top research school NOVA and in association with ASTRON, SRON and ESA. The Nijmegen
Institute for Mathematics, Astrophysics and Particle Physics

Dr Haili Hu’s graduated cum laude with her PhD thesis ‘Backtracking the evolution of subdwarf B stars with asteroseismology’. She also received an NWO Rubicon award, which will enable her to work for two years at the Astronomy Department of the University of Cambridge (UK).

The Institute participates in the following Dutch national research schools: MRI (mathematics), OSAF (elementary particles), LOTN (theoretical physics) and NOVA (astronomy). All researchers at the institute are a member of one or other of these research schools, which are accredited by the Royal Netherlands Academy of Arts and Sciences.

Research results

Research on the foundations of quantum theory and its relationship with classical physics led to a link being established between quantum theory and topos theory, thus paving the way for improving our understanding of quantum information theory. The research on non-commutative geometry and its application to elementary particle physics theory continued with the description of a supersymmetric version of Quantum Chromodynamics. The study of a specific example of a non-compact quantum group led to several new questions for special functions of basic hypergeometric type. Research on non-commutative integration theory in the context of quantum groups and non-commutative geometry and von Neumann algebras led to first results on the interplay between co-representation theory and Tomita-Takesaki theory. The research in the direction of matrix-valued spherical functions on Lie groups seems to be moving towards a general theory and several new examples of matrix-valued orthogonal polynomials.

In the study of quantum information theory, dark sub-spaces of Hilbert spaces were discovered from which no information can escape. The relationship between these dark sub-spaces and quantum correction codes with the Heisenberg uncertainty principle was analysed. A relationship was established between the combinatorics of the Dyson series and the Galton-Watson theory on the extinction of surnames.

The link that was established between the algebraic theory of automata and finite semi-group theory as a special case of extended Priestley duality has had ramifications for generalising the algebraic theory of finite state automata to a wider segment of problems in complexity theory, providing new perspectives in profinite algebras. Other work involved generalizing topological methods to non-distributive and/or categorical settings. This is relevant for substructural logics, models for the lambda calculus and for the logical foundations of quantum theory. Studies on co-algebras for modeling transition systems with uncertainty were carried out jointly with researchers at the iCIS. Cooperation with crystallographers focused on a systematic approach to partial symmetries which play a role in layered materials. A method using groupoids has been made accessible to crystallographers. It was found that an automorphism in three variables with one of them fixed can be mimicked by a list of tame automorphisms and that the Derksen group mimics the tame automorphism group. The ILLL algorithm for the simultaneous approximation of real numbers was developed. A study was made of Freiling’s axiom on throwing darts. Michiel de Bondt was awarded his PhD cum laude, for profound work on homogeneous Keller maps.
A milestone in re-orienting stochastics research to include the new area of the stochastics of the brain was the appointment of a new professor on 1 January 2010. Support was given to environmental research with studies of maximum likelihood estimators. Studies were made of the valuation of European options with stochastic volatility and stochastically risk-free interest.

In the past year the X-Shooter spectrograph was completed for the Very Large Telescope (VLT) of the Southern European Observatory. It was shipped to Chile early in 2009, commissioned at the telescope and regular observations started in October 2009. In its first semester it was already oversubscribed by a factor of 8: higher than any other instrument on the VLT.

A description and initial data from the UV Excess Survey of the Northern Galactic Plane (UVEX) were published. This will be followed by a public data release. From these Galactic Plane surveys, the first accurate catalogue of high proper motion stars in the Galactic Plane was published. A model was developed for the properties of the highly collimated jets of plasma originating in the super-massive black hole in the centre of our Milky Way. Researchers at the Institute participated in a large international effort on the Cataclysmic Variable binaries in the Sloan Digital Sky Survey. This revealed the true orbital period distribution of these systems, finding the long expected ‘period minimum spike’. On the ultra-compact AM CVn-type binaries, the initial results of a major campaign to find more of these systems were published.

A new radio-loud supernova was found in the inner, highly obscured regions of the galaxy M82, demonstrating the power of radio transient surveys for discovering rare events. The book ‘Neutron stars and Pulsars’ appeared, including a chapter by Prof. Kuijpers on the physics of pulsar drifting sub-pulses. Haili Hu was awarded her PhD cum laude for her remarkable work on combining detailed binary evolution calculations and asteroseismological properties of stars.

For the research on ultra-high energy cosmic rays, antennae for both LOFAR and the Pierre Auger Observatory were set-up and tested in the field. LOFAR is quickly reaching operational status and by the end of 2009 14 full stations were operational, allowing initial observations of the low-frequency radio sky. In a precursor experiment, the Westerbork radio array was used to set stringent limits on the highest energy cosmic ray flux from observations of the Moon serving as a colliding target. The LOPES proto-type system was exploited to investigate the properties, in particular the composition, and the radio emission of high-energy cosmic rays entering the Earth’s atmosphere. The Pierre Auger Observatory is now fully operational and many results appeared on the composition, flux and anisotropy of the highest energy cosmic rays.

The operation of the DØ experiment at the Tevatron collider at Fermilab – as well as that of the collider itself – further improved, leading to a total Run II integrated luminosity of almost 7 fb\(^{-1}\) collected (compared to 5 fb\(^{-1}\) at the end of 2008). Maintenance of the accelerator and experiment were performed during an extended shut down, leading to healthy prospects for the operation in the coming years. The single most precise measurement of the mass of the W particle was published, leading to a stronger constraint on the Higgs boson mass. Direct searches for the Higgs boson have revealed that its mass is unlikely to be around 165 GeV, while a, yet insignificant, signal is observed in the 120 to 140 GeV region, which is also indicated by precision electroweak measurements, such as the W mass. The first physics run with centre of mass energies up to 2.36 TeV – the highest humanly achieved energy in proton collisions – were established at the Large Hadron Collider at CERN at the end of 2009. The Atlas experiment was able to record data very efficiently and with near-perfect quality measurements. The electronics of the Atlas muon detection system that was designed, produced and commissioned by IMAPP and Nikhef, performs exactly as expected. At the end of 2009 a short technical stop was scheduled with an envisaged operation at a record collision energy of 7 TeV in 2010 and 2011 to collect a large data set. IMAPP prepared search analyses for the Higgs boson and supersymmetry at the LHC are ready to be applied to the data in 2010 and beyond.

Research on the concavity properties of theories with non-concave potentials was extended to Minkowski space. As a side-effect the long-standing problem of why a minimum of the action contributes to the path-integral and a maximum does not was solved. The uniqueness of the Kalb-Ramond field as the only mass-less boson state with non-maximal spin was proven. Spinor techniques were applied to allow a unified treatment of Dirac and Majorana fermions, which is important for supersymmetric models. The next-to-leading log resummation for squark-squark and squark-gluino production at hadron colliders was finished, completing the next-to-leading log resummation of the leading order supersymmetry production.

Societal impact

The Institute’s fundamental research is designed with long-term objectives in mind. Many results will only produce an impact in future decades, but may then have far-reaching consequences, even changing the way we view the world. The Institute plays an important role in national discussions on science and mathematics in secondary education, e.g. supporting the development of the new subjects Advanced mathematics and Nature, Life and Technology, as well as influencing the mathematics and physics syllabi in secondary education at the highest political level. Four staff members teach in the prestigious honours programme at the University. The Nijmegen Annual Mathematics Tournament and the national Kangaroo mathematics competition, both organized by IMAPP, have significantly improved the popularity and visibility of mathematics among school children. The Institute initiated the HiSPARC project, which involves placing air-shower array telescopes on high-school roofs (http://www.hef.kun.nl/nahsa). The astronomy
Key publications


Dissertations: 8
Scientific publications: 235
Professional publications: 2

Future research

A central topic of research at IMAPP is the origin and evolution of the universe. For the study of cosmic rays, techniques from radio astronomy and elementary particle physics are used and there is full cooperation between the astrophysicists and particle physicists in IMAPP. In elementary particle physics, an important topic is on the structure of the vacuum and the associated Higgs mechanism. The Tevatron collider provides a unique opportunity to get first hints of the Higgs boson, while in the long run the LHC will definitely discover and measure important properties of the Higgs boson. Knowledge of the vacuum has significant implications for our understanding of cosmology.

The mathematical physics department concentrates on methods originating in the mathematical foundations and analysis of quantum theory, applying these in quantum information theory, non-commutative geometry and in pure mathematics. These methods have profound implications for the interpretation of quantum physics theories and measurements as well as practical implications for formulating theories.
Director: Prof. Sijbrand de Jong

Sijbrand de Jong has been a Full Professor of Experimental Physics at Radboud University Nijmegen since 1998. From 1990 to 1998 he served in several functions at CERN in Geneva, Switzerland. He is an expert in the physics of elementary particles. His research focuses on the Higgs mechanism, which he studies at the large accelerators in CERN (Geneva) and Fermilab (Chicago), and on the origin of ultra high energy cosmic rays, which he studies at the Pierre Auger Observatory (Malargue, Argentina).

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The theoretical particle physics department uses existing theories to develop and implement methods for calculating measurable observables. A new research line has started, which combines algebra and logic, with extensions to both mathematical physics and computer science. Work on intuitionistic mathematics has been strengthened by the new algebra and logic research. The search for a proof of the Jacobian conjecture continues to generate valuable spin-off. The appointment of a new professor of applied stochastics makes it possible for the stochastics department to start research in the overlap region of stochastics, physics and neuroscience. Joint research with the Donders Centre for Neuroscience has also been initiated. A visiting professor of applied numerical mathematics has been appointed to balance teaching in both pure and applied mathematics.
Computer systems now influence virtually every aspect of our lives. Sometimes these systems appear in an easily recognizable form, as in eCommerce sites such as Amazon, and pocket calculators, but they are also increasingly hidden inside public transport cards (OV chip), television sets, multimedia devices, mobile phones, cars and washing machines, for example. This trend is known as ambient computing. However, while computing is becoming increasingly pervasive, there are growing problems with software in terms of security (breaches of information access restrictions or privacy), reliability (the system behaves erratically), safety (use of the system is harmful), trustworthiness (low reliability of system services), efficiency (the system is unable to handle problems of a particular size) and conformity with requirements. The inherent complexity of computer-based artefacts – together with the slow pace of software development, high costs and strong competitive pressures – further complicates the search for solutions.

The Institute for Computing and Information Sciences (ICIS) was established to improve the fundamentals of software development via formal, mathematically founded theories, methods and tools that support the specification, design, analysis and evaluation of computer-based systems. Research aims include improving the quality of software, with an emphasis on enhancing reliability, security, architecture, and system alignment. Work at the Institute is inspired by problems encountered in society, and in other disciplines. The applicability of the methods and tools is validated by tackling these problems. In 2009 the research at ICIS was assessed by an international committee. This committee was impressed by the Institute’s outstanding performance and judged its research programmes as strong, with outstanding researchers in all disciplines.

Research within ICIS is organized around three themes:

**Model-Based System Development (MBSD)**

to explore various formal methods for model construction, implementation, testing and validation with the explicit aim of bridging the gap between theory and practice through collaboration with stakeholders from industry and a range of application areas.

**Digital Security (DS)**
to develop theories and formal methods to analyze and improve the security of the digital world. This involves on the one hand investigating the security and correctness of software and other systems, and on the other identity-centric security and privacy, i.e. notions and protocols for managing and protecting digital identity.

**Intelligent Systems (IS)**
to develop and apply intelligent systems that can learn knowledge and reason with it, with as a long-term research goal aligning computer-based intelligent systems with their users, answering questions such as how to optimally combine knowledge from human experts and measurement data, how to enable users to guide computerized proof assistants and how to let humans profit optimally from a large repository of structured knowledge.

**Collaboration**
International cooperation is integral to the work done at ICIS, because developments in computing take place around the globe. Partners include the Dutch Ministry of Home Affairs (BPR), ST Microelectronics, Brussels, Belgium (PINPAS), University of Grenoble Joseph Fourier, France (Tarot), RWTH Aachen, Germany (Quasimodo, Mobius), Cap Gemini, Netherlands
Research results

In December ICIS was very successful in the NWO Open Competition: four projects were granted, in two of which ICIS was the main applicant. As a result, about half of the available money will come to Nijmegen.

In 2009 groundbreaking work on the cryptanalysis of RFID tags continued, resulting in a successful card-only attack on the Mifare Classic chip, which was awarded the IEEE Security and Privacy Magazine Outstanding Paper Award. The European project Mobius, on enabling Proof-Carrying Code for Java enabled devices, was successfully concluded and judged to be excellent in the final review. Work in this project on type enforcement of the immutability of object was published at ECOOP’2009. Chris Heunen was awarded a Rubicon grant by the Netherlands Organization for Scientific Research (NWO), which enables him to continue his research in ‘Quantum theory and categorical logic’ for two years at Oxford University after finishing his PhD. In June an international symposium entitled ‘In search of privacy’ was held, which was concluded by the inaugural lecture by Wessel Kraaij as Professor of Information Filtering and Aggregation. Ongoing collaboration with Makerere University in Uganda resulted in the successful defence of a PhD thesis on Service-Oriented Architectures by Benjamin Kanagwa.

In the context of our research on brain-computer interfacing the section Intelligent Systems developed and successfully tested a new paradigm based on covert attention, which allows continuous, rather than just binary (yes/no) control. The corresponding poster received the BrainGain poster award. Within a Vici project, new machine learning methods were developed for data representation and instance selection, which have been published in a high-impact-factor journal and presented at a top machine learning conference. In the Mind-Brain-Mindfulness line several experiments were finalized, most notably on the effects of mindfulness-based cognitive therapy and mindfulness meditation. Russel O’Connor received the judicium cum laude for an outstanding PhD thesis on formalizing logic and analysis in type theory. The MathWiki project started and initial experiments with wiki and Web technology for proof assistant support were carried out. Adriana Birlutiu received a Frye Stipendium.
Key publications


Dissertations: 9
Scientific publications: 154
Professional publications: 2

The Model-Based System Development section extended the specification language VDM++ with asynchronous communication and improved timing primitives, and defined an interface for co-simulating a VDM++ model with a continuous-time model of its environment. The meaning of the VDM extensions and the co-simulation concept has been formalized using an operational semantics. In addition, a tool has been developed that automatically translates a large subset of VDM and its associated proof obligations, which ensure model consistency, to the theorem prover HOL. Application of this approach to four case studies shows that a high degree of automation can be achieved. A tool for model-based testing has been developed, which has proven its worth in testing the new Dutch electronic passport. The section has also investigated probabilistic graphical approaches for mammographic diagnosis of breast cancer and demonstrated their advantages over black-box models such as neural networks for the same task. Work on the use of high level programming language concepts for defining workflow systems has resulted in a working prototype, the iTask workflow system.

In October the 4th SIKS/BENAIS Conference on Enterprise Information Systems was organized by members of MBSD specialized in enterprise engineering.

Societal impact

The Institute’s impact is evident in various industrial projects designed to improve the quality of software, for instance in the medical domain (decision support systems in the context of breast cancer screening, system development for electronic monitoring of pregnant women with high risk of toxaemia, and testing ‘mindfulness’), as well as with Océ® and ASML (model checking). Computer security and privacy are hot topics in our information society and the Institute has continued to play a prominent role in the public debate about such issues. In doing so, the group has contributed to broader awareness that security issues can make or break large ICT projects. The group’s expertise in these matters also continues to be actively sought, especially by various branches of the Dutch government. For instance, Prof. Jacobs was invited
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I: www.cs.ru.nl

Director: Prof. Tom Heskes

Tom Heskes has been a Full Professor since 2008, specializing in Artificial Intelligence, in particular Bayesian machine learning. Since 2007 he has been a Principal Investigator at the Institute for Computing and Information Sciences and an Affiliated Principal Investigator at the Donders Centre for Neuroscience. He won a prestigious Vici grant from the Netherlands Organization for Scientific Research in 2006 and is Editor-in-Chief of the journal Neurocomputing.

Future research

Within the section Intelligent Systems two new NWO projects have been granted: ‘Graphs for Multi-Task Learning’ in which research will be done on task relatedness based on an approach that combines graphs and non-parametric machine learning techniques, to improve generalization performance of multi-task learning algorithms. The other project is RUMPHI (Regulation Underlying Malaria Parasite Host Interactions) in which a new statistical model describing the activities of genes will be developed to understand the molecular mechanisms involved in the interaction between the malaria parasite and the patient’s immune system. Within the section Model-Based System Development Dr. Hommersom, who received a Veni grant in November 2009, will carry out research to improve clinical management, using statistical relational learning. Within the section Digital Security the potential for certifying the correctness of software written in Real-Time Java will be investigated in the new European research project CHARTER. This software may for instance be used in airplanes, cars, and medical equipment. Research will also continue on other projects, including the European FP7 project Quasimodo, StatPro kits for monitoring pregnant women, Prof. Heskes’ Vici project on new machine learning methods and research on identity-centric security.
In today’s knowledge society, technoscientific and societal developments are closely interrelated. We are in the midst of a techno-scientific revolution affecting all domains of society, resulting in a dramatic increase in the scale and pace of knowledge production, while new research fields in ICT, genomics and nanotechnology are emerging. These developments change the way we see ourselves. Science and technology clearly have a profound influence on society, but the reverse is also true: society significantly shapes the ways in which science and technology evolve. ISIS brings together experts from philosophy, the social and natural sciences to better understand, assess and improve the interaction between science, technology and society. In collaboration with other research institutes, our aim is to address the societal issues involved in ‘pervasive science’, the core theme of the Faculty of Science.

The Institute consists of three departments: the Department of Philosophy and Science Studies, the Department for Sustainable Management of Resources (DSMR) and the Department for Innovation Studies. Together, we address the following issues New visions of nature, Societal aspects of emerging life sciences, Sustainability and Managing innovation.

Department of Philosophy & Science Studies
In 2004 the Centre for Society & Genomics (CSG) was established at the Department of Philosophy & Science Studies, funded by the Netherlands Genomics Initiative (NGI). CSG is an interactive research centre that combines scholarly activities with innovative societal interaction and collaboration with genomics researchers, policy makers and societal stakeholders. In 2008 the successor of CSG, CSG Next has started. This programme for societal research and interaction in the field of genomics will run for a period of five years (2008-2012). The basic objective is to improve the societal embedding of genomics as well as the quality of the societal debate. Our research is developed along three lines: governance of genomics applications, setting the agenda for producing knowledge, and communication & education. Collaboration with all 14 Genomics Centres that our funded by the NGI is a core element of the programme. Related areas of interest are science communication and public perceptions of science, animal philosophy and environmental philosophy.

Department for Sustainable Management of Resources (DSMR)
An important focus for the DSMR is sustainable water management. Researchers address a wide variety of issues, combining scientific and societal perspectives and building on the ways in which researchers, policy makers, politicians and citizens view these issues. For centuries, the emphasis has been on technological mastery of water and river systems. Now, a more ecocentric approach is emerging. This ecological approach, which is based on river ecosystems, focuses on the strategies needed for more sustainable planning and design of river basins. Economic, ecological, societal and spatial planning aspects are all important. Research is carried out on a regional, national and international scale (e.g. with the Waal river, Rhine tributaries, the Meuse, Loire, Yangtze and estuarine lakes).
Department of Innovation Studies
The Department of Innovation Studies has developed – in close connection with the Master’s track Management and Technology – the Managing Innovation, Collaboration and Outsourcing in Research and Development (MICORD) research programme, for which funding was secured from various companies, research institutes and government ministries. This programme involves studying problems related to innovation and collaboration in three sectors that are of economic importance: food, chemicals and equipment manufacturing. Research in the programme is closely related to that taking place in the Centre for Innovation Studies (CIS) at Nijmegen School of Management.

Collaboration
ISIS collaborates with a large number of academic and societal organizations, both nationally and internationally.
• Locally: with the Institute for Water and Wetland Research (IWWR), the Nijmegen Centre for Molecular Life Sciences (NCMLS) and the Centre for Innovation Studies (CIS).
• Regionally: Waalweelde and Freude am Fluss are projects in which various regional societal partners participate.
• Nationally: CSG is a national research centre that is located at the institute. The current programme (CSG Next) involves collaboration with six peer departments at other universities and with sixteen research centres of the genomics network funded by NGI, but also with societal organizations and industry.
• Internationally (see below).

International collaboration
Department of Philosophy / CSG
CSG collaborates with a number of international partners, notably the ESRC Centre for Economic and Social Aspects of Genomics (CESAGen) at Lancaster and Cardiff Universities in the UK. Each year, international conferences on the societal aspects of genomics are jointly organized. CESAGen and CSG together host the online journal Genomics, Society & Policy. Through international funding opportunities the Department is consolidating an international network of groups working in the field of ELSA life sciences research.
Key publications


Dissertations: 2
Scientific publications: 78
Professional publications: 3

DSMR

• With the University of Duisburg-Essen and in collaboration with IWWR, ISIS offers a two-year international Master’s programme on Transnational Ecosystem-based Water Management (www.twm-master.com).

• Together with Chinese, Netherlands and German governmental and nongovernmental organisations, (GOs and NGOs) as well as universities, a knowledge exchange platform was launched to explore sustainable river basin management (the Healthy Yangtze project). This project forms an arena in which scientists, consultants, civil servants and entrepreneurs involved in water management innovations can exchange knowledge and experiences and identify cooperative ventures in research, education and business. Participants in China are the Tsinghua University, the Chinese Academy of Sciences and the National Science Foundation.

• The DSMR is either lead applicant or otherwise involved in four research/educational projects funded by one of the three European INTERREG programmes (Interreg A, B and C), in which various GOs, NGOs and universities are involved:
  - Transnational Water Management (Interreg IIIA); Germany, the Netherlands
  - SIRE (Interreg IIIA); Germany, the Netherlands.
  - Freude am Fluss (Interreg IIIB); Germany, France and the Netherlands
  - River Cross (Interreg IIIC); Germany, Greece, Poland and the Netherlands.

Innovation studies

MICORD receives funding for its research programme from a number of international companies, including AkzoNobel, Philips, Shell and the Dutch Polymer Institute.

Research results

Department of Philosophy & Science Studies

With ten PhD projects and a team of professors and assistant professors, the department has developed into a prominent, prolific research group, both nationally and internationally. In terms of team work, a highlight was the academic volume ‘New Visions of Nature; Complexity and Authenticity’ edited by Drenthen, Keulartz and Proctor.

DSMR

In November 2009 a kick-off conference was held to start the project Waalweelde Duurzaam. This conference was attended by 80 managers and other people involved in the environmental planning of the Waalstretch between Lobith and Gorinchem. Irene Dankelman MSc headed the Radboud Delegation to the Conference of Parties of the UNFCCC in Copenhagen in December 2009.
Director: Prof. Hub Zwart

Hub Zwart has been a Full Professor Philosophy of Science at Radboud University Nijmegen since 2000. The focus of his research is on epistemological and ethical issues in the life sciences: biomedicine (1988-1996), research with animals (1996-2003), environmental research (1998-2003), genomics (2003-now). He was also European leader of the EU-Canada exchange program Coastal Values (1999-2003). Since 2004 Prof. Zwart has been the director of the Centre for Society & Genomics. He is a co-editor of the journal Genomics, Society & Policy and member of the Editorial Boards of the journals Environmental Values and Tailoring Biotechnologies.

Department of Innovation Studies

The MICORD programme, which covers innovation processes in all major types of industrial sectors, involves six externally funded PhD projects as well as senior researchers. The programme organized two meetings to inform its sponsors (including several large companies as well as ministries, TNO and NWO) about the progress of research. Two PhD theses were completed in 2009 and these will be defended in 2010. The research done has shown that personal networks are of great importance to the innovative power of firms in the food industry, including networks in society. Also research on knowledge sharing between industry and knowledge institutes has shown that its most important use is in discontinuous innovation and technical competence building.

Societal impact

The innovative, interactive research agendas carried out at ISIS have a high degree of public visibility and relevance for society and policy. The Centre for Society & Genomics, which hosts the public website watisgenomics.nl (~20,000 hits each month), organizes a number of interactive workshops, public debates and on-line discussions (DNA dialogues) in collaboration with established podia such as the LUX cultural centre and various popular magazines. Continuous, systematic interaction with a variety of stakeholders and developing new tools for interactive research are key features of CSG’s methodology. Evidence of the societal outreach of the DSMR’s research can be found in the large number of public partners that collaborate in its projects, including government ministries, regional governmental organizations and – internationally – non-governmental organizations in China, Western Europe, Eastern Europe and the EU Rhine-Waal region. Educational programmes and materials have been developed that are used to train international professionals and academics and research has been undertaken to resolve specific issues raised by the partners. Regional development plans are structured according to a Joint Planning Approach, a stepwise decision-making method that involves all relevant stakeholders. The Department of Innovation Studies also involves key societal stakeholders in developing its research programme, in particular those from industry.

Future research

While genomics is now considered a ‘normal science’, new fields and challenges are emerging in the life sciences, such as synthetic biology, biomaterials and the convergence of genomics with brain research, raising new issues and concerns. CSG is now preparing a programme (CSG 3.0), which will include new themes and new strategic partnerships with research Institutes and industry. Over the next two years, the DSMR will guide and facilitate the transition process to Sustainability of the Waal between Lobith and Gorinchem in the Waalweelde Duurzaam project. The department of Innovation Studies is developing new ideas for research programmes that will be submitted early in 2010. In line with the goals of ISIS, these proposals will involve cooperation with a variety of societal partners. In total, at least five theses will be delivered in 2010. ISIS also has a new challenge: to mature into an Institute of national and international renown among academics and students as well as public and private partners.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
<th>Description</th>
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<tbody>
<tr>
<td>AGIKO</td>
<td>Arts/assistent-geneeskundige in opleiding tot klinisch onderzoeker – someone who has a Master’s degree in Medicine, has met the internship requirements, and is training as a clinical researcher</td>
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<tr>
<td>BSI</td>
<td>Behavioural Science Institute</td>
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<td>CLS</td>
<td>Centre for Language Studies</td>
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<td>CMBI</td>
<td>Centre for Molecular and Biomolecular Informatics</td>
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<td>CMR</td>
<td>Centrum voor Migratierecht – Centre for Migration Law</td>
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<td>CNR</td>
<td>Centrum voor Notarieel Recht – Centre for Notarial Law</td>
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<td>DCC</td>
<td>Donders Centre for Cognition</td>
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<td>DCCN</td>
<td>Donders Centre for Cognitive Neuroimaging</td>
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<td>DCN</td>
<td>Donders Centre for Neuroscience</td>
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<td>DFG</td>
<td>Deutsche Forschungsgemeinschaft – German Research Foundation</td>
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<td>DFN</td>
<td>Diabetes Fonds Nederland – Dutch Diabetes Research Foundation</td>
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<td>ERC</td>
<td>European Research Council</td>
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<td>ESF</td>
<td>European Science Foundation</td>
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<td>FOM</td>
<td>Stichting voor Fundamenteel Onderzoek der Materie – Foundation for Fundamental Research on Matter (Netherlands)</td>
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<tr>
<td>FP6; FP7</td>
<td>EU Framework Programme 6, respectively 7</td>
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<td>FTE</td>
<td>Full-time equivalent for research</td>
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<tr>
<td>FTE1st</td>
<td>Full-time equivalent for research directly funded by government</td>
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<tr>
<td>FTE2nd</td>
<td>Full-time equivalent for research funded by KNAW or NWO</td>
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<tr>
<td>FTE3rd</td>
<td>Full-time equivalent for research funded by other public and/or private organizations</td>
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<tr>
<td>HLCS</td>
<td>Institute for Historical, Literary and Cultural Studies</td>
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<td>ICIS</td>
<td>Institute for Computing and Information Sciences</td>
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<td>IGMD</td>
<td>Institute for Genetic and Metabolic Diseases</td>
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<tr>
<td>IMAPP</td>
<td>Institute for Mathematics, Astrophysics and Particle Physics</td>
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<tr>
<td>IMM</td>
<td>Institute for Molecules and Materials</td>
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<tr>
<td>IMR</td>
<td>Institute for Management Research</td>
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<tr>
<td>IRUN</td>
<td>International Research Universities Network</td>
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<tr>
<td>ISIS</td>
<td>Institute for Science, Innovation &amp; Society</td>
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<td>IST</td>
<td>Information Society Technologies</td>
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<td>ITEA</td>
<td>Information Technology for European Advancement</td>
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<tr>
<td>IWWR</td>
<td>Institute for Water and Wetland Research</td>
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<tr>
<td>KNAW</td>
<td>Koninklijke Nederlandse Academie van Wetenschappen – Royal Netherlands Academy of Arts and Sciences</td>
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<td>KWF</td>
<td>Koninkin Wilhelmina Fonds – Dutch Cancer Foundation</td>
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<td>MPI</td>
<td>Max Planck Institute for Psycholinguistics, Nijmegen</td>
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<td>NCEBP</td>
<td>Nijmegen Centre for Evidence-Based Practice</td>
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<tr>
<td>NCMLS</td>
<td>Nijmegen Centre for Molecular Life Sciences</td>
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<td>NHC</td>
<td>Nederlandse Hartstichting – Netherlands Heart Foundation</td>
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<td>NISCO</td>
<td>Nijmegen Institute for Social &amp; Cultural Research</td>
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<tr>
<td>NROG</td>
<td>Nationaal Regio-Orgaan Genomics – Netherlands Genomics Initiative</td>
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<td>NWO</td>
<td>Nederlandse Organisatie voor Wetenschappelijk Onderzoek – Netherlands Organisation for Scientific Research</td>
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<tr>
<td>N4i</td>
<td>Nijmegen Institute for Infection, Inflammation and Immunity</td>
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<tr>
<td>OO&amp;R</td>
<td>Onderzoekscentrum voor Onderneming &amp; Recht – Business and Law Research Centre</td>
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<td>RST</td>
<td>Research Institute for Religious Studies and Theology</td>
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<tr>
<td>Senter</td>
<td>An agency of the Netherlands Ministry of Economic Affairs which is responsible for managing grant allocation in technology, energy, environment, export and international cooperation</td>
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<tr>
<td>Spinoza</td>
<td>The most prestigious prize for scientists in the Netherlands who are at the very top of their research profession, awarded by NWO</td>
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<tr>
<td>SteR</td>
<td>Onderzoekscentrum voor Staat en Recht – Centre for State and Law</td>
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<tr>
<td>STW</td>
<td>Technologiestichting STW – Technology Foundation STW (Netherlands)</td>
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<tr>
<td>UMC</td>
<td>Radboud University Nijmegen Medical Centre</td>
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<tr>
<td>Veni grant</td>
<td>Personal grant from NWO awarded over a period of three years to researchers who have recently obtained their PhD, to allow them to continue to develop their ideas</td>
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<tr>
<td>Vidi grant</td>
<td>Personal grant from NWO awarded over a period of five years to researchers who wish to develop an innovative line of research in which they appoint one or more co-researchers</td>
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<tr>
<td>Vici grant</td>
<td>Personal grant from NWO awarded over a period of five years to senior researchers who wish to establish their own research group</td>
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<tr>
<td>ZonMw</td>
<td>ZorgOnderzoek Nederland NWO Medische Wetenschappen – Netherlands Organisation for Health Research and Development</td>
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