A high resolution observation in the H-alpha line of a dust lane in the outskirts of the Rosette Nebula, a nearby star formation region, as observed by the European Galactic Plane Surveys.
The past year proved to be another good one for Radboud University Nijmegen. Both the quality and the quantity of our research output have again increased substantially. Researchers from our 17 institutes have published more papers, many of which have been accepted by leading journals, while ten percent more young scientists received a PhD degree than in 2010.

External funding is becoming increasingly important for all Dutch universities. Against this strong competition, we have been very successful in acquiring research funding. The relatively large number of research grants received and prizes won in 2011 shows once again that the quality of our research is also recognized by external experts. We are especially proud of Professor Heino Falcke, who received the prestigious Spinoza Prize for his ground-breaking work on black holes and cosmic particles.

Since the work done at this University is firmly embedded in important societal issues, we aim to bridge the gap between academic research and practical applications. From language research and biology to social science, many of the projects that started in 2011 help to expand the limits of knowledge and human capabilities. The University has demonstrated an ability to successfully translate scientific expertise into projects with societal relevance, for example through four valorization grants that were awarded to Radboud spin-off companies by the Netherlands Technology Foundation (STW) and by the election of Professor Bas Bloem as ‘National Healthcare Hero’.

External evaluations of the Behavioural Science Institute, the Nijmegen Centre for Evidence-Based Practice and the Nijmegen Centre for Molecular Life Sciences – as well as national evaluations of Chemistry and Physics research – have shown that our institutes are in better than good shape and that the University is continuing to improve. This brings us one step closer to our ambition of becoming one of the world’s leading academic institutions.

As you can read in this report, the well-defined strategy, the emphasis on high-quality research and the clear societal mission of the Radboud University Nijmegen are bearing fruit.
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Introduction

The Radboud University Nijmegen is a student-oriented research university. We focus on quality, combining excellent education with leading-edge research. While leaving scope for diversity, we concentrate on four of the five major academic domains: Arts & Humanities, Social Sciences, Natural Sciences and Life Sciences. For work in the fifth domain (Technical Sciences) – which is not one of our core competencies – we cooperate closely with colleagues at the University of Twente, Eindhoven University of Technology and Wageningen University & Research Centre. Furthermore, our academic expertise is closely connected to important societal issues, both in the public and in the private domain.

Our ambition

Research at the University is organized within 17 dedicated institutes. These are responsible for planning research as well as for training and supervising new generations of researchers. We aim to ensure that all research programmes within the institutes are internationally competitive and make a significant contribution to each discourse community. Consequently, in independent peer review assessments, all research programmes are expected to receive at least “very good” for the criteria quality, productivity, societal relevance and vitality.

Regarding these criteria, all research institutes and their programmes have evolved and improved in recent years. The quality of research has been further enhanced by close cooperation with partners who complement our expertise, such as the various Max Planck Institutes, the Fraunhofer Institutes and the Netherlands Foundation for Fundamental Research on Matter (FOM). We also regularly join forces with a large number of academic partner institutions worldwide (see inside front cover).

It is our ultimate aim to become one of the leading academic institutions in the world. In 2011, we once again made good progress towards achieving this ambition. In the fourth successive year the Radboud University Nijmegen has risen on the Academic Ranking of World Universities (ARWU; Shanghai), reaching the 135th position in 2011. Numbers of academic publications, publications in top-ranking journals, citation impact scores, dissertations and research grants – mostly obtained in strong competition with other universities – have increased substantially (see Figures 1-4).

Aims for the near future are 1) to increase our academic impact, 2) to strengthen our societal impact and 3) to intensify utilization of our research results.

Our scientific profile

All research carried out at Radboud University Nijmegen already is or should soon become leading nationally and competitive internationally. Among the research topics, nine sub-disciplines have been identified in which the quality exceeds the generally high level of the rest of the University.

Organic Chemistry

The focus areas within Chemistry at our University (Material Science, Life Science, Biomedical Science and Supra-Molecular Chemistry) are all grounded in Organic Chemistry. We concentrate on Synthesis and on Physical Organic Chemistry, and recently the input from the Life Sciences has become more important. This research takes place within the Institute for Molecules and Materials as well as in the Nijmegen Centre for Molecular Life Sciences. The research infrastructure and facilities within these institutes are excellent. Another indication of top-quality research in Organic Chemistry is the numerous prestigious grants awarded in recent years, such as ERC Advanced Grants, Spinoza Awards and Netherlands Organisation for Scientific Research (NWO) Vici grants. In 2011, the Eindhoven University of Technology and Radboud University Nijmegen agreed to join forces in this field of research.

Physics of Condensed Matter

Research at the University on the Physics of Condensed Matter is strongly interrelated with Chemistry research. It is embedded in the national programmes Nanonved and Nanonext, as well as in international EU programmes. Unique infrastructures such as the High Field Magnet Laboratory (HFML) and three advanced Free-electron Laser Units (FELIX/FELICE/FLARE) create excellent opportunities for further extending international cooperation. Both Experimental Physics of Condensed Matter and Theoretical Physics of Condensed Matter at our University are at the forefront of current science. The cooperation between experimentalists and theoreticians on graphene formed the basis for the 2010 Nobel Prize in Physics, which was awarded to former Associate Professor Konstantin Novoselov, a PhD graduate from our University and current Extraordinary Professor André Geim and Professor Andrei Kelin.

Astrophysics

For many decades the Astrophysical research in the Netherlands has been influential and well organized. This research started more recently in Nijmegen. Since 2001, when a group of highly talented researchers joined us, Astrophysical research at our University has become truly competitive internationally. It focuses on the evolution of double stars, compact objects and astrophysical particles. The quality of the research is evident from the successful acquisition of prestigious grants such as ERC Advanced Grants and the Spinoza Award.

Microbiology

The research on gene-environment interactions at the University concentrates on the composition, functioning and evolution of ecosystems. This includes all major biotic organisms such as microorganisms, plants and animals, and their interactions. Adaptation and response to stress by these organisms are being investigated at the level of their molecular and physiological regulation mechanisms. The team of Microbiologists at the University focus on the reaction of ecosystems to water quantity and water quality. In particular,
their research on Anammox bacteria – that are able to efficiently degrade ammonium without oxygen – led to revolutionary new insights and world-class publications. The excellent quality of research in this field is demonstrated, for instance, by the team receiving an ERC Advanced Grant.

Cognitive Neurosciences

In 2000 the University established the F.C. Donders Centre for Cognitive Neuroimaging. In recent years leading-edge research on brain and cognition has accelerated and several related institutes on the campus joined forces to form the current Donders Institute for Brain, Cognition and Behaviour. Affiliated institutes (also on the campus) are: the Max Planck Institute for Psycholinguistics, the Centre for Language Studies and the Behavioural Science Institute.

The Cognitive Neurosciences at our University cover all aspects that are important for “cognition”: from molecules and genes, neurons and networks of brain areas, to behavioural and clinical implications. The multi-disciplinary approach taken by physicists, biologists, chemists, psychologists and informaticists, as well as the excellent advanced infrastructure and facilities create the conditions for high-quality research. This is apparent from the many grants won in strong competition by this institute: the ERC Advanced Grant, the Spinoza Award and several NWO Vici grants.

Infection and Immunology

Fundamental research and clinical translational research at the University take place at the interface between micro-organisms and man, defence mechanisms and inflammation mechanisms at infections, inflammatory diseases (such as auto-immune diseases), and on cancer and transplantation. There is close cooperation with researchers at the clinical centres for infective diseases, inflammatory diseases and immune diseases. The successful acquisition of several prestigious grants, such as the ERC Advanced Grant, the Spinoza Award and NWO Vici grants, confirm the excellent performance of the teams involved in Infection and Immunology.

Human Genetics

The identification of genes involved in congenital abnormalities, mental retardation, psychiatric diseases, heritable development of tumours, deafness, and blindness – as well as the mode of action of these genes – are studied at our University. The Human Genetics researchers have access to the most advanced technologies and modern Bio-informatics equipment. In addition to fundamental research, translational research is also highly successful. Some of the newest genetic techniques for diagnosis (such as DNA chips and Exome sequencing) have been applied here for the first time worldwide. The excellent qualities of the Human Genetics team are reflected in the very large number of papers published in top journals such as Cell, Nature Genetics and Science, as well as their success in acquiring multi-million euro grants from competitive research funds in the Netherlands and in the EU.
Introduction

Linguistics
Ground-breaking research on Linguistics is carried out in the fields of language, language behaviour, language and speech technology, and communication. The research focuses on two themes: Language in the mind (including learning mother tongue, production and processing of language) and Language in society (covering the use of language in diverse cultures and subcultures). Also because of the close multi-disciplinary cooperation with other institutes on the campus (especially the Max Planck Institute for Linguistics and the Donders Institute for Brain, Cognition and Behaviour) the Linguistic researchers at the Radboud University Nijmegen are among the best of the world. They have received prestigious grants such as ERC Advanced grants and the Spinoza Award.

Business and Law
Research at the Business & Law Research Centre is carried out in close cooperation with fourteen highly renowned – mostly international – law firms, financial institutions and companies. These joint efforts relate to academic research in 1) company law, 2) financing, security rights and insolvency, 3) business and patrimonial law, and 4) financial law. The Research Centre has excellent facilities and a very good library. The quality of its research is reflected in the production of numerous authoritative text books, monographs and serial volumes. Moreover, the research groups are very successful in raising funds for their studies.

Our societal themes
Much of the work done at the University is firmly embedded in important societal issues. Consequently, much of the research agenda is inspired by developments in and demands from society. As a result, we contribute significantly to achieving governmental objectives in relation to innovation. Our societal impact covers seven main themes:
• Europe’s “worlds”
• Language and communication
• Development of society and justice
• Behaviour and education
• Molecules and materials
• Water and wetlands
• Personalized medicine.

Some highlights from 2011 illustrate the relevance of our research in these themes:

Europe’s “worlds”
Until the end of the eighteenth century, the Middle Ages were dismissed as a dark, barbarian age between Antiquity and Enlightenment. Around 1800, this changed. The Middle Ages then became a period in which authentic humanity, a sense of community and mutual responsibilities could be discerned. In his seminal book (2011) ‘De ontdekking van de Middeleeuwen’ (The discovery of the Middle Ages) Prof. Peter Raedts demonstrates the ways in which people in Germany, Britain, France and Italy have constructed their own past. And it shows us why the Dutch view of their own history was completely different from that in the nations surrounding them.

Language and communication
Within the Centre for Language Studies, the Speech Technology group developed and deployed computer-assisted language learning applications and an initial reading tutor. A grant was obtained for the further development of ‘My Pronunciation Coach’ – a language guide that can be used on laptops or iPhones – into a commercial product.

Dr Elizabeth de Groot received the Best Applied Paper Award at the 2011 Conference on Corporate Communication, which was held at Baruch College, City University of New York, for her paper ’Personal Preference or Policy? Language Choice in a European-based International Organization’.

Development of society and justice
Dr Marcel Becker taught a series of seminars about integrity in public administration to civil servants. These seminars were organized in collaboration with the Office for Promoting Integrity in the Public Sector (BIOS).

Members of the Digital Security group are actively involved in issues such as privacy-friendly public transport cards, electronic road pricing and smart electricity meters and identity cards.

Dr Karen Anderson was invited to join an Expert Workshop on “The Swedish Pension System: Lessons for Germany”, organized by the Friedrich-Ebert-Stiftung, Berlin (Germany), as an academic expert.

Researchers at the Business & Law Research Centre have invested substantially in international and comparative research on insolvency law. A pilot study has been completed on the topic ‘Commencement of Insolvency Proceedings’, which has been published recently in the Oxford International & Comparative Insolvency Law (ICIL) series.

Behaviour and education
Dr Rebecca De Leeuw et al. demonstrated that adolescents with permissive parents are affected by sensation seeking tendencies and exposure to smoking models in movies.

Within the Social Development programme Dr Carolina De Weerth and colleagues showed for the first time that infant attachment to mothers is related to infant night waking and that maternal anxieties during pregnancy predict infant reactions to stressful situations.
Prof. Marianne Riksen-Walraven et al. demonstrated that friendships are a buffer against the negative effects of social rejection and help children to manage stress.

Molecules and materials
Professor Roeland Nolte won an ERC Advanced Researcher Grant to further develop his idea on a molecular tools, which will be used to catalyse successive chemical reactions in polymere molecules. His idea is inspired by the way DNA molecules are being changed in organisms.

Dr Frans Harren has obtained a grant for developing a sensitive mid-infrared Fourier Transform Spectrometer (FTS) for chemical analyses. A new generation of FTSs will be developed for real-time, reliable spectral analysis of complex chemical mixtures. In collaboration with industrial partners, the analyser will be experimentally deployed in a wide range of potential applications, such as real-time industrial process control, environmental and workplace monitoring, biological and medical diagnostics, and security applications.

Profs. Floris Rutjes and Joost Schalkwijk invented a new class of antibiotics and received a Pre-Seed Grant to facilitate business opportunities for start-ups in order to exploit original ideas and technologies.

Water and wetlands
A pilot plant study, which showed that Methylomirabilis oxyfera and anammox bacteria can together remove nitrogen compounds from industrial and municipal wastewater, had considerable impact on the application of this process in full-scale plants.

Researchers at the Aquatic Ecology and Environmental Biology group carried out two major Aquatic Science Innovation Programmes, including the first successful large-scale use of iron in lakes to combat eutrophication.

Personalized medicine
Prof. Jan Smeitink and Saskia Koene (MD), published ‘Mitochondrial Medicine, a clinical guideline’. This richly illustrated booklet (free of charge) – with contributions from many international experts – describes clinical signs and symptoms, mitochondrial syndromes, diagnostic tools and treatment options. This book has so far been distributed in Europe, Asia, the USA and Brazil.

Prof. Jelle Barentsz contributed to the 2011 European Guidelines for Prostate MRI.

Utilization
Utilization – the conversion of academic knowledge into outputs with societal value – takes place in various ways within each of the academic domains.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Interaction with society</th>
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<tbody>
<tr>
<td>Arts &amp; Humanities</td>
<td>Public debates, expositions, lectures, NGOs</td>
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<tr>
<td>Social Sciences</td>
<td>Law, Mental Healthcare Institutions, Governments, NGOs</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td>Industries, NGOs</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>Hospitals, Industries, Companies, NGOs</td>
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</table>

In order to encourage the use of academic knowledge in society the University has developed the following activities: post-academic education, joint research with private and public partners, public events, facilitating the establishment of new companies, stimulating start-up companies and educating students in entrepreneurship.

Through these activities and instruments the University has successfully spun off dozens of innovative companies in the past decade. As a result, employment in the region has increased substantially. Researchers at the University have been very successful in acquiring Valorization Grants from the Netherlands Technology Foundation (STW). The idea is to develop innovative high-tech entrepreneurship based on new results from academic research. In 2011, the STW awarded total of approximately €675,000 to various project proposals made by researchers at our University. This exceptional achievement is remarkable for a general (i.e. not technical) university and demonstrates the power and societal relevance of our research.

Some examples of utilization in 2011:
Prof. Peter Desain and Prof. James McQueen applied for a patent on their brain-computer interface (BCI) feedback system.

The Donders Centre for Cognitive Neuroimaging has several collaborative projects with industry. The Centre participates in the BrainGain and VIP Brain Networks consortia and cooperates with several partners from industry, including Siemens and DSM. The latter cooperation resulted in a joint application for a patent on functional food.
Introduction

Three Valorization Grants have been awarded to spin-offs the Institute for Molecules and Materials: TeraOptronics, SynAffix and Noviotech.

Contribution to government objectives
Recently the Dutch Government identified ten sectors of major economic importance for the Netherlands (‘Top sectors’). Around the same time the EU listed six ‘Societal Challenges’ in its strategy document ‘Horizon 2020’. The academic profile and societal themes at Radboud University Nijmegen that have been developed systematically over the last decade, fit well within the national ‘Top sectors’ and the EU’s ‘Societal Challenges’.

This can be visualized as follows:

<table>
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<th>Top-research Radboud University</th>
<th>Netherlands Economic Top-sectors</th>
<th>Societal themes Radboud University</th>
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<tr>
<td>Organic Chemistry</td>
<td>Chemistry</td>
<td>Molecules and Materials</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>High Tech Materials</td>
<td>Molecules and Materials</td>
</tr>
<tr>
<td>Physics of Condensed Matter</td>
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<tr>
<td>Infective diseases</td>
<td>Life Sciences</td>
<td>Personalized Medicine</td>
</tr>
<tr>
<td>Immunology</td>
<td>Life Sciences</td>
<td></td>
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<tr>
<td>Human Genetics</td>
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<tr>
<td>Cognitive Neurosciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microbiology</td>
<td>Water</td>
<td>Water and Wetlands</td>
</tr>
<tr>
<td>Cognitive Neurosciences</td>
<td>Agrofood</td>
<td>Behaviour and Education</td>
</tr>
<tr>
<td>Business and Law</td>
<td>Headquarters</td>
<td>Development of society and justice</td>
</tr>
<tr>
<td>Linguistics</td>
<td>Creative Industry</td>
<td>Language and Communication</td>
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<td></td>
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<td>Europe’s “worlds”</td>
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<tr>
<td>Logistics</td>
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<tr>
<td>Horticulture</td>
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<td>Energy</td>
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<th>Top-research Radboud University</th>
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<th>Societal themes Radboud University</th>
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<td>Organic Chemistry</td>
<td>Health, demographic change and wellbeing</td>
<td>Molecules and Materials</td>
</tr>
<tr>
<td>Infective diseases</td>
<td>Food security and sustainable agriculture, marine and maritime research, and bio-economy</td>
<td>Water and Wetlands</td>
</tr>
<tr>
<td>Immunology</td>
<td>Climate action, resource efficiency and raw materials</td>
<td>Molecules and Materials</td>
</tr>
<tr>
<td>Human Genetics</td>
<td>Inclusive, innovative and secure societies</td>
<td>Development of society and justice</td>
</tr>
<tr>
<td>Cognitive Neurosciences</td>
<td></td>
<td>Language and Communication</td>
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<td>Europe’s “worlds”</td>
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<tr>
<td>Organic Chemistry</td>
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<tr>
<td>Physics of Condensed Matter</td>
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<tr>
<td>Business and Law</td>
<td>Secure, clean and efficient energy</td>
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<td></td>
<td>Smart, green and integrated transport</td>
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</table>
Our scientific reputation

The NWO awards the annual Spinoza Prize to a maximum of four Dutch researchers who have reached the absolute top in their field both nationally and internationally. These scientists receive this prestigious prize for their outstanding, ground-breaking and inspiring research, and their record in enthusing young researchers.

In 2011, Prof. Heino Falcke (Full Professor in Astroparticle Physics and Radio-Astronomy at Radboud University Nijmegen) was one of the three NWO Spinoza Prize laureates. Prof. Falcke obtained this €2,500,000 prize for his research on black holes and cosmic particles.

Professor Falcke (Cologne, Germany, 1966) studied Physics at the Universities of Cologne and Bonn. He received his PhD (summa cum laude) from the University of Bonn in 1994 and started his career in Astronomy at the Max Planck Institute for Radioastronomy in Bonn, followed by work at three universities in the USA. In 2008 he received the prestigious European Research Council Advanced Investigator Grant. Professor Falcke is currently also a key researcher of the Netherlands Research School for Astronomy (NOVA), an international project scientist at the Netherlands Institute for Radio Astronomy (ASTRON), and affiliated to the Max Planck Institute for Radioastronomy in Bonn.

Black holes are probably the most mysterious objects in the universe. The gravitational pull in a black hole is so strong that even light cannot escape. Another feature of black holes is their ability to convert matter into energy very efficiently. Based on his theory and observation of the super-heavy black hole at the centre of our Milky Way and the radio emissions from there, Prof. Falcke has published a number of papers on how we should imagine a
black hole since 1998. In recent years Prof. Falcke concentrated on the new generation of radio telescopes such as the Low Frequency Array (LOFAR)-telescope. He is currently working on the origin of the most energetic cosmic particles, and contributing to the Square Kilometre Array-project, an extension of LOFAR on global scale.

External evaluations
Research institutes such as those at our University 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, including an evaluation of the training and education programme for PhD students. 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:
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 2011 the research at three research institutes at Radboud University Nijmegen was evaluated. In addition, several departments at other research institutes participated in nation-wide organized research assessments of either Chemistry or Physics.

Nijmegen Centre for Molecular Life Sciences (NCMLS)
The Evaluation Committee wrote in its report on the NCMLS:
“Quality and productivity over the entire range are high. The institute is generally regarded to perform research and education beyond an internationally competitive level. There is a good mix of volume and quality. A significant number of spin-offs have been set up and several patents have been filed. All facilities are of high quality, cover many of the essential technologies and are easily accessible. To safeguard the institute’s performance in the future it is necessary that the two partners (Faculty of Medicine and Faculty of Science) keep up the current financial and organizational support.”

In summary, the Committee assessed the research at NCMLS as “very good” to “excellent” on each of the four criteria.

Nijmegen Centre for Evidence-Based Practice (NCEBP)
The research at NCEBP was also highly appreciated. The Assessment Committee wrote: “The quality and productivity of the research of the NCEBP show impressive achievements. Most programmes and themes are outstanding. The societal impact of the institution’s research is sub-
stantial. The PhD training program is of high quality. The Committee suggests more attention should be given to developing the value of the NCEBP as a trademark. The institutional board should develop the branding of the NCEBP as a national institution that is reputed for its excellent research and implementation tools for improved healthcare. The matrix collaboration within the institute (embracing the NCEBP, the clinical departments and the University Medical Centre) is widely appreciated as fruitful and productive for innovative multidisciplinary research. Nonetheless, the matrix structure could be improved”.

In summary, for three of the four criteria NCEBP was assessed “excellent”, and for one criterion as “very good”.

Behavioural Science Institute (BSI)
The research at the BSI also received a very positive assessment. Quotes from the Assessment Report: “Clearly, the BSI is highly effective in fostering and supporting a remarkably high level of functioning in its constituent units. Most important, all six programs reported increases in the common indicators of quality (e.g., number of publications in higher impact journals, indicative Hirsch-indices for senior scholars) from 2004 to 2010. BSI collectively and programs individually report high and increasing levels of vitality. The PhD training is excellent and supervision is taken very seriously.”

In conclusion, the Committee considered the research at BSI “very good” to “excellent” for all four criteria.
Chemistry
The Assessment Committee that evaluated all Chemistry research throughout the Netherlands wrote in its report: "The Chemistry research at the Radboud University is of very high quality". On average, the nine research groups assessed received "very good" to "excellent" scores for all four criteria. As a result of the departure of their research leader during the evaluation period, two groups received somewhat lower marks.

Physics
The Physics research also received a remarkably positive assessment (on average "very good" to "excellent" for all four criteria. The Committee recommends strengthening the Biophysics research at the Donders Institute in order to better exploit the potential for applications.

In addition to these external evaluations, the NWO awarded grants for proposals from the Institute for Molecules and Materials (IMM), Nijmegen Centre for Molecular Life Sciences (NCMLS), and the National Research School for Classical Studies (OIKOS; chaired by Radboud University Nijmegen) to establish an excellent education and research environment for highly gifted young researchers.

Talent policy
The Radboud Honours Academy offers the ten percent most talented and motivated Bachelor’s students of the University the opportunity to follow a special supplementary programme during the second and third year of their Bachelor’s programme.

Radboud Honours Academy is made up of nine disciplinary honours programmes for students who wish to deepen the knowledge of their own field of study and one interdisciplinary honours programme for students who wish to broaden their knowledge of other disciplines. The programmes, which are offered in addition to the students’ regular course of study, have a workload of approximately 850 hours.

For the University it is of the utmost importance that excellent students work and study in a high-quality international academic or professional setting. This is why all of the programmes at the
Radboud Honours Academy offer students a work placement at a renowned foreign university, research institute, company or office. These associated partners of the Academy are not merely engaged in regular training. They are also involved in planning the structure of each programme and the individual coaching of students.

During their Honours programme students are personally supervised by a senior researcher, who works closely together with them in order to achieve the targets specified in the student’s personal training agreement.

At the Master’s stage talented students who plan a career in research have the opportunity to follow a two-year Research Master’s Programme. Radboud University Nijmegen has ten Research Master’s Programmes (see box on page 13).

Grants and awards for excellent young scientists
Many young scientists and Research Master’s students at the University won prestigious national or international grants or awards in 2011, competing with some of the best in the world.

In 2011 seventeen researchers received an NWO Veni grant, which will enable them to do research for three years after graduating with a PhD. The winners were Drs Shahla Abdollahi-Roodsaz, Marieke van den Brink, Emily Cross, Monique Flecken, Evert Glebbeek, Lotte Hogeweg, Alexander Holschen, Harm Kaal, Boran Kartal, Ellen Ormel, Hanneke den Ouden, Joost te Riet, Eva van Rikxoort, Pedro San-Cristobal, Frank van de Veerdonk, Jasper Visser and Joas Wagemakers.

Five post-doctoral researchers received NWO Vici grants, which will enable them to develop their line of research for five years. These grants were awarded to Drs Mirjam Ernestus, Chris de Korte, Frank van Kuppeveld, Asifa Majid and Prof. Pieter Medendorp.

Four prestigious Starting Grants from the European Research Council were awarded to Drs Pieter Medendorp, Mirjam Ernestus, Joris Veltman and Timothy Radstake. With this grant (which is worth €1,500,000) these starting top researchers can initiate their own line of investigation.

Three talented medical students (Drs Dirk Geurts; Dick Janssen and Ilse Rood) won a ZonMw AGIKO grant, which will allow them to be trained both as medical specialists and as clinical researchers.

Five young researchers received an NWO Rubicon Scholarship to enable them to go abroad to conduct research immediately after gaining their doctorates. These scholarships were awarded to Drs Sakia Haegens, Martijn Langereis, Annemarie Boleij, Jennifer Cook, and Liesbeth Janssen.

Two Research Master’s students (Alsya Affandi and Miski Mohamed) were awarded an NWO Mozaïek Grant for a four-year PhD research programme which they designed themselves. The NWO Mozaïek Grant, which is awarded to talented students from ethnic minorities, is designed to support their academic careers.

Dr Hilde Bras was elected to the Young Academy of the Royal Netherlands Academy of Arts and Sciences.

Prof. Rutger Engels won the prestigious Dutch national Huibregtsen Prize for best academic research that is remarkably innovative, while at the same time containing considerable societal promise. Prof. Engels’ research focuses on the early phase of addiction in adolescents.
The mission of the Research Institute for Philosophy, Theology and Religious Studies is to carry out top-level research using a variety of methods and approaches. The central topic of the philosophical programmes is the concept of ‘rationality’. Rationality is often seen as a distinctive characteristic of human beings. What does it mean to be a rational being, and how can ‘rationality’ be defined? From what standpoint can we judge the rationality of the beliefs, actions and practices of ourselves and of others? What are the foundations of rationality and how has this concept developed over time? The research programmes in the fields of theology and religious studies focus on the development and interaction of religions in their various social, cultural and political contexts. Their central topic is the concept of ‘transformation’, 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.

A systematic study of rationality is carried out in the following four research programmes:

- **Cognition, Interpretation and Context** – This programme relates to conceptions of belief, cognition and language. It addresses the various ways in which we interpret and understand human behaviour.
- **The Project of a Hermeneutic Philosophy** – In this programme the relationship between rationality, meaning and interpretation is examined.
- **From Natural Philosophy to Science** – This programme focuses on the emergence of science as the paradigm of rational thinking in Western Europe.
- **Ethos, Polis and Religion** – This programme focuses on the concept of ‘practical rationality’ and its impact on ethics, politics, and religion.

The study of the transformations of religions and religiosity in their various social, cultural and political contexts is carried out in the following five research programmes:

- **Trajectories of Religiosity** – This programme combines comparative religious studies with the anthropology of religion and focuses on ritual, religiosity, and the history of religions.
- **Biblical Studies, Ancient Judaism, Early Christianity, and Gnosticism** – This programme focuses on biblical and extra-biblical texts that reflect religious transformations in social, political or religious contexts.
- **Transformations of the Concepts, Practices and Representation of Discipline in Christianity** – This programme studies concepts and practices of ‘discipline’ in the history of Christianity.
- **Transformation of Religion within the Frameworks of Modernity** – This programme investigates the effects of social and cultural transformation on the normative quality of religious interpretative systems.
- **Religious Identity Transformation in Context** – This programme develops theories about the transformation of religious identity within a pluralizing and individualizing context.
Staff
Prof. P.J.J.M. Bakker (p)
Prof. W.P. van den Bercken (e)
Prof. J.A.M. Bransen (o)
Prof. H.G.G.M. Driessen (e)
Prof. G. Essen (o)
Prof. M.A.C. de Haardt (p)
Prof. P.I.M.M. van Haute (o)
Prof. C.A.M. Hermans (o)
Prof. A.J.M. van den Hoogen (p)
Prof. C.H. Lüthy (o)
Prof. H. Motzki (p)
Prof. D.A.T. Müller (o)
Prof. P.J.A. Nissen (p)
Prof. J. van Oort (p)
Prof. R.A. van der Sandt (o)
Prof. J.B.A.M. Schilderman (p)
Prof. M.V.P. Slors (o)
Prof. H.G.B. Teule (p)
Prof. J.M.M.H. Thijsen (o)
Prof. P.J.M. van Tongeren (o)
Prof. B.H. Vedder (o)
Prof. P.J.C.L. van der Velde (p)
Prof. H.J.M. Venbrux (o)
Prof. J.G. van der Watt (o)

Prof. F.J.S. Wijsen (o)
Prof. J.-P. Wils (o)
Prof. E.J. van Wolde (o)
Prof. E. van der Zweerde (p)

(o), (e) and (p) see Glossary

Tenured
Full Professors 8.8 FTE
Associate Professors 1.5 FTE
Assistant Professors 7.3 FTE
Researchers 2.8 FTE

Non-tenured
Researchers 6.4 FTE
Doctoral candidates 17.1 FTE

Research facilities
The faculty library, which is integrated into the central humanities library, houses excellent collections of books and journals on philosophy (especially the history of philosophy), theology and religious studies. In addition, it houses one of the world's largest microfilm collections of medieval and Renaissance manuscripts on logic, semantics, natural philosophy, metaphysics, and theology. The library possesses several special collections, such as the Egyptological collection of books named after the Nijmegen professor J.M.A. Janssen, and the collection of the Titus Brandsma Institute, a fine collection of books and journals on spirituality and mysticism.

The humanities library also houses the collection of the Catholic Documentation Centre, which includes a wealth of audio-visual materials, as well as a collection of about 1000 interviews on CD-ROM with Dutch missionaries about their work overseas – a unique source for anthropological and missiological research.

Collaboration
Individual researchers participate in national research schools such as the Netherlands Research School for Practical Philosophy, the Netherlands School for Advanced Studies in Theology and Religion (NOSTER) and the Netherlands Interuniversity School for Islamic Studies (NISIS).

The Institute has formal agreements of cooperation with the DePaul University (Chicago), the University of Edinburgh, the University of Fribourg (Switzerland), the University of Helsinki, the University of Istanbul, the University of Krakow, the University of Leuven, the University of Münster, the University of Paris IV (La Sorbonne), the University of Rome (La Sapienza), the University of Sao Paolo and the University of Stellenbosch.

Researchers in the fields of theology and religious studies collaborate closely with several Nijmegen-based institutes such as the Institute of Eastern Christian Studies, the Titus Brandsma Institute, the Institute of Catholic Education and the Nijmegen Institute of Mission Studies.

< Cover of book 'Democracy as Cult' by Dr Marin Terpstra, depicting 'Unterschied zwischen der waren Religion Christi und falschen abgöttischen Lehre des Antichrists in den fürnehmsten Stücken' from Lucas Cranach the Younger (1545).
Research results

Cognition, Interpretation and Context
Within the framework of this philosophy programme, Prof. Marc Slors developed a new approach to psychopathologies, according to which psychopathologies are – at a fundamental level – dysfunctions in our basic, body-based orientation to the physical and social world, rather than dysfunctions at higher levels of cognition. He organized, together with Dr Bart Geurts, an international workshop on mind reading, which brought together linguists, philosophers, and psychologists to discuss Theory of Mind and related topics. The members of the NWO project Quantity Matters were strongly represented at the Amsterdam Colloquium, which is the main international conference on semantics. Veni fellow Dr Corien Bary continued to work on direct and indirect reports and on the related distinction between mention and use.

The Project of a Hermeneutic Philosophy
In the context of his Veni project on present-day philosophical conceptions of plurality, Dr Gert-Jan van der Heiden examined to what extent the critique of Alain Badiou and others on the hermeneutic paradigm is viable. He also published a volume on the importance of ‘subjectivity’ in phenomenology (together with László Tengelyi, Inga Römer and Karel Novotný). Dr Veronica Vasterling concentrated on the hermeneutic and phenomenological import of Hannah Arendt’s philosophy of plurality. Prof. Philippe Van Haute investigated the topicality of the psychoanalytic approach to philosophical anthropology. Prof. Ben Vedder and Dr Gert-Jan van der Heiden successfully applied for a five years research project entitled Overcoming the Faith-Reason Opposition, on the importance of Saint Paul’s letters in contemporary philosophy.

From Natural Philosophy to Science
Dr Sander de Boer defended his PhD thesis on the transformations of the Aristotelian science of the soul between 1260 and 1360. Dr Hiro Hirai concluded his book entitled Medical Humanism and Natural Philosophy. This book documents for the first time the importance of medical humanism to the emergence of early modern science. Dr Carla Rita Palmerino demonstrated that up to the Newtonians of the early eighteenth century, natural philosophers routinely assumed the existence of an isomorphism between all extended magnitudes (space, time and matter). Dr Leen Spruit, an Associated Researcher at the Center of the History of Philosophy and Science, discovered the earliest manuscript of Spinoza’s Ethica in the Vatican. This discovery, which was front-page news in various national and international newspapers, sheds new light on the evolution of Spinoza’s most famous book and on the early ecclesiastic attempts to prevent its dissemination. Prof. Paul Bakker worked on the concluding volume of his NWO Vidi project during a research sabbatical at the Netherlands Institute for Advanced Studies (NIAS).

Ethos, Polis and Religion
Researchers involved in this philosophy programme worked on the role of Aristotelian ‘naturalistic’ ethics in the domains of sociobiology and the social sciences. Dr Marcel Becker and Prof. Paul van Tongeren showed that Aristotle’s ethics offers unexpected
and unexplored possibilities to account for human freedom and responsibility. Dr Marin Terpstra and Prof. Evert van der Zweerde focused on the philosophical analysis of current theories of democracy and their underlying assumptions. They also studied the controversial role of religion and the meaning of the theory of secularization. Prof. Paul van Tongeren completed a further set of lemmata for the Nietzsche-Wörterbuch and a book on nihilism and morality during a research sabbatical at NIAS.

Trajectories of Religiosity
Researchers involved in the NWO Refiguring Death Rites project – led by Prof. Venbrux and Dr Quartier – showed how new ritualizations of death in the Netherlands entail new notions of religiosity. Prof. Van der Velde’s comparative research revealed remarkable contrasts between Asia and the West with respect to the interpretation of the Buddha image and the saintly figure of the Dalai Lama. Against the background of the momentous changes in the Middle East, researchers of Islamic studies focused on the significance of concepts such as ‘democracy’ and ‘citizenship’ in the context of the ‘Arab Spring’. Dr Roel Meijer examined the Arab revolts in Tunisia, Libya, Morocco, Egypt, Syria and Bahrain. Dr Joas Wagemakers studied the ideological and national background of the concept of ‘citizenship’ for Saudi Shiites, its practical application and its implications for the future. He also obtained a NWO Veni grant for a project on Jordanian Islamic political and social activists (Loyal Subjects or Reluctant Inhabitants?). Dr Martijn de Koning focused on Salafism as a social movement. The role of artistic expressions as mobilizing forces within revolutionary changes has been taken up by Nina ter Laan MA, who received a Radboud University Frye Stipend, and Prof. Karin van Nieuwkerk.

Biblical Studies, Ancient Judaism, Early Christianity, and Gnosticism
Prof. Ellen van Wolde continued the debate on the meaning of the Hebrew verb ‘bara’ (‘to separate’, instead of ‘to create’) and its consequences for a new understanding of biblical texts on creation. Prof. Van Wolde’s views were discussed at the Annual Meeting of the American-based Society of Biblical Literature in San Francisco. In New Testament studies, Prof. Jan van der Watt focused on various aspects of Johannine ethics. He developed a new interpretation of the concept of ‘leadership’ in Johannine literature.

Transformations of the Concepts, Practices and Representation of Discipline in Christianity
Prof. Daniela Müller (with Dr Gian Ackermans) published on the position of church history as an academic discipline in its own right and on various models of female leadership in the Middle Ages. Dr Gian Ackermans studied the eighteenth-century conflict in the Catholic Church of the Northern Netherlands, which resulted in the Old Catholic Schism of 1723. He showed that the personal interaction between the bishop and the priests had a huge impact on the genesis of the schism which to this day divides Dutch Catholics.

Transformation of Religion within the Frameworks of Modernity
Dr Inigo Bocken organized a conference in Hildesheim (Germany) on Michel Foucault and Michel de Certeau. He also reconstructed the life and work of Charles de Bovelles (1470-1560). Aloys Wijngaards, MA concluded his research on the connection of public theology and economics. He investigated a dominant idea in neo-classical economics that separates positive assessments of market behavior and normative assessment of ethics and the meaning of life. Dr Ria van den Brandt and Kasia Szurmiak, MA explored new themes in holocaust studies, focusing on religious and existential discourses of Jewish victims and survivors of the Shoah.

Religious Identity Transformation in Context
Dr San van Eersel defended his PhD thesis on interreligious communication between teachers and students in primary schools. Dr Paul Vermeer studied the effects of religious upbringing on the basis of a unique longitudinal, panel dataset of more than 400 families. Prof. Chris Hermans and Dr Theo van der Zee studied afterlife beliefs of primary school children to enhance theory formation on the development of religious beliefs. In the NWO funded research programme Ethno-religious conflicts in Indonesia and the Philippines, led by Dr Carl Sterkens, large-scale quantitative survey data were gathered on this subject (3000 respondents randomly sampled). Prof. Frans Wijzen started a project on post-colonial immigrants in the Netherlands.

Societal impact
The Institute incorporates the Soeterbeeck Programme, which promotes reflection and public debate on matters of science, society, religion and worldviews, and the Kaski (Katholiek Sociaal-Kerkelijk Instituut) – a Catholic research center specializing in issues of religion and society. The Kaski publishes advisory reports at the request of various societal organizations. Individual 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.

In 2011, Dr Marcel Becker taught a series of seminars to civil servants about integrity and public administration. The seminars were organized in collaboration with the Office for Promoting Integrity in the Public Sector (BIOS). He also offered a seminar at the Court of Justice in Arnhem about ethics and the quality of jurisdiction. Researchers in Islamic studies cooperated in the Islam Research Project (IRP) on Saudi Arabia initiated by the Dutch Ministry of Foreign Affairs. The results of their work should be directly useful in Dutch foreign policies. Dr Roel Meijer’s book on The Muslim Brotherhood in Europe has been adapted to appeal to a more general Dutch audience in order to increase its societal impact. Dr Paul Vermee’s findings of his research on religious upbringing have been published in several national journals such as Trouw and the Reformatorisch Dagblad. He presented
Key publications


Dissertations: 7
Scientific publications: 176
Professional publications: 61
his results at a conference for ministers and youth workers of the ‘Hervormd-Gereformeerde Jeugdbond’ (HGJB). Within the project ‘The story of your schools’, several school teams in the Netherlands have been trained on the basis of a narrative theory of the identity formation of Catholic schools. Researchers involved in the Refiguring Death Rites project discussed their research results with professional undertakers. In cooperation with the National Open-air Museum in Arnhem they examined the possibilities for representing the funerary culture of migrants in the museum. They also contributed to catalogues of exhibitions on death and religion in museums such as the Tropenmuseum in Amsterdam and the Kunsthal in Rotterdam.

Future research
Within the Research Institute for Philosophy, Theology and Religious Studies, three new research programmes are currently being developed that will formally replace the existing programmes in philosophy, theology and religious studies as of January 2013. The first programme will focus on the relationship between philosophy, theology and science as rivals in explaining and interpreting the world. Researchers study the various ‘knowledge claims’ of philosophy, theology and the (natural and social) sciences from a historical and contemporary point of view. The second programme will concentrate on the various relationships between culture, religion and cognition. It will not only focus on the role of cognitive mechanisms in the formation and development of culture and religion, but also on the role of culture in a broad sense (including religious phenomena) in the formation of the human mind and identity. The third programme will examine the dynamics of moral, political and religious communities. Researchers study themes such as secularisation and sacrality, state and social cohesion, and religion in the public sphere. Researchers in the fields of philosophy, theology and religious studies will closely collaborate within the framework of these three new research programmes. They will continue and intensify their cooperation with colleagues from the Institute for Historical, Literary and Cultural Studies and the Centre of Language Studies in the framework of two multidisciplinary research themes: Europe’s Identities Past and Present and Language in Mind and Society.

As of January 2012, the PhD training programmes of the Research Institute for Philosophy, Theology and Religious Studies, the Institute for Historical, Literary and Cultural Studies and the Centre of Language Studies have been integrated in the newly founded Graduate School for the Humanities.

Director: Prof. Paul Bakker

Paul Bakker has been a Full Professor of Medieval and Renaissance Philosophy at Radboud University Nijmegen since 2008. His current research focuses on the tradition of commentaries on Aristotle’s De anima (from the late Middle Ages until the seventeenth century) and specifically on the methodology of the science of the soul and its impact on views concerning the relationship between soul, mind and body. He is also interested in the institutional setting of Medieval and Renaissance university teaching and in manuscript studies. Prof. Bakker is a member of the board of the Société Internationale pour l’Etude de la Philosophie Médiévale.

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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 research in the fields of literature and literary theory, cultural studies, history, art history and archaeology. HLCS research is organized in programmes based on common research issues, themes and methodologies, or a common focus on a specific period. Each programme is designed to maximize integration through joint projects. Research initiatives that combine expertise from different areas and maintain a rigorous standard have ensured that the HLCS retains a prominent profile, both nationally and internationally.

There are four research programmes:

**The Ancient World**
The Ancient World is an interdisciplinary programme in which classicists, ancient historians and archaeologists study ancient Greek and Roman civilization and its reception from the Middle Ages until the present day.

**Memory: Cultural and Religious Identities**
Scholars in this interdisciplinary programme explore how people in various historical and cultural settings construct their identity by actively recollecting, shaping, re-shaping and mediating the past.

**Public and Private Life: the History of Politics and Human Life Courses**
This programme tackles the long-term developments in politics, economy and culture of Dutch, European and Asian societies.

**Studying Criticism And Reception Across Borders (SCARAB)**
SCARAB focuses on the role of literary professionals – book reviewers and critics, and institutions, periodicals and societies, as well as printing and publishing firms – as ‘bearers’ of literary culture and instrumental in the production, dissemination and consumption of literary culture over the centuries.

**Awards**
Dr Vincent Hunink, Assistant Professor in Latin, was given a translation prize by the Dutch Foundation for Literature. Hunink received 10.000 euro for his ‘literary non-fiction’ translations from Latin.

Dr Louis van den Hengel received the Jan van Gelder prize for his PhD thesis on Roman emperors’ portraits, with which he graduated in 2009 cum laude. The award was presented by the Association of Dutch art historians.

Dr Lotte Jensen, Associate Professor in Dutch Historical Literature, was awarded a gold medal of honour by the Teylers Foundation. Jensen received the prize for a paper in which, by exploring Dutch fiction, she demonstrates that the Dutch did resist Napoleon in the French-Batavian period. The paper was based on her book *De verheerlijking van het verleden* (The glorification of the past).
Dr Hilde Bras, associate professor economic and social history, 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.

Research facilities
- The Humaniora Library (155,000 volumes, 15,500 serial volumes, 750 serial subscriptions and 600 manuscripts)
- Catholic Documentation Centre: archives and publications of Catholic institutions and individuals in the Netherlands, 1800-2000 (www.ru.nl/kdc)
- Centre for the Documentation of Art History: collections of pictures, photographs, and slides (www.ru.nl/ckd)
- The Auxilia archaeological project bureau (Provincial Roman History; excavations in the former territories of Germania Inferior, especially in Ulpia Noviomagus Batavorum (www.ru.nl/auxilia)

Collaboration
Prof. Olivier Hekster and Dr Gerda de Kleijn are members of 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 from 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.

Prof. André Lardinois is one of the founders and chair of a network engaged in the study of archaic Greek lyric, iambic and elegiac poetry and song, with representatives in most European countries as well as from major American universities (Berkeley, Harvard, Stanford and Yale). 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 president of the board of the Association Internationale pour la Peinture Murale Antique (AIPMA), an international network of researchers working on ancient wall painting. The board organises conferences and edits a bibliographical Bulletin, called Apelles.

Prof. Marit Monteiro is a member of the board of RELINS-Europe (European Forum on the History of Religious Institutes in the 19th and 20th centuries), a collaborative venture between KADOC Leuven, Universität 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 Institute, 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, which studies 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.

Research results

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

Prof. Eric Moormann and alumna Dr Gemma Jansen are editors (and authors) of Roman Toilets. Their Archaeology and Cultural History, a book that treats all aspects of Roman toilets. Multi-seater latrines, as we find them in Roman Ostia and in many other sites across the Mediterranean, are well known both to tourists and archaeologists, but few people understand how they really functioned technically or how they may have been perceived in the context of Roman society. This handbook by an international group of specialists in archaeology, anthropology-, and classical literature addresses a wide variety of questions about toilets in the Greco-Roman world, making it the most complete study of this subject to date.

According to art historian Dr Renilde Vervoort, we owe our contemporary image of witches to a drawing by Pieter Bruegel from 1565. Vervoort studied pictures of witches in the Low Countries between 1450 and 1700 when witch hunts reached their peak.

“Witches were what terrorists are now. They lived amongst the people and could do a great deal of harm, but one could not recognise them”, says Vervoort. There was a need for a clear image of a witch. Bruegel introduced the witch that flies off through the chimney on a broomstick. Without Bruegel, in Vervoort’s opinion, our image of witches would have been very different.
Up to the end of the eighteenth century, the Middle Ages were dismissed as a dark, barbarian age between Antiquity and Enlightenment. Around 1800, this changed. The Middle Ages then became a period in which authentic humanity, community and mutual responsibility could be discerned. In his book *De ontdekking van de Middeleeuwen* (The discovery of the Middle Ages) Prof. Peter Raedts demonstrates how this radical revision was related to the rise of the modern nation state and the transition from an agricultural to an industrialized society, during which existing social structures were drastically undermined. To cope with the many ill effects of this, writers, poets, philosophers and politicians looked for ideals of national traditions and spirit – and found them in the Middle Ages. *De ontdekking van de Middeleeuwen* is a seminal book about the ways in which people in Germany, Britain, France and Italy have constructed their own past. And it shows us why the Dutch view on their own history was completely different from that of the nations surrounding them.

Traditionally, parents provide for their children as an investment. The children subsequently ‘pay back’ their parents either economically and/or by taking care of them. But there have always been other models for the development of the parent-child relationship. In his farewell speech in November, Paul Klep, Professor of Economic & Social History, demonstrated the range of different parent-child relations in rural parts of the Netherlands around 1900. Remarkably, the relation was considered ‘good’ in all varieties, except for those where ‘rotten kids’ defied parental authority. Klep emphasizes the difference in growth potential of the different family systems he distinguishes, an important insight for the fight against poverty on a global scale.

**Societal impact**

Mycenae is already described as a special city in Homer’s *Iliad*. The authors of *Cultuurgeschiedenis van de oudheid* (Cultural history of antiquity) use the many myths about Mycenae to explore the mythology that played such an important role in the lives of ancient Greeks and Romans. This is how they proceed throughout the book: twelve cities serve as a basis for the treatment of a theme in the cultural history of antiquity. The book was written by specialists from HLCS as a handbook for students. Because of the accessibility of the texts and the abundant images, the book is also an ideal introduction into classical antiquity for the generally interested.

The Historical Museum Arnhem and HLCS researchers organized an exhibition on a small, highly interesting group of 16th century literary manuscripts of a mystical nature in the vernacular. At the opening of the exhibition, the book *Verborgen leven: Arnhemse mystiek in de zestiende eeuw* (Hidden life: Arnhem mysticism in the sixteenth century) was presented. This richly illustrated volume, edited by Dr Hans Kienhorst and Dr Jan Kuijs, focuses on the spirituality and history of the St. Agnes Convent in Arnhem.

The exhibition and book contribute to the HLCS research on book collection and production in convents of the Devotio Moderna.

Historian Erie Tanja investigated views on what were considered to be ‘good politics’ according to members of parliament between 1866 and 1940. What ‘good politics’ are, is not defined anywhere. But for different periods in parliamentary history a predominant style can be distinguished. In the period mentioned, the Dutch House of Representatives changed from a private discussion area for independent and prominent male citizens into an assembly room for professional politicians belonging to a particular party, with an eye for the voter. With the emancipation of the lower classes, the elite in The Hague were joined by members of parliament with ‘simple’ origins. Independence, rationality and distance from the voters were slowly replaced by involvement in a party, emotion in debate and connection with certain interest groups and voters.

One hundred years ago, boys were seen as men-to-be, heading for an important role in society. That they were cheeky and rowdy was not considered to be a problem. Nowadays, those qualities are a problem, especially in the classroom. But boys have not changed; what has changed is the way educators see them, historian Angela Crott claims. She obtained her PhD for a study of educational literature on boys written between 1882 and 2005.

Gerard Mostert has written a biography of Marga Klompé, who died twenty-five years ago. In 1956 Klompé was the first female minister of the Netherlands. Mostert asks whether and, if so, how Klompé’s womanhood played a role in her political work. Klompé was ambivalent in her thinking about femininity. On the one hand she spoke about men and women as different but equal and complementary; on the other hand she stated that gender differences played no role at all in e.g. political activities. By 1956, argues Mostert, Klompé had lost patience with questions about her ‘female touch’ in politics.
Key publications


Dissertations: 10
Scientific publications: 232
Professional publications: 218
Director: Prof. André Lardinois

André Lardinois has been a Full Professor of Greek Language and Culture at Radboud University Nijmegen since 2001. He received his PhD in 1995 from Princeton University with a dissertation on proverbial expressions in archaic Greek poetry, after which he taught for six years at the University of Minnesota. His main interests are Greek lyric poetry and Greek drama. He is a founding member of the European Network for the History of Ancient Greece, and founder and co-chair of the Network for the Study of Archaic and Classical Greek Song. Since January 2011 he has been the academic director of OIKOS, the National Research School in Classical Studies.

Future research

In 2012, two Veni laureates will begin their projects with HLCS:

Dr Diederik Burgersdijk: A Monument of Romanitas: Nazarius’ Speech to Constantine the Great
During the reign of Constantine the Great, the Gallic orator Nazarius gave an official speech before the emperor. The speech contains important information about the state of the Roman empire in the early fourth century, when Christianity had begun to make rapid advances. This project will investigate the carefully crafted speech as a literary product and a reflection of its time.

Dr Harm Kaal: Constructing constituencies: Dutch political parties and the language of politics, 1880 to the present
The language of politicians is more than a means of conveying their political viewpoints. Language also carries identity-forming concepts and representations that are used by politicians to bind voters to their political party. This research will study the development of the language of political movements in the Netherlands from the start of the 19th century.

The Alexander-von Humboldt Foundation granted Prof. Olivier Hekster a highly prestigious ‘Humboldt Research Fellowship for Experienced Researchers’, to spend the academic year 2012-2013 doing research with the Commission for Ancient History and Epigraphy in Munich.

The donation of half a million euros by the Gieskes-Strijbis Fund completes the funding for an ambitious high-tech research project on the paintings by Hieronymus Bosch. Project leaders of the Bosch Research and Conservation Project are Prof. Jos Koldeweij, Professor of Art History of the Middle Ages, and Dr Matthijs Ilsink, curator of the Noord-Brabants Museum and alumnus of HLCS. In this international art historical research, modern technology will be used for a fundamental reappraisal of Bosch’s work. Art historians, curators and conservators from museums and institutions around the world work together to analyze and preserve the heritage of one of the most creative artists.
The Business & Law Research Centre (Prof. C.J.H. Jansen)

The Business & Law Research Centre – Onderzoekcentrum Onderneming & Recht (OO&R) – involves cooperation between the Law Faculty of Radboud University Nijmegen and fourteen prominent, mostly international, law firms and Dutch multinationals: ABP Pension Funds, AEGON NV, AkzoNobel, Allen & Overy, De Brauw Blackstone Westbroek, Clifford Chance, Eumedion, Houthoff Buruma, ING, Loyens & Loeff, NautaDutilh, Pels Rijcken & Droogleever Fortuijn, Rabobank Netherlands and Stibbe.

The Centre conducts fundamental research in ‘Business and Law’. It also offers a comprehensive educational programme for gifted young scholars and is actively involved in a wide variety of postgraduate educational and professional training programmes.

The Centre combines academic excellence with the expertise and practical experience of its partners. This unique collaboration has led to cross-fertilization between legal practice and the academic world.

The four key research programmes are:

- Company Law
- Finance, Security Rights and Insolvency Law
- Business and Patrimonial Law
- Business and Financial Law

A major theme of the research conducted by the Centre in all research programmes is European private law, comparative law and private international law. The Centre, which was established in 1991, is recognized as a research school by the Royal Netherlands Academy of Arts and Sciences (KNAW). In 2009, the accreditation was renewed by the KNAW and is now valid until 2015. The Centre’s
Staff

Prof. S.E. Bartels (o)
Prof. F.E.J. Beekhoven van den Boezem (o)
Prof. J.M.A. Berkvens (e)
Prof. P.P.T. Bovend’Eert (o)
Prof. Y. Buruma (o)
Prof. D. Busch (o)
Prof. E.C. Coppens (p)
Prof. D.R. Doorenbos (o)
Prof. J.C.J. Dute (e)
Prof. N.E.D. Faber (o)
Prof. R. Fernhout (e)
Prof. J.H. Gerards (o)
Prof. J.W. van de Gronden (o)
Prof. L.E. de Groot-van Leeuwen (p)
Prof. C.M. Grundmann-van de Krol (o)
Prof. E. Guild (o)
Prof. J.J. van Hees (o)
Prof. C.M. Hilverda (o)
Prof. C.J.H. Jansen (o)
Prof. P.H.P.H.M.C. van Kempen (o)
Prof. J.J. Kilborn (o)
Prof. E.J.J.M. Kimman (o)
Prof. C.J.M. Klaassen (o)
Prof. A.M. Korebriks (e)
Prof. R.H. Maatman (o)
Prof. A.J. Machielse (o)
Prof. T.J.M. Mertens (o)
Prof. G.T.K. Meussen (o)
Prof. R.E.C.M. Niessen (p)
Prof. M.P. Nieuwe Weme (o)
Prof. A.G.A. Nijmeijer (p)
Prof. A.J.M. Nuytinck (o)
Prof. M. van Olffen (o)
Prof. A.A. Quaedvlieg (o)
Prof. W.A.K. Rank (o)
Prof. B.P.M. van Ravel (o)
Prof. T. Richter (o)
Prof. J.S.L.A.W.B. Roes (p)
Prof. H.J.B. Sackers (p)
Prof. R.J.B. Schutgens (o)
Prof. V.P.G. de Serière (o)
Prof. C.H. Sieburgh (o)
Prof. G.M.F. Snijders (e)
Prof. G. van Solinge (o)
Prof. J.H.V. Stuyck (o)
Prof. A.B. Terlouw (o)
Prof. J.B. Terpstra (p)
Prof. J.D.A. den Tonkelaar (e)
Prof. P.C. Vegter (e)
Prof. L.G. Verburg (o)
Prof. H.L.E. Verhagen (o)
Prof. B.P. Vermeulen (p)
Prof. K.C. Wellens (o)

Tenured
Full Professors 11.3 FTE
Associate Professors 6.6 FTE
Assistant Professors 3.0 FTE
Researchers 3.5 FTE
Lecturers 1.0 FTE

Non-tenured
Researchers 3.0 FTE
Lecturers 8.7 FTE
Doctoral candidates 33.8 FTE

Educational programme for gifted young scholars is certified by the Accreditation Organization of The Netherlands and Flanders (NVAO).

Research facilities

The Centre houses the Information and Documentation Centre for Business and Law (CIDOR). It has a collection of books, journals and electronic publications on international and domestic Business Law that is unique in the Netherlands.

Collaboration

Within the framework of International Working Groups established by the Centre in Company Law, Security Rights, Insolvency Law and Financial Law, the Centre cooperated in 2011 with leading academics from the following universities and research centres: Adelaide (Australia), Bar-Ilan (Israel), Basel (Switzerland), Beijing – China University of Politics and Law (China), Berlin – Humboldt (Germany), Bern (Switzerland), Bolzano (Italy), Budapest (Hungary), Cambridge (UK), Chicago – John Marshall Law School (USA), Dublin (Ireland), Duke (USA), Edinburgh (Scotland), Geneva (Switzerland), Genoa (Italy), Ghent (Belgium), Göthenburg (Sweden), Hamburg – Max Planck Institute (Germany), Johannesburg (South Africa), Krakow (Poland), Leeds (UK), Leuven (Belgium), Luxembourg (Luxembourg), Madrid (Spain), Marburg (Germany), Melbourne (Australia), Montpellier (France), Münster (Germany), Nottingham (UK), Örebro (Sweden), Oxford (UK), Paris – Pantheon-Sorbonne (France), Pozna (Poland), Pretoria (South Africa), Prague (Czech Republic), Rome – Luiss Guido Carli (Italy), Rutgers-Camden (USA), São Paulo (Brazil), Seoul – Ewha (South Korea), Toledo (Spain) and Toronto – Osgoode Hall Law School (Canada).

The Centre also collaborated with various international organizations (e.g. IMF, UNCITRAL, and INSOL Europe).
Research Centres of the Faculty of Law

In February 2011, Janneke Gerards was appointed Research Professor in the Department of Constitutional Law. Prof. Gerards is an internationally renowned expert on fundamental rights law, equal treatment, judicial review and comparative public law. Central to her research is the relationship between the European Convention on Human Rights, EU law and national law.

Research results
A main topic in company law addressed by the Centre is corporate governance. Extensive research has also been carried out on corporate litigation and alternative forms of dispute resolution.

Dr C.D.J. Bulten’s PhD dissertation examined special court proceedings intended to facilitate dispute resolution between shareholders while, in addition, a new volume has been published which contains essays on various aspects of Alternative Dispute Resolution (ADR), including on arbitration, binding legal advice and mediation. Other important research results in company law include the PhD dissertation of Dr J.J. van den Broek on remaining tax obstacles in cross-border mergers within the EU, and the Centre’s Company Law Department biennial conference on limitations imposed on using corporate forms.

Researchers of the Centre have invested substantially in international and comparative research on insolvency law. A pilot study has been completed on the topic ‘Commencement of Insolvency Proceedings’, which will be published in the Oxford International & Comparative Insolvency Law (ICIL) Series. Within the framework of the ICIL Series, the divergences and common features of domestic insolvency laws from twenty countries across the world are inventoried and critically analyzed. The International Working Group on Security Rights is looking at the future of European security rights. This project involves a comparative study of the existing laws of several European countries with a view to the future of European security rights. This could provide a widely acceptable foundation for any future harmonization of security rights. PhD dissertations in finance, security rights and insolvency law included the thesis of Dr A.D.W. Soedira on composition schemes and the thesis of Dr A.J. Tekstra on set-off by the tax authorities.

Research in European Private Law conducted by the Centre analyses the influence of European law on domestic private law. Prof. A.S. Hartkamp was invited by the Max Planck Institute in Hamburg to deliver the prominent Ernst Rabel Vorlesung. A new international research project initiated by researchers of the Centre entails the forthcoming publication of the Ius Commune Casebook on comparative European Private Law. Prof. C.H. Sieburgh was invited to issue a preliminary report for the Association of Dutch Lawyers on the legitimacy of judgments and law generated by the confrontation of European law and private law.

Other research in Business and Patrimonial law includes the legal analysis of securities trade and related capital markets transactions, private law aspects of securities, the use of securities as collateral in secured transactions, and dematerialized securities and private international law. In the field of receivables financing, a PhD dissertation was published by Dr J.W.A. Biemans on undisclosed assignment of claims.

The Centre has rapidly expanded its research capacities in the field of financial law. A team of international experts has published a major work on the liability of asset managers. Another main area of research is pension funds. Legal and economic essays have been published in a new volume. Other main research outcomes include the inaugural lectures of Prof. D. Busch on the liability of financial supervisory authorities and Prof. V.P.G. de Serière on intervention...
powers in the financial sector. Dr G.T.J. Hoff’s PhD dissertation on ‘Disclosure of price sensitive information’ was published.

Societal impact

The societal relevance of research conducted by the Centre is clearly demonstrated by the turmoil caused by the credit crisis and the current Euro zone crisis. Best practices relating to corporate governance, shareholder activism and financial markets supervision are central to the research of the Centre. A book about Pension Funds was presented during a seminar at the Dutch Central Bank, and organized in conjunction with the Network for Studies on Pensions, Aging and Retirement (NetSPAR). The first annual conference of the Centre’s Financial Law Department was organized in 2011 on the effectiveness of financial supervision in Dutch law.

Most senior researchers occupy key positions in law reform committees, courts, the Netherlands Authority for the Financial Markets, law firms, banks and/or companies. Researchers are also consulted by transnational organizations (e.g. the IMF). The Centre has also participated in consultations on the Dutch Intervention Bill (containing proposals for the implementation of intervention measures in the financial sector) and on the EU Framework for Bank Recovery and Resolution.

Future research

Particular reference should be made to comparative research conducted by the International Working Group on one-tier and two-tier board models in major European countries. It aims to find out how the two models are regulated and how they are actually working, and to what extent a functional convergence between the two models can be detected. The project is a joint initiative of the Centre and the Max Planck Institute Hamburg.

Future research projects relate to the following topics: corporate inquiry proceedings, treatment of contracts in insolvency, secured transactions in comparative law, corporate board structures, administrative enforcement of financial law and combating insolvency fraud.

Particular consideration will be given to establishing international research in the field of company law, secured transactions and patrimonial law. The Centre will also pursue research endeavours within the context of new volumes of its ICIL Series. This major research project was initiated by the Centre in 2010 and is designed as a comparative analysis of core issues of insolvency law in 20 selected countries from across the globe. Published volumes are destined to function as a main source of reference in the field of international and comparative insolvency law. Follow-up comparative research has also been initiated in the field of financial law.

Awards and Acknowledgements

• Miss F.G. Laagland was awarded the Frye stipend for promising female researchers to conduct research abroad.
• The Utrecht Research Master Prize 2011 was awarded to I.V. Aronstein for her Master’s thesis on “European Law and Open Norms”.

Research Centre for State and Law

(Prof. R.J.N. Schlössels)

The Centre for State and Law – Onderzoekcentrum voor Staat en Recht (SteR) – 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 provides a stimulating environment in which high-quality, national and international multidisciplinary research can flourish. SteR includes three research programmes:

• Centre for Migration Law (CMR)
• Administration of Justice
• Principles of Public Law

CMR brings together researchers from various disciplines. Its purpose is to provide a stimulating context for fundamental and applied research 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 research.

The CMR provides a thorough academic training and a stimulating research climate, operating a guest programme that attracts promising PhD students and young post-docs from all over Europe. Research is carried out 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, the Fundamental Rights Agency, Amnesty International and the European Council on Refugees and Exiles.

Researchers at the CMR also contribute to the drafting of new European migration law. They organize international conferences and edit the European Journal of Migration and Law, a series of books on Immigration Law and Policy in Europe, and a yearbook on Dutch and international migration law (Rechtspraak Vreemdelingenrecht).

Researchers working on the theme ‘Administration of Justice’ focus on law in action – the working of the courts, public prosecutors and the legal profession. New developments in procedural law are monitored closely against the background of the principles of effective legal protection. In 2011 special attention was paid to the phenomenon of convergence of civil, criminal and administrative
### Key publications

#### Business and Law Research Centre


#### State and Law


procedural law. Common principles and concepts of legal proceedings are also an important research topic. ‘Administration of Justice’ involves research in four main areas:

- Legislation and case law relating to procedural law, including the position of citizens in adjudication.
- Organizational design and practice of the administration of justice.
- The quality of administration of justice from the points of view of legality, effectiveness and efficiency.
- The legitimacy of the administration of justice, from the perspective of the ethics of legal professionals.

Researchers working on the theme ‘Principles of Public Law’ focus on the main principles of public law from national, European and international perspectives. They investigate the relationship between principles of the democratic constitutional state (i.e. the rule of law, human rights, the democratic order, and accountability) and national and international social developments. The principles are studied with a keen eye on European and global developments. Within the programme, the expertise and know-how of constitutional, administrative, criminal, European and jurisprudential scholars are combined. Research includes exploring the impact of European and International law on fundamental concepts of national law. Due to the Europeanization and internationalization of law these concepts are continuously evolving.

Prof. J. Gerards, an internationally renowned expert in fundamental rights law, was appointed as a research professor in the Department of Constitutional Law. Her research focuses on fundamental rights, equal treatment law, judicial review and comparative public law. The interrelation of the European Convention on Human Rights, EU law and national law plays a central role in her research. In September 2011, Prof. Y. Buruma left the university to join the Dutch Supreme Court. His valedictory lecture discussed the most important developments in criminal law and criminal procedure of the last 10 years.

Awards and acknowledgements

- NWO (Netherlands Organization for Scientific Research) awarded a grant for Prof. Th. Mertens’ research proposal ‘Human Rights and Human Duties: Assessing the Obligations entailed in Human Rights’.
- NWO awarded a grant for Prof. J. Gerards’ PhD project ‘The Core of Fundamental Rights and the European Court of Human Rights’

Collaboration

SteR participates in the International Research Universities Network (IRUN), collaborating with the universities of Münster, Kiel, Leuven, Poitiers, Montpellier, and Exeter. It also has ties with the Max Planck Institute for Foreign and International Criminal Law (Freiburg, Germany), the Challenge project (Challenge Centre for Notarial Law


Research Centres of the Faculty of Law

Landscape of European Liberty and Security), the International Penal and Penitentiary Foundation, the EU-AGIS programme 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.

CMR is responsible for coordinating the European Network on Free Movement of Workers within the EU, which is funded by the European Commission. It 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
CMR researchers are involved in research with the Irish Immigration Council on the implementation of the Family Reunification Directive; in research with the University of Madrid Commillas on Best Practice of Integration measures of the Highly Skilled, and in a research project for the Fundamental Rights Agency about access to justice in discrimination cases.

In 2011 several workshops and seminars were organized by the CMR. Among others, these were about deprivation of citizenship, the Returns Directive, Polish Migrants, about dealing with psychological problems in the asylum procedure, Time and Asylum and the Blue Card Directive. In addition, the CMR-newsletter NEMIS on European migration issues for refugees was launched in 2011.

In 2011 two symposia were organized around the theme ‘Administrations of Justice’. The first dealt with the relationship between the judiciary and politics. The second was on complaint procedures against judges and other court personnel. This research was funded by NWO.

Within the programme ‘Principles of Public Law’, the research project Cosmopolitanism in a world of interconnected threats and challenges continued, based on a Vidi grant from NWO Dr. R. Tinnevelt is a participant in the international scientific research community being set up to study ‘Global Governance versus Global Government’. The Research Foundation - Flanders (FWO) has awarded a grant for this project.

A seminar was organized in 2011 on State, Law and Religion. This seminar covered themes like disestablishment, freedom of education, religion and the magistrate, and Sharia and Dutch 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. CMR’s publications have affected both the political and the public debate on a range of issues. Dr A. Böcker and Prof. A.B. Terlouw, the Dutch experts in the EU-funded Network of Socio-Economic Experts in the Non-Discrimination Field, produced in 2011 national reports on active ageing and the economic case for anti-discrimination.

Books published by researchers of the programme ‘Administration of Justice’ were presented to both Queen Beatrix and the President of the Supreme Court.

Prof. L.E. de Groot-van Leeuwen is a member of the Advisory Editorial Board of Legal Ethics. She chairs the Working Group on the Comparative Studies of the Legal Profession (RCSL).

Prof. Y. Buruma chaired the Admittance Committee Regarding the Evaluation of Completed Criminal Cases. Prof. J. W. van de Gronden is a member of the Committee on International Affairs and of the Commission for Consumer Affairs of the Social-Economic Council (Sozial-Economische Raad).

Prof. H.J.B. Sackers was a member of the commission that investigated the system of controlling possession of arms for recreational shooting. This commission was established after the shooting incident in a local shopping centre in Alphen aan den Rijn on 9 April 2011.

Future research
The CMR will coordinate the Network on Free Movement of Workers for a period of four years. Research currently funded by the European Commission on new forms on access to asylum procedures and research on monitoring guidelines with regard to traumatized asylum seekers will continue. In 2011 three new PhD students began research projects on pensioned people on the move, on access to legal aid in asylum cases and on experts and migration cases. In 2012 another PhD student will begin research on ethnic registration. In 2012 the CMR will organize conferences on Family Reunification and Social Rights and Citizenship.

Within the programme ‘Administration of Justice’, research on judicial decision-making and on lawyers’ ethics will continue. In 2012, a book will be published on methods of interpretation.
Research Centres of the Faculty of Law

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Director: Prof. Steven Bartels

Steven Bartels is Professor of Private Law at Radboud University Nijmegen. Since 1 September 2010 he has been Vice Dean for Research at the Faculty of Law. He is a member of the Board of the Business and Law Research Centre (OO&R) and of the Board of the Law Firm School (an educational institute established by 14 internationally renowned law firms, which offers professional training programmes certified by the Dutch Bar Association). Prof. Bartels is also a member of the Advisory Board of the prominent Asser Series and editor-in-chief of the editorial board of the civil law review Nederlands Tijdschrift voor Burgerlijk recht.

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

The Centre for Notarial Law – Centrum voor Notarieel Recht (CNR) – was established in 2008. Its key research programme addresses notarial law, in particular family property law (personal and family law, relationship between property law, inheritance law and estate planning). The strength of CNR’s research lies in the combination of tax and civil law and cross-fertilization between legal practice and the academic world. Particular attention is paid to the bearing of these fields on general property law, and to the combination of legal fields, e.g. marital property law, real-estate law and company law. CNR researchers seek to provide a firm foundation for notarial practice.

Collaboration

CNR cooperates with ABN Amro Bank NV on estate planning and monitors the academic level of the consultancy services provided by the bank. It also cooperates with the Dutch Foundation for the Professional Education of Notaries (SBN), the Royal Notarial Association (KNB), the Association of Estate Planners in Notarial Practice (EPN), and the Network Notarial Association.

Research results

CNR publishes a series called ‘Publicaties vanwege het Centrum voor Notarieel Recht’ (currently 9 volumes). The fifth edition of volume 2 on Inheritance law was published in 2011.

Societal impact

There are strong links between the CNR and legal practice. Researchers are actively involved in lectures, training and legal advice and often comment on current issues in the media. Researchers are advisors to the Dutch Government, lecturers (in charge) for the SBN, for the KNB, for the estate planners of EPN, and for Novex (the Dutch Association for Executors). They also participate in the Commission Succession Law II of the KNB and in the Commission Inheritance Tax Law of the KNB, the Board of the Institute for Agricultural Law in Wageningen, the Stichting tot Bevordering der Notariale Wetenschap and the Scientific Council and Board of the Thijmgenootschap.

Future research

Continuing projects include the historical development and current legal position of the surviving spouse in Dutch civil law, the legal exegesis of the provisions of last wills, delegation of last wills to third parties, the new inheritance tax law, international aspects of estate planning and developments in the legislation on marital property. The results of an empirical study on nuptial agreements will be published in 2012.

of various court levels in civil, criminal and administrative law (including tax law). Finally, a conference will be organized on the convergence and divergence of process law.

Within the programme Principles of Public Law a PhD student funded by the law firm AKD will start research on the principles of liability.
Institute for Management Research

The mission of the Institute for Management Research (IMR) is to create knowledge in the service of society. IMR conducts fundamental and applied research on the design, development and performance of public and private structures that regulate, govern, and manage human interactions. Structures are addressed at various levels of analysis, ranging from national and international communities to local urban networks and from macro-economic management systems to organizations, firms and individuals.

IMR’s multidisciplinary composition makes it possible for researchers to analyze such structures from various theoretical perspectives, using managerial, economic, geographic and political lenses. The aim is to combine a variety of theoretical perspectives and related methodologies to provide a richer understanding of international, societal and organizational challenges and to contribute to the development and evaluation of intervention strategies.

IMR bundles its research in three programmes:

**Distributional Conflicts in a Globalizing World: Consequences for State-Market-Civil Society Arrangements (DisCon)**
Researchers associated with DisCon investigate the impact of globalization on potential distributional conflicts, regarding material (e.g. resources, economic structures) and immaterial (e.g. social-cultural) issues within social systems. Analyses focus on the effects of the birth, nature and development of these conflicts on the nature of arrangements between states, markets and civil society. DisCon researchers also explore the means and strategies that aim at preventing or managing (potential) conflicts.

**Responsible Organization (ResOrg)**
Researchers associated with ResOrg investigate the design, development and evaluation of organizations that create value in multiple dimensions, in particular the functions, objectives and impact of organizations with respect to society. Strategies leading to environmental, social and economic sustainability are studied from various perspectives, notably using social, institutional and intervention-oriented theories. Central themes are: (1) value creation in multiple dimensions, (2) institutional arrangements within organizational networks, (3) relationships between stakeholders and (4) accountability and reliability.

**The Shaping and Changing of Places and Spaces (SCAPES)**
Researchers associated with SCAPEs study processes of changing (social, economic and environmental) meanings of places for individuals, communities and states, and their consequences for territorial governance. The following themes are addressed: transnational territorial identities and cooperation, the geopolitics and geography of territorial borders, migration and development, regional governance, transport and spatial development, water management, environmental policy and governance, and land policy and location development.
Research facilities
The IMR operates the Nijmegen School of Management (NSM) Decision Lab and the Visa Skills Lab. In the Decision Lab, experimental research – based on game and social choice theory – is conducted to study cooperative decision-making in various empirical domains. The Visa Skills Lab – an electronic meeting / group decision room for studying group processes – supports investigation of policy making processes. In 2011 the IMR has invested substantially in an extension of the Decision Lab. The lab can now be used for more complex economic and financial trading experiments.

IMR researchers also actively participate in the construction of special data sets. For example, the DisCon research group on Contagious Conflict together with the Dutch trade union CNV constructed a data set related to mobilization and populism. Researchers in ResOrg constructed data sets in cooperation with others including the Cranfield Network on International Human Resource Management (Cranet). Finally, within SCAPES a national database was completed on characteristics and investments in Dutch industrial estates.

Collaboration
The focus on complex societal issues requires that IMR researchers extend and intensify their contacts outside the institute. IMR researchers therefore collaborate with partners in both national and international research networks. In 2011, several new cooperative ventures were established:

- Prof. de Jong participates in the EU-COST (European Cooperation in Science and Technology) project Systematic Crises, Financial Crises and Credit, with experts from several European countries.
- Dr van der Vleuten participates in the international research project on ‘Exporting Good Governance’ financed by the Deutsche Forschungsgemeinschaft (DFG) and led by the Freie Universität Berlin (Germany), with experts from several European countries.
- Dr Zaslove and Dr Jacobs cooperate with the Department of Politics and Contemporary European Studies of Sussex University (United Kingdom) in research on populism.
- Prof. Weitzel collaborates with the Maastricht School of Management on large-scale global experiments conducted in more than 15 countries.
• Prof. Benschop and Prof. van Riel collaborate with the Parkinson Centrum Nijmegen of the Radboud University Nijmegen Medical Centre (UMCN) in a joint PhD-project.
• Prof. van Kranenburg and Prof. van Riel collaborate with the HAN University of Applied Sciences in the project ‘Kennisalliantie Rijn-Waal 2020’.
• Dr Lagendijk coordinates research of partners from five European countries in the Euregio-funded INTERREG IV programme ‘Brain Flow’, on preventing highly skilled employees from leaving non-core regions.
• Dr van Houtum participates in the EU 7th Framework Programme Project ‘Borderscapes’, in which the Nijmegen Centre for Border Research (NCBR) is one of the twenty partners.
• Prof. van der Krabben cooperates with two universities of São Paolo (Brazil) in a Nuffic (Netherlands organisation for international cooperation in higher education) project in research on land management strategies for urban transformation projects.

Research results
In 2011, 16 PhD candidates successfully defended a dissertation, a record in the history of the IMR. Further noteworthy results, published or to be published in international journals or books, include:
• Dr Jansen found that party positions hardly explain the assumed linear decline in class-based voting and that the rise of social-cultural specialists is important for understanding changes in the class–vote relationship.
• Dr Smits, Prof. de Jong and PhD researcher Webink analysed child labour in 16 developing countries. They illustrated the existence of substantial amount of “hidden” child labour.
• Dr van der Vleuten explained how the European Court of Justice expanded its mandate by granting social economic rights to LGBT (Lesbian, Gay, Bisexual, Transgender) people, which went beyond national legislation.
• Prof. Weitzel and Dr Qiu provided experimental evidence on how individuals take decisions and learn in ambiguous situations.
• Prof. Weitzel, Dr Füllbrunn and Dr Rau provided experimental evidence that ambiguity aversion is a phenomenon of individual decision-making that does not occur in financial market trading.
• Dr Wigger identified the political power constellations underneath European competition regulation, covering merger control, cartel prosecution, state aid and privatization.
• Dr Meijerink, Dr Huitema and Dr Lebel showed that water policy entrepreneurs in many countries use similar strategies in water transition: initiate small scale pilot projects and adjust strategies to the institutional context.
• Dr Lagendijk studied the changing policy rationalities underpinning EU regional innovation policy in the period 1980-2011. He showed that recent developments aim at the acceptance of spatial differentiation, moving away from the prevalent ‘Cohesion’ approach.
• Prof. van der Krabben and Prof. Tira investigated land management strategies for urban transformation projects in an international comparative study. Cities are not yet prepared for managing brownfield projects. Various experiments with new legal and financial instruments have been initiated.
Awards and grants

• Prof. Leroy received the ‘Prijs Rudi Verheyen’ (on behalf of the Flemish government) for his lifelong work on environmental policy.
• Dr Anderson and Dr Delsen obtained funding from the Instituut Gak foundation for a postdoc researcher into pension policies.
• Prof. Benschop and Dr Gremmen received a grant from the NSvP (Nederlandse Stichting voor Psychotechniek) for research on collaboration between corporate/ professional women’s networks and their organizations. They are developing a practical tool to sustain and improve collaboration.
• Dr Bleijenbergh received an EU 7th Framework Programme subsidy for the project ‘Structural Change To Achieve Gender Equality in Science (STAGES)’, as part of the programme Science for Society, a joint venture in which research institutes in Italy, Romania, Denmark and Germany participate.
• Dr van den Brink received a NWO Veni grant for the research project ‘Sustainable change towards diversity: the role of change agents and organizational learning’.
• Dr Driessen obtained a research grant from Agentschap NL (Ministry of Economic Affairs, Agriculture and Innovation) for studying innovation networks related to subsidized sustainable innovations.
• Prof. van der Krabben and Dr Martens received a grant for the NWO Urban Regions in the Delta project ‘DELTA OOST’ together with the Faculty of Science, Wageningen University and the Stadsregio Arnhem-Nijmegen. The aim of the project is to develop innovative solutions both for water management and transit-oriented developments.
• Prof. van Kranenburg and Dr Rouwette received a research grant from Infrastructure Next Generation and Alliander N.V. for a PhD project.
• Dr Lagendijk received a grant in the first round of the NWO Complexity Programme. He and his team will explore the proliferation, development and growing significance of the slow food movement worldwide.
• Prof. Lauche and Prof. van Riel have received a grant for a 3-year project on ‘Tools for Orchestrating Value Chains for Sustainability in New Product Development’, funded by Agentschap NL/ IOP Integrale ProductCreatie en Realisatie (Ministry of Economic Affairs, Agriculture and Innovation).
• Dr Martens and Dr van Kemenade received a Valorisation Grant from Technology Foundation STW for the further development of PARKAGENT, an innovative parking model that enables cities to predict the effects of parking policies.

Societal impact

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. Some milestones in 2011:
• Dr Anderson was invited as a scientific expert to join an Expert Workshop on “The Swedish Pension System: Lessons for Germany”, organised by the Friedrich-Ebert-Stiftung, Berlin (Germany).
• Prof. Dankbaar was appointed to a committee for the evaluation of the Programmatic Approach in Dutch Innovation Policy 2005-2010 for the Ministry of Economic Affairs, Agriculture and Innovation.
• Dr Delsen was invited to participate in a workshop on “Work Life Balance”, organised by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) in collaboration with IBA GEI (International Bar Association – Global Employment Institute) in Dublin (Ireland).
• Prof. B. van der Heijden was invited to join the European Society for Vocational Designing and Career Counselling.
• Prof. R. van der Heijden was invited to join a committee that advises the Minister of Infrastructure and Environment on the logistics power of the Netherlands.
• Prof. de Jong contributed to Me Judice, an independent discussion forum for debate among economists, as well as to newspapers and radio programmes such as “Met het oog op morgen” (NOS) and BNR Nieuwsradio. He was regularly invited for meetings and conferences on economic issues, e.g. at the University of Humanistic Studies in Utrecht and the Clingendael Institute in The Hague.
• Prof. Jonker launched the project ‘Our Common Future 2.0’ for the Netherlands. This project developed a vision on sustainability related to 19 societal themes including learning, water, energy, the economy and health care, resulting in a conference with more than 1000 participants in May and a book entitled ‘Duurzaam Denken en Doen’.
• Prof. van Kranenburg was invited as a keynote speaker to talk about Strategy, Innovation and Value Creation in Media Management at the conference on Media and new business models at MHHK Macromedia University for Media and Communication in Munich (Germany).
• Prof. Lauche gave a presentation at the Drilling Engineering Association meeting and contributed to the recommendations of the International Association of Oil & Gas Producers (OGP) on the human aspects of the Macondo explosion and the oil spill in the Gulf of Mexico.
• Prof. Sent was elected to the Senate of the Netherlands and she became a member of the Social Sciences Council (SWR) of the Royal Netherlands Academy of Arts and Sciences (KNAW).
• Dr van der Velde and Dr Smith, together with Gadyah Mada University (GMU) and UNIKA University in Semarang, organized a two-week workshop in Yogyakarta (Indonesia) entitled: ‘Climate and Environmental Change and Their Impacts on Livelihoods, Mobility, and Regional Development’.
• Dr Wigger organized a series of public debates entitled ‘Real World Economics Lectures’ at CREA, the cultural organization of the University of Amsterdam.
• Prof. Wissenburg led an expert group publishing a report on fairness and justice for the Teldersstichting, the national liberal think tank.
Key publications


Dissertations: 16
Scientific publications: 244
Professional publications: 133
Future research

In 2013 the IMR will be formally evaluated. The focus for future research will be on 1) further elaboration of the three multidisciplinary programmes in terms of projects and collaborations with internal and external partners, 2) further strengthening the quality of research, as measured in the quality of publications and the acquisition of external funding, and 3) further increasing the number of PhD candidates and the number of successfully defended dissertations.

Regarding the first goal, the IMR invests in organizing research events (some of which are for all researchers, while others are dedicated specifically to PhD candidates) to stimulate multidisciplinary debates and link researchers. Examples of planned activities are:

• ResOrg, in association with University of New York, Ohio State University and Ipsos Inc., will organize the international “Thought Leaders in Services Management” conference from June 27-29, 2012.

• The Department of Public Administration will organize the annual conference of the Transatlantic Dialogue (EGPA) on “Transitions in Governance” in 2012.

• The Economics Department will organize a workshop entitled “Ambiguity in the Economy and in Economics”, to be held on 5 October 2012, in Nijmegen.

A self-evaluation report on research, which will provide the basis for the independent evaluation in 2013, will be used to intensify the internal debate on the focus and strategic development of IMR.

To increase the quality of its research, the IMR encourages the successful transformation of research grants into operational research projects, which require excellent PhD candidates and post doc researchers. In addition, IMR is preparing research proposals for major subsidies (e.g. ERC, EU, NWO programmes, Dutch ‘top sector’ programmes, FP7 and Horizon 2020). IMR research output will further benefit from the fact that in 2012 eleven additional assistant professors will be appointed, all of whom will will have a partial research commitment.

Regarding the third goal (strengthening PhD research), in 2011 the IMR invested in nine PhD positions for research within the core themes. These PhD candidates form a cohort and participate together in several multidisciplinary trainings. At least eight new PhD positions will be created in 2012. Depending on the success of applications for external funding, this number may increase to ten. Furthermore, the ResOrg PhD programme offers an alternative route for selecting and training external potential PhD candidates.
Researchers at the Nijmegen Institute for Social & Cultural Research (NISCO) use integrated multidisciplinary and comparative approaches to describe and explain changes in socio-cultural participation and organization in both Western and non-Western societies. Theoretical approaches, research design and data collection and analysis constitute complementary aspects of a single framework and a common research goal. Researchers at NISCO focus on three themes: inequality, cohesion, and modernization. To understand the dynamics of societal phenomena and processes, they examine these aspects both from a historical perspective within a single society and in a comparative perspective across different societies. The accredited Research Masters programme in Social Cultural Science provides high-level training in theories and methods for conducting comparative research on societies. NISCO – a research institute of the Faculty of Social Sciences – consists of two research groups: 1) the Cultural Anthropology and Development Studies Research Group and 2) the Sociology Research Group.

**Inequality**

This theme is about differences in access to and control over resources that affect peoples’ opportunities, such as educational level, success in the labour market and differences in lifestyles. Research focuses on the effect of resources on socio-economic achievement and on how variation between and within countries is affected by structural social differences and national policies. Ways in which individual, family and group resources affect outcomes – such as cultural and political participation as well as intra-, and intergenerational mobility – are also studied.

**Cohesion**

The aim of this research is to describe and explain differences in social participation in formal organizations as well as in informal social networks, including families and other groups. There are three core topics. First, developments in the relations between individual resources and both pro-social attitudes and antisocial behaviour are explored, focusing on variations among societies with different welfare-state regimes. Secondly, a comparative examination is made of the extent to which social groups display exclusionist attitudes and behaviour towards particular out-groups, considering differences in economic, cultural and demographic contexts. Thirdly, 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.

**Modernization**

Researchers at NISCO compare the economic and technological developments that accompany secularization in Dutch and European societies with such processes taking place in other societies. Much attention is paid to belief systems and to meaning derived from religion, to conceptions of justice and altruism and the implications for societal participation. NISCO research also focuses on modernization processes in developing countries and their effects on inequality and poverty, as well as on social and political cohesion, whilst also including other aspects such as gender differences and ethnic identities. In this context, responses
of governments to different aspects of modernization processes impacting at different levels (e.g. civil society organisations and individual citizens) are also investigated and assessed.

**Research facilities**
Researchers at NISCO specialize in the collection of large-scale data for the relevant scientific communities. These include both longitudinal collections – on individuals and their life courses and networks within specific social contexts (in The Netherlands and several other countries) – and cross-national collections that embrace a wide range of countries. These data are valuable for comparative research, providing useful opportunities for multidisciplinary cooperation. A new edition of the survey on Social and Cultural Developments in The Netherlands was begun in 2011 and will be completed in 2012. The Dutch database on non-governmental development cooperation was also further elaborated (see: www.ngo-database.nl).

**Collaboration**
NISCO collaborates closely with:
- Australian National University (Canberra) and the Cairns Institute (James-Cook-University, Australia)
- The Universities of Antwerp, Ghent and Leuven (Belgium)
- The University of Aarhus (Denmark)
- 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)
- Harvard University, Northwestern University, Evanston (Illinois) and John Hopkins University (USA)
- The Centre for Comparative Social Surveys in London and the Universities of Oxford and Sussex (United Kingdom).
There are also extensive research collaborations with:

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

International partnerships have been established through the South Africa-Netherlands Research Programme on Alternatives in Development (SANPAD), with Bethlehem University, on the MICAD project and with East African universities on Edulink programmes. 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); the European Consortium for Sociological Research (ECSR); the European Association of Social Anthropologists (EASA); the European Society for Oceanists (ESfO); the European Research Centre on Migration and Ethnic Relations (ERCOMER); the Research Network on European Port Cities; ERANET Learning in Knowledge Society; the Network of Excellence ‘Enhancing the Interest in Science in a Developing Europe’ (EISDE); the International Communication Organization (ICA); the International Association of Mass Communication Research (IAMCR); the Development Policy Review Network, and the International Civil Society Forum on Conflicts (INFOCON).

NISCO researchers also participate in several national and international organizations such as the International Sociological Association (ISA), 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), the Association for Social Anthropology in Oceania (ASAO), the Caribbean Studies Association (CSA), the 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) and the Interuniversity Centre for Social Science Theory and Methodology (ICS).

Awards and acknowledgements

- New research grants were received for large-scale data-collections: (1) from the Netherlands Organisation for Scientific Research (NWO’s) programme for long-term studies on social-cultural changes in The Netherlands under the heading of Social and Cultural Developments in The Netherlands, has provided high-quality data to the scientific community since 1980; (2) from NORFACE on the Causes and Consequences of early socio-cultural integration processes among new immigrants in Europe.
- In NISCO, Dr Lubbers was awarded the Vidi grant (NWO) for ‘Cultural sameness or the preservation of own identity: national cultural consumption in times of European integration and mass migration.
- Five PhD grants were received from the NUFFIC-sponsored project ‘Supporting the development of Commercial Agriculture Programmes’ at Ethiopian universities (NICHE/ETH/019). A PhD research grant was received from the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR) of the Ministry of Justice.
- A postdoc grant was received from the NWO Invaluable Biodiversa programme as well as a part time post-doc position for an impact evaluation of its ‘People’s Participation Programme: evaluation of the SNV pro-poor value chain interventions in Ethiopia’.

Associate Professor Marcel Lubbers is a Vidi laureate working on the relationship between nationalism and the consumption of national cultural goods. He has also received grants from NORFACE to fund a large-scale data collection project on migrants who recently entered the Netherlands.
Research results

The debate on ‘reinvention of tradition’ in the Pacific was invigorated by research on modernization processes, by examining the question of why the focus in the cultural renaissance is normally on the continuity of culture and traditions, while the discourse of tradition indicates that renewed attention to the past is actually a sign of modernity, which is to say that the historical consciousness is part of the modern mentality. This paradox is addressed with an ethno-historical analysis of the Maori concepts of ‘tribe’ (iwi) and associated notions of ‘love for kin’ (aroha). Changing meanings of these concepts are discussed as well as variations in their meaning for various sections of the contemporary Maori population. This analysis suggests that the focus on continuity in the reconstitution of traditions is part of a strategy to cope with the fundamental transformation of Pacific societies in the wake of colonialism. In concluding, a preliminary attempt is made to draw out the continuities and discontinuities of this process of cultural change.

Under the heading of inequality, ‘land grabbing’ in Africa by China has received considerable attention, whereas land grabbing in post-Soviet Eurasia has gone largely unnoticed. In fact, foreign states and private companies have also acquired vast areas of farmland in this region. This line of research shows factors that make post-Soviet Eurasia such an attractive region for international investment, arguably encompassing much greater agricultural land reserves than most regions in sub-Saharan Africa or Asia. Both domestic and international acquisition of land is dealt with, situating it in the domestic context of agricultural development and institutions. The main investors involved in land grabbing are identified. The main obstacles concerning the emergence and effectiveness/performance of domestic, and especially international, agro-holdings in the region are outlined in this research.

Sociology Research Group

Research within the Sociology group has focused on a cross-national comparison of social cohesion, taking advantage of high-quality data from the European Social Survey. This research has shown a direct positive effect of ethnic diversity on informal help at the national level. At the regional level, only an indirect effect of ethnic diversity was found. Rather, ethnic diversity increases the likelihood of inter-group contact, which in turn is positively related to both informal social meeting and helping each other. Ethnic diversity thus turns out to increase rather than decrease these dimensions of social cohesion, contributing to a lively societal debate.

Life-course research on the Family Surveys of the Dutch Population answers questions on inequality, i.e., on the educational attainment and the occupational careers of men in the Netherlands whose working life began in the 1950s, 1960s, and 1970s. The results show that a man’s education depends upon his father’s job, and that, for any specific labour market entry cohort, this effect has not changed. When explaining a man’s first job, his father’s job is influential once more, independent of a man’s education. A man’s education has a direct positive effect on his first job, his job after 10 and 20 years, and his peak job, but again the differences in status attainment between labour market entry cohorts are limited. Findings also reveal that advantages accumulate during a person’s working life.

Research on modernization processes over a span of 18 years, demonstrated the changes in attitude towards Europe and towards ethnic diversity among the Dutch between 1990 and 2008. A comparison of attitudes on the eve of the signing of the Treaty of Maastricht with attitudes after the Dutch ‘no’ in the referendum on the European Constitution showed a strong increase in euroscepticism among the Dutch. The less educated have become more cynical about politics and have also come to perceive a greater ethnic threat than before, which may explain the increase in euroscepticism. In contrast to 1990, a perceived ethnic threat was the main predictor of euroscepticism in 2008.

The Communication Science research group moved to the Behavioural Science Institute (BSI) in 2010, opening up new and fruitful scientific perspectives for cooperation between NISCO and BSI.
Key publications


Dissertations: 9
Scientific publications: 93
Professional publications: 27

Societal impact

Members of NISCO regularly advise a wide range of public and private institutions and have advisory positions in a variety of domains. This work includes supporting international data collections (European Social Survey, European Value Survey), national data collections (CBS, DANS, NELLS, Rekenkamer, WODC, ZonMW and CBF) and data on funding provided by public and private organizations engaged in development cooperation (DGIS/ Ministry of Foreign Affairs, Cordaid, ICCO, Plan Nederland, PSO, Hivos, Oxfam-Novib and others).

NISCO fellows are editors of Focaal, Ecological Economics, the Netherlands Yearbook on International Cooperation, and the International Spectator; guest editors for the Third World Quarterly and International Journal of Cultural Property, and members of the editorial boards of the Journal on Chain and Network Science, Bulletin of New Zealand Studies, Oceania Newsletter and Open Anthropology Journal.

NISCO researchers participated widely in public debates and media presentations on topics such as the role of ethnic diversity
In the Sociology Research Group the focus is on the key themes inequality, cohesion and modernization, with publications containing life-course analyses and multi-level modelling on topics such as:

• social capital and health
• abortion rules and abortion practices
• cultural capital in schooling
• composition of neighbourhoods and their effects
• attitudes on children’s socialisation
• integration processes of migrants and labour market vulnerabilities
• criminal careers
• and inter-ethnic prejudice and contacts in European and Asian social contexts.

In particular, cross-national research in the research programmes is being extended. Results from the recently conducted survey on Social and Cultural Developments in the Netherlands will be processed and analyzed. The NWO programme on Conflict and Security has funded studies on the correlates of ethnic diversity in local communities in Europe and will be carried out by two postdocs, while the programme on ethno-religious conflicts in South-east Asia will be carried out by four PhD students plus one postdoc. Funding is also received for the five-yearly survey ‘Social and Cultural Developments in the Netherlands’.
The mission of the Centre for Language Studies (CLS) is to carry 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.

The CLS has 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.

Awards

At the 2011 Interspeech Conference the ISCA Award for Best Student Paper was awarded by the International Speech Communication Association to Maarten Versteegh MSc, for his paper on *Modelling Novelty Preference in Word Learning*.

Dr Elizabeth de Groot received the Best Applied Paper Award at the 2011 Conference on Corporate Communication, which was held at Baruch College, City University of New York, NYC, for her paper *Personal Preference or Policy? Language Choice in a European-based International Organization*.

Research facilities

CLS research is becoming both more empirical and more 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 – play an increasingly important role.
### Staff

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### 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.
- 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’.
- Collaboration within Taalportaal, an NWO-groot project, together with the University of Gent; City University York; Freie Universität Berlin; Hokkaido University Graduate School Sappora Japan; Université de Paris - Sorbonne; and Univerzita Karlova, Prague.
- Collaboration within the Sign Linguistics Corpora Network with Stockholm University, Heriot Watt University in Edinburgh, Magdeburg-Stendal University of Applied Sciences, ISLP Athens, University College London, and Hamburg University.
- Collaboration within the network GREAT (Grammatical Acquisition, Elicitation and Typology), which was created in order to develop standardised visual stimuli for the elicitation of grammar in acquisition and language contact studies. Other member institutions are the University of Essex, Jawaharlal Nehru University, New-Delhi, and La Trobe University (Australia).
- Collaboration with the Sint Maartenskliniek in Nijmegen and the associated Development Centre for Speech and Language Technology in a Communication Assessment project.
- Participation 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).
- 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

In 2011, twelve dissertations were successfully defended, one of which cum laude: Dr Mark Dingemanse on The meaning and use of ideophones.

Studies in the Grammar and Cognition programme pursue the hypothesis of a multi-tiered interconnected language system in which elements may fulfil several functions simultaneously. Linking elements in compounds turn out to be such forms, which combine the prosodic function of improving the rhythmic structure of a word, the morphosyntactic function of structural separator and the semantic function of expressing plurality. Evidence suggesting that the rhythmic and semantic functions date back to medieval times has been found. Seemingly conflicting evidence for the influence of rhythm on conceptual plurality can be explained by different modes of processing for written pseudo compounds and spoken compounds on the one hand versus written existing compounds on the other.

In the Sign Language group, further studies on handedness have demonstrated that the handedness of signers can be linked to the tendency among ambidextrous signers to alternate hands during discourse. At the same time, this ‘dominance reversal’ was shown to occur regularly for all signers, both in planned and more spontaneous registers. Further quantitative analysis of signers’ movements has revealed more consistent distinctions between lexical and transitional movements and demonstrated complex coarticulation effects in hand height. The lexicon with ID-glosses has been further expanded and is systematically being applied to all existing glosses. The development of ELAN for this purpose, which has continued within Onno Crasborn’s ERC project, is helping to substantially improve annotation quality.

The researchers in the NWO programme Syntax and Information Structure: discourse options after the loss of V – using the corpus tools developed by Erwin Komen – further refined and extended their database for all stages in the history of English. In this database word order patterns can be traced, together with co-reference annotations for noun phrases.

Within Prof. Pieter Muysken’s ERC project ‘Traces of contact’, which was set up to establish criteria for using results from language contact studies to strengthen the field of historical linguistics, a number of results have been achieved:

• A typological database for South American languages has been created, including approx. 320 detailed questions on tense/mood/aspect/evidentiality, noun phrase structure, argument realization, and subordination. The data are being coded for approx. 70 languages. GIS-mapping techniques are explored, as well as the comparison between lexical and structural data.

• In addition an online storage site for instruments and materials for fieldwork elicitation has been created; this includes non-verbal stimulus materials such as video clips, drawings, photographs, as well as story-based and list-oriented questionnaires. This material has been used with speakers in Surinam, Chile, Morocco, Hong Kong, Aruba, Turkey, Indonesia, India and the Netherlands to see whether people who have immigrated to Surinam and the Netherlands have adapted their native languages to the dominant language in the country of arrival, Sranan and Dutch, respectively. The languages involved are Surinam Hindustani, Javanese, Sranan, Surinamese Dutch, Ndunya, Akan, Spanish, Moroccan Arabic, Cantonese, Mandarin, Hungarian, Papiamentu and Turkish.

• An experimental design has been devised to study online interlinguistic syntactic priming between Dutch-Papiamentu and Dutch-Turkish with promising initial results.

Prof. Mirjam Ernestus received a Vici grant from the Netherlands Organisation for Scientific Research (NWO), which she will use to investigate how people learning a foreign language store variant pronunciations in memory. She also received an ERC Starting Grant for research on understanding spontaneous speech in foreign languages. These two studies intersect.
The Stevin Nederlandstalig Referentiecorpus (SoNaR project, which is funded by STEVIN – the Essential Speech and Language Technology Resources research programme), was completed successfully. This project has yielded a large reference corpus of written Modern Dutch, which will be maintained and distributed by the Flemish-Dutch Human Language Technology AgencyTST-Centrale.

Applications such as information extraction, question-answering, document classification, and automatic abstracting that are based on underlying corpus-based techniques will benefit from large-scale analyses of particular features in the corpus. Moreover, the corpus constitutes a test bed for evaluating applications, whether or not these applications are corpus-based.

How to best put together an international team is a key issue for multinational companies. Within the field of international advertising, the composition of a team set up to design successful campaigns in a global market is of the utmost importance. The results of a meta-analytic review show that international research teams are more capable of designing pairs of culturally adapted (versus unadapted) advertisements compared to national teams. It is, however, not clear whether the international team needs to include a representative of the target audience's culture.

The relationship between personality dimensions and foreign language mastery may also be indicative of success. In a survey, differences between the internal and external stakeholders in an organization were studied to determine whether intercultural competencies and language mastery make it possible to discriminate between these groups.

It appears that international employees are more open-minded and flexible than national employees, and that the former group was found to be more emotionally stable than the group of business contacts. On average, the international employees reported speaking one foreign language more than both other groups. Emotional stability, open-mindedness, and speaking a number of foreign languages appear to predict successful membership of a team that operates internationally.

Societal impact
In Dutch society there has been an ongoing debate on whether to use an e or and en when forming compounds. Writing e(n) in compounds has been a major bone of contention for nearly a century. Our studies aim to show why this is so. Systematic form and meaning variation were found across language users from different backgrounds that may explain why opinions differ.

A research seminar was organized for everyone interested in how children learn language. With lectures, film viewings and debates the general public was made aware of research at Radboud University Nijmegen. Questions such as how babies learn, think and feel were addressed.

Work continued on descriptive grammars of Amerindian languages; earlier output of grammars and texts are used to construct models of their relatedness (through descent and language contact), using computational phylogenetic methods. Researchers in the project Multilingual Convergence in the Netherlands use these and other methods to study the linguistic situation in Surinam and the Netherlands. This research has an impact on issues related to immigration and integration.

Researchers in the NWO project Syntax and Information Structure: discourse options after the loss of V2 study the interaction between syntax and information structure, and the way such interaction can be modelled. Although constructing a model of this interaction represents a major advance in our insight into language change, there are also wider implications in that information structure tends to account for the more subtle differences between languages that mark a non-native speaker as non-native, even at a very advanced level. The results of this project may ultimately contribute to better standards in teaching, translation and editing practices.

In projects funded by the STEVIN programme, as well as in a project funded by NWO, CLS’s Centre for Language and Speech Technology (CLST) develops and deploys computer-assisted language learning applications and an initial reading tutor. A second-phase STW valorisation grant was obtained for developing ”My Pronunciation Coach” – a language guide that can be used on laptops or iPhones – into a commercial product. In collaboration with Novay (the former Telematica Institute) and the company TeleCats a research system for determining the proportion of music in TV-programmes has been converted into an operational second opinion system for two commercial broadcast organisations (SBS and RTL). In collaboration with the Sint Maartenskliniek, tele-health applications are being developed that are designed to support speech and language therapy.

A study funded by NWO Humanities intended to chart the impact of the increasing use of digital technologies in providing public information showed that the enormous increase in the volume of information has improved the chances of relevant information being available, while at the same time reducing the chances of this information being found. Problems include the unappealing way the information is presented as well as its incomprehensibility. There also appears to be a lack of knowledge on how best to combine different channels to optimize the communication process.

Research on professional communication in foreign languages – in collaboration with the Radboud University Language Centre Radboud in’to Languages – has led to the refinement of a curriculum, which now targets second language users (rather than language learners aspiring to attain near-native competence). Moreover, the insights gained are being used to design teaching material and teaching manuals produced in cooperation with educational publishers.
Future research

Dr Mirjam Ernestus received a Vici grant worth €1.5 million from NWO for a study on how people learn pronunciation variants for words in a foreign language. In everyday conversations, people do not always pronounce words in full. The Dutch word ‘natuurlijk’ can sound like ‘tuuk’, the English ‘support’ like ‘sport’, and the French ‘peloton’ like ‘ploton’. This project will produce the first theory of how late learners of a language build mental representations for pronunciation variants in that language. In addition, it will provide information about how native learners learn and store these variants. Dr Ernestus also received a Starting Grant worth €1.5 million from the European Research Council for investigating how advanced learners of a language who have mental representations for reduced pronunciation variants understand complete sentences containing these variants. Since both projects focus on reduced pronunciation variants, they will reinforce each other.
CLST has obtained a European Lifelong Learning grant for developing online games which help people learn foreign languages. The project *Games Online for Basic Language learning* (GOBL) will involve collaboration with colleagues from Kortrijk (KU Leuven), Newcastle and Pretoria. Coordinator is speech technologist Dr Helmer Strik. The idea behind this project is for young people and adults to practice their basic skills in Dutch, English and French using accessible computer games.

Dr Ellen Ormel received a Veni grant for her project *Handy connections between signing and speaking: Cross-language activation and cognitive effects in bimodal bilinguals*. Fluency in several spoken languages is considered to be a form of mental exercise. However, not all languages are spoken languages. This research project will determine how languages ‘cooperate’ and the cognitive advantages this yields if one of the languages concerned is a sign language.

Dr Lotte Hogeweg obtained a Veni grant for her project *Lexical flexibility: formal semantics meets experimental psycholinguistics*. Words are incredibly diverse in their meaning. For example, in Dutch the word ‘strong’ can be used in the expressions ‘as strong as an ox’, ‘strong coffee’ or ‘a strong (meaning tall) story’. She will investigate how we can understand each other’s words so well despite heterogeneous meanings.

Dr Onno Crasborn’s joint grant application for an NWO α Added Value project (a programme designed to make humanities knowledge suitable and usable for third parties outside of the scientific domain) with Doverschap, the association for deaf people in the Netherlands, has been successful. A first start has been made towards the creation of a website in sign language which will explain research results to the deaf community. A deaf video producer and website developer will be involved in creating a multimedia experience.

Dr Mily Crevels and Prof. Pieter Muysken received a grant in December 2010 from the SURF Foundation for completing the editing of volumes II-IV of *Lenguas de Bolivia A supporting website*, created to disseminate the material in the book to a wider audience is now on line. In 2012, a follow up project – *The social embedding of the Lenguas de Bolivia* – which received funding from the NWO α Added Value programme in 2011 – will be used to extend the website, write newspaper articles and create educational materials.

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A Marie Curie Initial Training Network grant was awarded to the team who work on INSPIRE: *Investigating Speech Processing in Realistic Environments*. In everyday life, people listen to speech under a wide range of conditions that are suboptimal relative to the controlled conditions in laboratory experiments. Classical research methods can only deal with the effects of individual adverse conditions. This has contributed to the fragmentation of speech communication research into numerous sub-disciplines between which there is minimal interaction.

The long-term objective of the network is to create a community of researchers who can exploit synergies between the sub-disciplines established to study specific aspects of speech communication. INSPIRE will create a permanent collection of measurement data and tools that are accessible for external researchers for testing and comparing speech intelligibility models, thus enabling a breakthrough improvement in hearing instrument tuning. There will be a broad cooperation with several European Universities and with Philips Electronics Netherlands.
The Behavioural Science Institute (BSI) conducts top-level research on the fundamental principles and processes that govern human behaviour. In addition to this fundamental aim (‘to understand behaviour’) we aim to achieve societal relevance (‘to influence behaviour’). A distinctive feature of the BSI is a strong emphasis on an integrative approach to human behaviour that transcends the traditional disciplinary boundaries in psychology and education.

The BSI – a research institute of the Faculty of Social Sciences – was accredited as a research school by the Royal Netherlands Academy of Arts and Sciences in 2006. The Institute offers a two-year Research Master’s programme in Behavioural Science (www.ru.nl/master/behaviouralscience), which is taught within the BSI Graduate School. The School was officially recognized by the Netherlands Organisation for Scientific Research (NWO) in 2010.

BSI researchers investigate the nature and development of social cognition and behaviour, executive control and automatic processes, as well as 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, psycho-physiological measurement, behavioural and social neuroscience methods, behavioural genetics paradigms, randomized controlled trials and intensive longitudinal designs. BSI research is integrated in six closely linked programmes:

**Developmental Psychopathology**

The central theme of this programme is the interplay between individual characteristics (such as personality, expectancies, implicit associations and genes), as well as environmental cues and social interactions, in relation to the development of psychopathology.

**Experimental Psychopathology and Treatment**

Research is focused on abnormal psychology through the experimental study of cognitive and biological processes. Attention, interpretation, approach and avoidance, and memory are studied in relation to different disorders, in order to assess their current status, control them, predict treatment success and relapse, and help prevent psychological dysfunctions among individuals who are at risk.

**Learning and Plasticity**

Researchers in this programme explore the micro-analysis of learning and cognitive plasticity. The main focus is on learning and the development of communication and cognition in normal and atypical populations. Special attention is paid to the cognitive constraints related to 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 are investi-
gated, including 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
Researchers in this group study fundamental processes of typical and atypical social development and related cognitive processes over the human life span from a behavioural, psychobiological, and neuroscientific perspective. Clinical applications are also investigated. Areas of research include early child development and child care, peer relationships, ADHD, cognitive and motor processes in typical and visually impaired children, as well as successful aging among older adults.

Work, Stress and Health
This programme focuses on high-quality research in occupational health psychology. It combines fundamental theory-driven research and scientifically grounded applied research. Its fundamental goal is to advance our knowledge of the cognitive, motivational and physiological processes that underlie human work behaviour. Its applied goal is to provide evidence-based guidelines to design healthy jobs, to prevent stress, and to promote recovery, motivation, learning and performance.

In 2010 a new research group called ‘Communication and Influence’, led by Prof. Rick van Baaren, became part of the BSI. The main research issues are communication and media, social influence and behavioural change. This group’s research will be internally evaluated in 2013.

Research facilities
The Behavioural Science Institute has excellent research facilities:
- Two Virtual Reality Labs with sophisticated computers, utilizing high-end stereoscopic video processors, projection, and tracking systems to create immersive, three-dimensional computer generated environments in which participants can move around freely.
- Two mobile labs, with flexible furnishing, can be used to accommodate different experimental setups outside university (EEG recordings, computerized tests, observations of interactions between subjects). This facilitates research with young participants (e.g. children can be visited at schools).
- The Physiological Measurements laboratory has state-of-the-art facilities (including EEG) for measuring the neurocognitive and biochemical mechanisms involved in behaviour. These facilities are shared with the Donders Centre for Cognition.
- Eye-tracking equipment with 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.

- Three stabilometric platforms allow for research on automatic freeze behaviour and approach-avoidance responses to stimuli.
- The observational laboratory comprises several child-proof rooms with one-way screens and multiple cameras.
- The computer laboratory consists of 22 identical cubicles, each with a PC and software designed for computerized experiments. Licenses are available for various research-related software packages, including packages that enable on-line research.
- The Bar Lab (with unobtrusive cameras, recording devices, and a professional beer tap) is used for observation studies of social behaviour in a natural setting.

Collaboration
Within the BSI there is a great deal of collaboration among researchers, both within and between research programmes (e.g., joint publications, joint research grant proposals, joint supervision of PhD students). In addition to this fruitful internal cooperation, researchers at the BSI actively collaborate with many national and international partners. The BSI has also appointed several international fellows, thus strengthening the collaboration with many distinguished scholars and their institutes. Currently, Profs. Charles Perfetti (Pittsburgh University), Alex Todorov (Princeton University), Janet van Hell (Pennsylvania State University), Mitch Prinstein (University of North Carolina), Marcel Brass (University of Ghent), William Bukowski (Concordia University), Stefan Hofmann (Boston), and Emmanuel Kuntsche (Lausanne) are BSI fellows.

Furthermore there is a formal collaboration arrangement with the Trimbos Institute and with the Work and Employment division at TNO. Within the Radboud University formal collaboration arrangements consist with the Radboud University Nijmegen Medical Centre, the Donders Institute and its Centres for Cognition (DCC) and Cognitive Neuroimaging (DCCN), whereas the collaboration with Max Planck Institute for Psycholinguistics (Nijmegen) continued.

Awards and acknowledgements
- Prof. Rutger Engels received the Huibregtsenprijs 2011, which is an award for the best Dutch research that is both scientifically innovative and societally relevant.
- PhD student Renske Koordeman, MSc won the 2011 Frye Stipendium award.
- PhD student Shanti Ganesh received the Creative Mind Prize 2011.
- Dr Emily Cross won an NWO Veni Award.
- Dr Karina van de Voorde won the 2011 Emerald/EFMD Outstanding Doctoral Research Award in Human Resource Management.
- Dr Karina van de Voorde won (with S. Beijer) the Personnel Review-sponsored Best Paper Award at the International Conference of the Dutch HRM Network.
- Dr Annet de Lange won (with A. Schmitt and H. Zacher) the best paper award on the 9th Industrial and Organisational Psychology Conference 2011.

Research results
Within the Developmental Psychopathology programme, De Leeuw et al. demonstrated that adolescents with permissive parents are affected by sensation seeking tendencies and exposure to smoking models in movies. Studies on imitation using dynamic eye-tracking show that a) smokers focus attention on smoking actors, b) drinkers adjust their drinking pace to that of actors drinking on screen, and
Numerous studies within the Experimental Psychopathology and Treatment programme investigated automatic approach-avoidance tendencies, using different tasks (e.g. joysticks and stabilometric platforms), and addressing disorders such as social anxiety, phobias, and addictions. Several studies investigated the feasibility of Cognitive Bias Modification techniques, showing, for instance, that the risk of relapse for alcohol-addicted inpatients can be reduced through joystick retraining of alcohol-avoidance tendencies. Research on eating behaviour addressed protective and risk factors for weight gain. Neuroimaging studies showed that testosterone modulates frontal-amygdala connectivity during social-emotional behaviour and that social-emotional behaviour can be altered by direct neural intervention. It was also shown that patients with trauma have stronger freeze responses.

Within the Learning and Plasticity programme cognitive and linguistic markers were highlighted that relate to speech perception, auditory rhyme, phonemic awareness, reading acquisition, code-switching, spatial reference and motor planning. Furthermore, it was shown how linguistic processes vary in deaf children, second language learners and children with cognitive impairment. Progress was also made on intervention for people with mental disabilities, motor impairment and language impairment. Finally, the impact of construction in educational gaming and the role of school diversity on student learning were studied.

Within the Social Cognition programme Dotsch et al. demonstrated that social categorization is biased at the level of category allocation. In their experiments, participants overallocated faces with criminal features to the stigmatized Moroccan category, especially if they were prejudiced. Pronk et al. showed that executive control is associated with romantically involved individuals’ ability to stay faithful. People with a higher level of executive control reported less difficulty in staying faithful to their partners and engaged in less flirting behaviour with an attractive colleague. Prof. Dijksterhuis co-edited a special issue of Social Cognition on Unconscious Thought in which Strick et al. published a meta-analysis that revealed various moderators of the unconscious thought effect.

Within the Social Development programme De Weerth and colleagues showed for the first time that infant attachment to mothers is related to infant night waking and that maternal anxieties during pregnancy predict infant reactivity to stressful situations. Riksen-Walraven et al. demonstrated that friendships are a buffer against the negative effects of social rejection and help children manage stress. Lansu and colleagues demonstrated that early adolescents have negative implicit perceptions of popular peers. Burk et al. demonstrated that peers influence prosocial behavior and externalizing and internalizing problems in childhood and adolescence. Scheres and colleagues found that children and adolescents with ADHD have relatively strong preferences for small immediate rewards and are influenced by delay-related negative feelings.

Within the Work, Stress and Health programme, De Bloom et al. found in a diary study that employees’ health and well-being improved during short vacations due to pleasant vacation activities, relaxation and psychological detachment from work. In a laboratory study, Radstaak et al. showed that blood pressure recovery after stress exposure was hampered by rumination and negative affect. Oosterholt et al. revealed that burnout patients had more cognitive difficulties than healthy individuals and that a behavioural cognitive treatment resulted in enhanced subjective health and cognitive functioning but not in improved cognitive test performance. Kompier et al. provided evidence for strong associations between sleep quality, occupational stress, fatigue and work-related rumination.

In 2011 an international research evaluation of the BSI and its research programmes was conducted. The report was very positive. The Committee concluded: ‘Today, the BSI is strongly emerging as a center of excellence in behavioural science research, it is multiply connected to leading networks of behavioural scientists, and in an excellent position to continue to produce compelling research findings of both scientific and applied significance’. In terms of ‘Quality’ four of our research programmes received the highest score: ‘5’ (‘excellent’), whereas the two other programmes received the score ‘4.5’. All other scores for ‘Productivity’, ‘Societal Relevance’, and ‘Vitality and feasibility’ were also either ‘5’ or ‘4.5’.

**Societal impact**

- The BSI collaborates closely with the Academic Centre for Social Sciences (ACSW) in joint externally funded projects on mental health-related topics.
- In 2011, 7 new PhD projects were started in the context of the ZonMw-funded programme Academic Centre Youth Nijmegen, a multi-disciplinary collaboration on prevention, treatment, policy, research, teaching and training in relation to internalizing and externalizing problems (Principal Investigator: Prof. Rutger Engels).
- Prof. Clemens Hosman is Vice Chair of the World Consortium for the Advancement of Prevention and Promotion in Mental Health, in which 17 international organizations are involved. Since 2010 he has chaired the International Taskforce for Capacity Building and Workforce Development. He also chairs the Board of the Dutch Databanks on Effective Interventions of the National Institute of Public Health and Environment and the National Youth Institute.
Key publications


Dissertations: 18
Scientific publications: 357
Professional publications: 89
Director: Prof. Michiel Kompier

Prof. Michiel Kompier has been Professor of Work and Organizational Psychology at Radboud University Nijmegen since 1995. He previously worked at the Universities of Groningen and Amsterdam, and at TNO Work and Employment. His research interests include mental workload, work stress, fatigue, job design, motivation, working time arrangements, intervention research and policies on working conditions. He is associate editor of the Scandinavian Journal of Work, Environment and Health and a member of the editorial boards of Work and Stress, Journal of Occupational Health Psychology, and the International Journal of Stress and Health.

Future research

In 2011, as in previous years, the BSI was successful in obtaining grants for fundamental and applied research from the NWO and the Dutch Organisation for Health Research and Innovation (ZonMw). BSI researchers were also successful in acquiring contracts for PhD projects and other research.

The BSI aims to deliver top-level research with societal relevance and is confident that linking fundamental research with applications will continue to lead to innovative new projects. The institute will continue to strengthen both internal and external cooperation (for example, with Donders Institute on the neurocognitive foundations of behaviour), make sure research programmes are fully staffed, hire top national and international researchers and increase the number of international fellows. Future research (and also teaching in the School of Psychology and Artificial Intelligence and in the School of Education) will be further enhanced by the appointment of nine new assistant professors within the BSI. Stimulated by academic and societal discussions on codes of conduct for research integrity, BSI will also prioritize the maintenance of high standards of scholarly conduct and ethical behaviour in professional scientific research. BSI also aims to further enhance its impact through publishing in top journals and to further professionalize its grant writing.
Understanding mind and brain

The Donders Institute (DI) for Brain, Cognition and Behaviour at Radboud University Nijmegen is a leading centre of expertise with a strong international reputation. The institute is young, has an enterprising spirit and an excellent track record of research on Brain, Cognition and Behaviour. Its scientific output is prolific and renowned for its quality. Key success factors include a highly interdisciplinary approach. The breadth of the DI, which spans the faculties of Natural Sciences, Social Sciences and the University Medical Centre, is unrivalled worldwide. Collaboration extends beyond the borders of the institute, both nationally and internationally. Harold Bekkering, who took over the Donders chairmanship from Peter Hagoort as on 1 January 2012: "The state-of-the-art research equipment as well as the thematic focus that we have achieved over the last few years attract researchers from all over the world. Our strong focus on the system level of human brain and cognition makes us a world-wide key player within the huge field of Cognitive Neurosciences."

Critical mass and focus

Over 500 researchers work at the DI on unravelling the mechanisms of the brain. Thanks to the integration of basic sciences in the institute, there is also a strong theoretical approach. The research includes exploring cognition and behaviour in humans as well as work on the neuronal substrate, including the genetic, molecular and cellular processes that underlie cognition and behaviour. The DI’s full spectrum of research ‘from Molecule to Man’ is structured within four main themes:

Language and Communication

Studying Language and Communication involves understanding core language and communication operations and working out how these are grounded in (or related to) other domains of cognition, including perception, action, memory, and sociality. An important goal is to determine how the human language faculty is rooted in the ‘language-ready’ human brain.

Perception, Action and Control

Researchers working on Perception Action and Control study sensorimotor mechanisms, their cognitive and social components, their clinical implications, and their relevance for robotics. Research methods include theoretical analysis, psychophysical and behavioural studies, neurophysiological techniques, neuroimaging, clinical and pharmacological interventions, developmental and genetic approaches.

Learning, Memory and Plasticity

The development and decay of the healthy and the maladaptive brain is the main focus of researchers working on Learning, Memory and Plasticity. They study the mechanistic underpinnings and behavioural consequences of long-term changes in neural structure and function. Genetic, molecular and cellular methods, animal models, as well as human neuroimaging and cognitive neuropsychology are used.

Brain Networks and Neuronal Communication

This theme centres on brain networks, ranging from the very smallest – communication between individual neurons – to the largest: communication between different brain areas and the outside world. The research groups combine developing new techniques for electrophysiological and anatomical measurements of connectivity and activation with data analysis and the experimental application of these techniques in studies of cognition in humans, non-human primates and rodents. Computational modelling is an important component, integrating multi-level experimental data in an attempt to arrive at a clearer understanding of cognitive processes.

Benefits for society

The research conducted at the DI has considerable potential for benefiting society, for example in the domains of health, education and safety. Many diseases like Alzheimer, are best studied over the whole range of Molecule to Man. At the moment, recent scientific insights are translated into clinical programmes. For a long time, education has been studied in separation from related fields like psychology and medicine. The DI is actively involved in creating learning programs for primary schools in the Netherlands, based on recent insights about cognitive, social and emotional early human development. Finally, the issue of improving societal safety is seen as an important issue for the years to come. The DI is actively involved in several programmes involving treating and diagnosing different forensic populations (i.e., anti-social or extreme violent behaviour). In future the intention is to tailor programmes in all three domains mentioned (health, education and safety) to individual needs.
The Donders Graduate School for Cognitive Neuroscience

In order to train young talent in the broad field of cognitive neuroscience, the Institute has established a graduate school, which offers students a high-quality tailor-made educational programme at both the Master’s and the PhD level. The school is intended for the best international students in biology, physics, psycholinguistics, behavioural studies and medicine who are strongly motivated to do research in cognitive neuroscience. Indeed, the Donders Graduate School for Cognitive Neuroscience (DGCN) attracts triple-A students (Active, Ambitious and Autonomous) and DGCN Master’s graduates are much in demand around the world.

DGCN hosts a yearly 'Top Talent' programme, which provides funding for excellent young Master students to enroll in the PhD programme.

Brain research clearly benefits from cooperation across disciplines, which is why the training programmes are mostly cross-disciplinary. Students experience a range of aspects of the Institute before they start on their own research. And it’s not only the trainees who profit from this approach. All of the researchers who are involved in the DGCN are able to extend their expertise by working together with colleagues who are tackling brain research from a different angle.

The DGCN is officially recognized as a national graduate school within the NWO Graduate School Programme that’s endorsed by the Dutch Minister of Education and the MSc programme is approved by the Accreditation Organisation of the Netherlands and Flanders (NVAO).

Future developments

Based on the recommendations by the evaluation committee in 2010, a Scientific Advisory Board consisting of renowned international scientists, was established. The Board made a first, introductory, visit to the DI in November 2011. It was ‘very impressed by the quality as well as the quantity and breadth of the research presented, and also the attempts to generate a coherent research strategy across different levels of neuroscientific research.’ Their advice proved very valuable and strengthens the purpose of the DI to remain a leading institute on Brain, Behaviour and Cognition.

The DI aims to support its researchers and considers it important to define the values of the Institute for those who work in it. This has been specified in a vision document, which explains DI’s commitment to equal opportunity for all, irrespective of age, religion or gender. To this latter aim a ‘Gender Steering Group’ has been established in 2011, to plan proposals for the DI board on DI gender policy.

www.ru.nl/donders
The Donders Centre for Cognition (DCC) is one of three centres at 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 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.

Research collaboration with the Donders Centre for Cognitive Neuroimaging (DCCN) and the Donders Centre for Neuroscience (DCN) embraces four Donders research themes: Language and Communication (LC), Perception, Action and Control (PAC), Learning, Memory and Plasticity (LMP) and Brain Networks and Neuronal Communication (BNNC). The DCC has five research divisions.

**Psycholinguistics (PL)**
Researchers in Psycholinguistics study the cognitive processes and representations underlying the use of language in a variety of contexts, including speaking, reading and listening, at the levels of word, sentence, and discourse. Various techniques are used, including studies of reaction time, eye-tracking, neuro-imaging and computational modelling, with a special research focus on contextual flexibility and multilingualism. Researchers in this division are all also involved in work on Language and Communication.

**Action, Intention and Motor control (AIM)**
The objective of this division 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. Key focus areas include Sensorimotor Integration, Intention and Control, and Social Interaction. All members of AIM contribute to research on Perception, Action and Control.

**Biological Psychology (BP)**
Research in the Biological Psychology group involves a broad methodological spectrum, ranging from rodent research – using behavioural, EEG and neuroimaging studies in healthy participants – to studies in selected clinical populations, in order to bridge the gap between cognitive & systemic and basic neurosciences. In addition, the group carries out pharmacological and genetics studies. Significant contributions have been made to research on Perception, Action and Control, with a specific focus on cognitive control, as well as to Learning, Memory and Plasticity and Brain Networks and Neuronal Communication.

**Neuropsychology and Rehabilitation Psychology (NRP)**
Research within the division of NRP focuses on the interplay between executive control, learning and memory using interdisciplinary, patient-centered studies or ageing individuals in...
combination with structural and functional neuroimaging methods. An important topic is learning, which can be examined from the perspective of rule learning and learned irrelevance (Perception, Action and Control) and learning as part of memory acquisition and cognitive rehabilitation (Learning, Memory and Plasticity).

Cognitive Artificial Intelligence (CAI)
The research focus of this division is on cognition as well as communication and cooperation in people, their environment and artificial systems. The main research topics are Brain Computer Interfaces and Brain Decoding (within Brain Networks and Neuronal Communication), Theoretical Cognitive Science and Ethics of Cognitive Neuroscience (Perception, Action and Control).

Awards and acknowledgements
• I. Brazil MSc received the Stichting Koningsheide Award for psychopathy research.
• Prof. Kessels received the Betto Deelman Award from the Stichting Neuropsychologie.
• Prof. Bekkering et al. received two Netherlands Organisation for Scientific Research (NWO) grants (programmes: ‘Brain and Cognition’ and ‘Societal relevance’).
• Prof. Desain, Prof McQueen and Dr Sadakata received a The Dutch Technology Foundation (STW) Open Technology Programme: “EarOpener” grant.
• Prof. Knöblich has gained funding from the European Science Foundation (ESF) for the collaborative research project DRUST.
• Dr Flecken received an Veni grant.
• Prof. Medendorp received an ERC grant.
• Prof. Medendorp received a Vici grant.
• Dr Toni et al. received an NWO MagW grant (programme: ‘Brain and Cognition: An Integrated Approach’).
• Dr Toni and Prof. Stegenman received an equipment grant from nwo/ZonMw.
• Prof. McQueen, Prof. Desain et al. received an NWO grant (‘Brain and Cognition programmes for Excellence’).

Research facilities
• A Baby Lab, including a Tobii eye-tracker and a 48-channel active EEG setup.
• 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 during the execution of such tasks as reaching, grasping and manipulating objects.

- ‘Reach-in’ 3D-visualization and force-feedback machinery, allowing experiments on manual actions in three-dimensional virtual reality.
- A Cognitive Artificial Intelligence laboratory, which is used to analyse human-computer interaction, the dynamics of intelligent behaviour, ‘embedded embodied cognition’ and information retrieval.
- A laboratory and studio for research on auditory perception and music cognition.
- Several laboratories for behavioural studies using visual/auditory stimuli.
- Animal laboratories for long-term electrophysiological recordings using rats with chronically implanted electrodes and for learning studies.
- Facilities for stereotactic animal operations.
- A biochemical laboratory for identifying brain substances.

In addition, DCC researchers have access to the brain-imaging facilities of DCCN (fMRI, MEG, EEG and TMS).

Collaboration

The DCC collaborates with the following partners in the international research universities network IRUN:

- Jagiellonian University Kraków, Poland: collaboration on research on the endogenous factors controlling absence epilepsy and learning.
- Westfälische Wilhelms-Universität Münster, Germany: joint research on the lateralization of processes related to performance monitoring.

The DCC also engaged in structural collaboration with many other academic institutions, including:

- King’s College, London: collaboration on amnesia and contextual memory research.
- UCL London: motor control and computational modelling of amnesia and working-memory capacity.
- Max Planck Institute for Neurological Research and University Hospital Cologne Germany: joint research on the effects of deep brain stimulation on performance monitoring.
- Max Planck Institute for Human Cognitive and Brain Science: genome-wide association study of performance monitoring, combined rTMS – fMRI study.
- York University, Canada: research on goal-directed movement control.
- University College London: collaboration on motor control research.
- Western Ontario University, Canada: neuroimaging of perception and action.
- Minho University, Portugal: research on cognitive robots.
- Research on multilingualism, together with CNRS (Marseille/Aix en Provence), France and the University of Nottingham, UK.
- Universität Bielefeld, Germany: morphology.
- University of Massachusetts, Amherst, USA: L1 and L2 segmentation.
- University of Toronto, Canada: joint research on segmentation.
- University of Trento, Rovereto, Italy: word learning.

Research results

Language and communication

Studies on speech perception carried out by the Psycholinguistics division have demonstrated a relationship between the probability...
that spoken words will be distorted and the way these words are recognized. The group has also shown that six-year-old children already adjust to speaker variation in speech, revealing that they have detailed and abstract phonological representations, which they apply during spoken-word recognition. Electrophysiological studies further revealed that listeners to sentences are sensitive to both matching and mismatching between accentuation patterns and linguistic and visual context. PL researchers also examined the processing and decision components used in naming. Induced emotional states (happy, sad) were found to cause N400 effects. Finally, there were studies in which the way spelling and morphology affect L1 and L2 reading development in healthy and patient populations was examined.

The Brain Computer Interface team in the Cognitive Artificial Intelligence division developed stimulus specific neuro-feedback methods to accelerate the learning of perceptual categories in second languages and music.

Perception, Action and Control
In 2011 the Baby Research Centre at the University investigated early development in the domains of imitation and joint action. In contrast to prevailing theories, it was found that the imitation of observed novel actions depends on activating the motor system rather than the mentalizing system. Researchers from the sensorimotor lab developed an inverse probabilistic approach to distinguish the contribution of various sensory signals in spatial perception. In addition, using fMRI recordings, they developed a novel view of the functional organization of the human posterior parietal cortex. Using magneto-encephalography, it was further shown how oscillatory activity in the brain reflects the time-variable coding of information in multiple reference frames during sensorimotor integration. Other research has shown that tremor, a principal sign of Parkinson’s disease, emerges from maladaptive interactions between two functionally and anatomically distinct cerebral circuits. In the domain of social interactions, evidence has been reported that control over human social emotional behaviour requires the anterior prefrontal cortex (aPFC) to bias neural processing towards rule-driven action selection and away from automatic emotional tendencies.

The Neuropsychology and Rehabilitation Psychology division studied learning and executive control and its disorders in neuro-psychiatric disorders such as psychopathy or genetic syndromes. An important result was that psychopathic individuals are not unable to process their own errors (as was previously assumed), but rather have specific problems with monitoring the outcome of others’ actions.

Researchers in the Biological Psychology division have shown that the thalamic ventral anterior and ventrolateral anterior nuclei are necessary for the monitoring and conscious perception of errors. Modulating the ventral striatum function by deep brain stimulation has been shown to alleviate otherwise intractable alcohol dependence and to increase the amplitude of error-related negativity, indicating a close functional interaction with the system that monitors medial frontal cortex-based performance.

The CAI division made a careful conceptual analysis, unravelling the different possible interpretations of “action understanding”, “action goals,” and “motor resonance”.

Learning, Memory and Plasticity
The NRP division examined the underlying cognitive mechanisms of working memory and episodic memory formation in brain-diseased patients (amnestic syndrome, Alzheimer’s disease) and in normal ageing. The memory of Alzheimer patients with severe hippocampal dysfunction is partially intact for landmarks in a virtual maze, providing important insight into the automaticity and the role of attention in landmark recognition. Further work showed that patients with autism have specific deficits in learned irrelevance, but made fewer errors in shifts involving a choice between a novel irrelevant attribute and a familiar, previously irrelevant but now relevant attribute. These results show that reduced processing of novelty is an important aspect of autism.

Research efforts of the Biological Psychology Group focused on investigating the neuroplastic changes that occur during epileptogenesis. Preictal activity in the occipital cortex was found in children with absence epilepsy.

Brain Networks and Neuronal Communication
Spatially distributed phase-heterogeneous patterns of oscillatory phase-amplitude coupling were identified by the Biological Psychology researchers. Further research showed evidence for spatio-spectrally specific modulations of oscillatory neural activity in anticipation of a sensory event.

New levels of robustness and reliability were achieved in Brain Computer Interfaces for handicapped individuals by advancing the underlying machine-learning methods and building on knowledge from neurocognition. Understanding both the fundamental process of mental imagination and that of forming perceptual categories and tracking these processes in various modalities with markers in EEG has improved, enabling new experimental paradigms and the potential for real-world applications. Research on the ethical implications of neurotechnologies has been amplified.

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.
Donders Institute for Brain, Cognition and Behaviour
Centre for Cognition

Key publications


Dissertations: 17
Scientific publications: 238
Professional publications: 13

There were numerous media appearances, in both Dutch and international media. For example Prof. Bekkering appeared on television (Vandaag de Dag, Ned. 1) and the radio (Omroep Gelderland) in programmes about the mimicry of yawning. NRP research, for instance, I. Brazil MSc and Dr de Bruijn’s research on psychopathy, also attracted media attention.

In September 2011 a researchers’ night in the Lux cultural centre in Nijmegen entitled ‘Baby Brain’ (presented by the Baby Research Centre) attracted a wide audience. Dr van Lier was invited to the annual symposium of the Dutch foundation “Kleurenvissie” to lecture to a mixed audience of artists, designers and architects on colour-form interactions and their effect on perceptions of visual surroundings.

Prof. Kessels co-authored a book for the general public on learning in dementia ‘(Op)nieuw geleerd, oud gedaan: Over het lerend vermogen van mensen met dementia’ and he was the keynote speaker at the annual Alzheimer Nederland conference in Utrecht, also for the general public.
The BrainGain Project headed by Prof. Desain successfully disseminated knowledge on new applications of neuro-cognition to a broad audience through various events and media. A communication app is now used with success by amyotrophic lateral sclerosis (ALS) patients. Dr Haselager contributed to public awareness of ethical issues, both for general audiences and professionals who request advice on rapid technological developments (e.g. Kenniskamer Ministerie van Veiligheid en Justitie).

Prof. Desain and Prof. McQueen applied for a patent on the brain-computer interface (BCI) feedback system they are using in the STW project.

Future research

Adopting a multi-disciplinary approach, DCC will continue to study the relationship between brain and cognition, with a focus on applied studies and research. DCC will continue to encourage research within the four Donders themes. A further goal is to increase the proportion of external funding from the EU’s 7th Framework Programme.

Grants that were acquired in 2011 will be used to set up new research projects. Prof. Medendorp received an ERC and Vici grant, both of which will fund unique work on sensorimotor integration and decision making in dynamic environments. The STW Open Technology Programme “EarOpener” grant, awarded to Prof. Desain and Dr Sadakata will facilitate studies of the learning auditory categories using brain signals. An STW valorisation grant, awarded to Prof. Desain and Dr Dimitriadis, will be used to fund a project commercializing human BCIs for ALS patient communication.

Using funding from NWO Brain & Cognition (Societal Relevance), Prof. Bekkering will start coordinating research on the learning mind. He will also lead a project funded by the NWO PROO fund for research in education entitled: Yes Wii Can: An Embodied Cognition Approach for Improving the Design of Animations for Primary Education.

Four NWO Open Competition grants that were awarded in 2011 to fund three PhD projects (two led by Dr Van Gerwen, and one advised by Prof. Medendorp) and one postdoc project (advisor Prof. Medendorp) will continue. Dr Flecken will start the research funded by her Veni award, entitled “Thinking for speaking about events: a cross-linguistic approach to processing in L1 and L2’.

Other ongoing work includes two Brain & Cognition grants (one for Prof. Bekkering and one for Profs Desain and McQueen), an STW EarOpener grant (Prof Desain and Prof. McQueen), two Veni projects (Dr Lemhöfer and Dr Selen), a Vidi project coordinated by Prof. Kessels, a Vidi project coordinated by Dr Fiebach, several open competition projects funded by the NWO, and a ‘visiting’ Marie Curie grant awarded to Dr Loehr (mentor: Prof. Knöblich). Prof. Meulenbroek’s research in PAC’s Joint Action subtheme, which will be extended to Sports Psychology, is expected to have an impact on further professionalization of this field.
The mission of the Donders Centre for Cognitive Neuroimaging (DCCN) is to conduct basic and applied research in cognitive neuroscience. Much of the recent rapid progress in this field is driven by the development of complex neuro-imaging 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 also aims to establish how the different brain areas coordinate their activity with very high temporal accuracy 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 the 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, for which both a deep understanding of brain functioning and technical excellence are required.

All research at the DCCN is done within the context of the Donders Institute for Brain, Cognition and Behaviour. Research is organized in Principal Investigator groups, which work within one of the four major research themes of the Donders Institute.

**Language and Communication**

Language processing is more than just decoding meaning from spoken or orthographic inputs. One has to infer what the speaker wants to achieve, as in the statement “It’s cold here”, which is usually interpreted as a request to do something about it (for example, close a door or window and/or turn up the heating). DCCN researchers have shown that these inferences involve the contribution of the Theory of Mind areas in the brain. This provides evidence against strong versions of the Mirror Neuron hypothesis, which claim motor resonance to be sufficient for language understanding. These findings also extend the Memory, Unification, and Control (MUC) model.

Another aspect which was studied is Information Structure. The language system has means available for highlighting new information relative to what has already been shared between speaker and listener. One of these is accentuation. Researchers were able to show that this linguistic marking triggers the general
Staff

Prof. J.K. Buitelaar (o)
Prof. J.P.J.M. van der Eerden (o)
Prof. G.S.E. Fernandez (o)
Prof. P. Hagoort (o)
Prof. D.G. Norris (o)
Prof. D.J. Ruiter (o)

Tenured

Full Professors 3.4 FTE
Associate Professors 1.0 FTE
Researchers 7.6 FTE

Non-tenured

Researchers 26.5 FTE
Doctoral candidates 49.8 FTE

Perception is not merely a passive process of accumulation of sensory evidence. Rather, it is strongly influenced by the top-down influence of internal brain states, incorporating goals, expectations and knowledge about the world. The complex relationship between these various top-down factors is characterized using fMRI and MEG. The results showed partly independent mechanisms of attention and expectation affecting sensory processing.

In a TMS study the Neurocognition of Language group demonstrated the causal role of the Left Inferior Frontal Gyrus in the unification operations that were hypothesized to recruit this part of the brain.

The Principal Investigator working on this theme is Prof. P. Hagoort.

Perception, Action and Control

The Intention & Action group studies how perceptual and conceptual information can structure action plans as well as the brain dynamics that makes human action possible. They have shown that conceptual knowledge influences sensorimotor processes by biasing movement selection at the earliest stages of planning, in contrast to models postulating temporal precedence of visuospatial over perceptual information processing. They have also extended this framework to include emotional control, conceptualized as a rapid response selection problem based on abstract rules that need to override predominant action tendencies. In this context, it was shown that frontal portions of the brain solve this problem by up-regulating posterior parietal regions involved in rule selection and down-regulating regions that support the automatic evaluation of emotions.

Perception is not merely a passive process of accumulation of sensory evidence. Rather, it is strongly influenced by the top-down influence of internal brain states, incorporating goals, expectations and knowledge about the world. The complex relationship between these various top-down factors is characterized using fMRI and MEG. The results showed partly independent mechanisms of attention and expectation affecting sensory processing.

How is visual information represented in the brain and how are visual representations adjusted to better serve behavioural demands? Research has focused on these and other questions relating to the neural basis of visual perception. Results have demonstrated that top-down processes such as attention selectively enhance the neural representation of the task-relevant visual features – but not the irrelevant features – of an attended object.

The mechanisms of individual and interactive decision-making are investigated by combining methods such as behavioural experiments, functional neuroimaging, pharmacology and economic models.

Researchers in one group study how social factors such as trust and
fairness can alter interactive choices and judgments, in contrast to ‘rational’ models of behaviour. They also construct biologically-based models of emotional influences guilt and empathy. Results show that prior knowledge about what is typical in a social exchange can radically change our decisions, that affective factors play an important role in decision-making. The researchers also explore the neural systems underlying interactive choice.

The psychopharmacological mechanisms of the motivational and cognitive control of healthy and disordered decision making are assessed. This work focuses on the role of the fronto-striatal circuitry and its neuro-modulation by dopamine and serotonin with the ultimate translational aim of understanding the neurochemical basis of a variety of neuropsychiatric disorders. Researchers have been successful in setting up pharmacological fMRI and patient protocols to study the role of dopamine and serotonin in Parkinson’s disease, depression, pathological gambling, ADHD, psychopathy and borderline personality disorder. The results demonstrate the critical role of dopamine and serotonin in the motivational control of decision making and a step towards elucidating their neural mechanism of action.

The Principal Investigators working on this theme are Dr I. Toni, Dr F. de Lange, Dr J. Jehee, Dr A. Sanfey and Prof. R. Cools.

Learning, Memory and Plasticity

One research line involves investigating how the brain maps space and forms memories. By combining fMRI with virtual reality techniques it was discovered that there are grid-cell-like representations of space in the human brain. These representations, which support spatial memory, are found in a circuit of regions that markedly overlap with the network for autobiographical memory. This approach demonstrates the potential of fMRI for inferring the fine-scale properties of neural systems in humans by building on animal models.

Another research line focuses on the neural underpinnings of memory, emotion and their interactions. A series of fMRI studies were used to explore how psychological stress affects cognitive and affective processing. The results revealed that stress modulates several processes in a carefully orchestrated and highly adaptive way, improving the chances of survival under adverse conditions. In addition, various breakthroughs were made while studying the fundamental processes of long-term memory consolidation. For instance, it is revealed how the existence of prior knowledge augments processes underlying the acquisition of new, related knowledge. Researchers showed how these frontally mediated processes have direct consequences on study success at university.

The Principal Investigators working on this theme are Prof. G. Fernández and Dr C. Döller.

Brain, Networks and Neuronal Communication

Researchers working in the Neuronal Oscillations group investigate how oscillatory brain activity shapes the functional architecture of the working brain. They have demonstrated that alpha band activity (10-12 Hz) functionally inhibits task-irrelevant areas. This inhibition helps to suppress incoming distracting information, while allocating resources to task-relevant areas. A failure to sufficiently inhibit task-irrelevant areas using alpha activity impairs behavioural performance. This case has been made using MEG and intracranial monkey data in the context of attention and memory studies. A second line of research involves the development of brain-computer interfaces based on attentional modulation of oscillatory brain activity.

The group ‘MR techniques in brain function’ conducts research that is designed to improve our ability to measure brain function and structure using magnetic resonance techniques. These techniques are also used to evaluate the connectivity between brain regions. To achieve these goals the group either develops novel techniques or improves existing methodologies. Areas of interest
include the acquisition of fMRI data (in activation studies and in the resting state), diffusion tensor imaging, proton spectroscopy and ways to measure brain connectivity.

The Statistical Imaging Neuroscience group develops unified analytical approaches to analysing neuroimaging data in order to provide imaging neuroscientists with powerful multimodal research tools and clinicians with advanced practical tools. These tools are used for investigations of cognition, in clinical settings (dementias, MS, addiction and oncology) and in other challenging imaging scenarios such as pharmacological studies and studies of early brain development in neonates.

The Principal Investigators working on this theme are Dr O. Jensen, Prof. D. Norris and Prof C. Beckmann.

Awards and acknowledgements

- Prof C. Beckmann received the 2011 Wiley Young Investigator Award from the Organization for Human Brain Mapping
- Dr R. Helmich was awarded the 2011 Susanne Klein-Vogelbach Prize for the Research of Human Movement
- K. van Borries and I. Brazil received the 2011 Stichting Koningsheide Award
- Dr J Cook received a Rubicon grant
- Dr E. Aarts and Dr J Cook received an AXA postdoctoral grant
- Dr H. den Ouden received a Veni grant
- S. Ganesh was awarded the 2011 Creative Mind Prize.
- Dr I. Toni, Dr F. De Lange and Prof R. Cools received an NWO Open Competition Grant
- Profs. R. Cools and G. Fernández received a Radboud Science Award.

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, 273-channel MEG system, for measuring neuronal activity with high temporal and good spatial resolution
- two EEG laboratories, with 128 channel recording possibilities, for measuring the synchronous electrical activity of large ensembles of neurons
- a dedicated 64-channel EEG system for measuring EEG in the MR scanners
- two behavioural laboratories
- integrated stimulus presentation facilities for auditory and visual presentation and activities such as somatosensory stimulation
- dedicated eye-tracking facilities suitable for fMRI, MEG and behavioural experiments
- 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 TMS.

Collaboration

The DCCN is a research centre at Radboud University Nijmegen in which the universities of Maastricht, and Twente as well as the Radboud University Medical Centre and the Max Planck Institute for Psycholinguistics in Nijmegen also participate.

The DCCN collaborates with the University of Duisburg-Essen, Germany – a preferred partner of the Radboud University Nijmegen – on the operation of a joint research centre for high-field MR imaging in Essen.

The DCCN is also engaged in structural collaboration with many other academic institutions, including:
- Columbia University, New York, USA (TMS, perceptual awareness)
- University of Arizona, Tucson, USA (decision neuroscience)
- University of Trento, Italy (decision neuroscience)
- Kansai Medical University, Moriguchi City, Japan (cognitive control)
- University of California, Berkeley, USA (cognitive control)
- University College London, UK (neural representation of space)
- National Institute of Mental Health, Bethesda, US (oscillations, networks and memory)
- University of Edinburgh, UK (memory consolidation)
- Universidad Nacional Autónoma de México, México (oscillations in the somatosensory system)
- Imperial College London, UK. (neonatal imaging)
- University of Oxford (image analysis and imaging genetics)
- Ernst-Strüngmann Institute, Frankfurt, Germany (neuronal coherence)
- Heinrich-Heine Universität, Düsseldorf, Germany (multi-lingualism).

Societal impact

The DCCN contributes to a better understanding of the nervous system by disseminating its expertise and knowledge to both the scientific community as well as 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 several lectures for the general public, including a presentation at the Besiendershuis “Eerst zien, dan geloven?” by Dr de Lange in collaboration with Mrs. Dekyndt (artist in residence). Prof. Cools received the Radboud Science Prize leading to a programme which yields teaching materials for primary schools based on her research on punishment and reward. She also organized the Radboud Honours Academy course on ‘Wider Implications of Neuroscience’. In this course, a select group of international master students works for one year in think tanks on assignments provided by the Public Prosecution Service and the Scientific Council for Government Policy.
Key publications


Dissertations: 8
Scientific publications: 141

Future research

Language and Communication

Future work will focus on various aspects of language production, bilingualism as well as related structural and functional changes. Moreover, language behaviour will be studied in a conversational setting in a Virtual Reality environment.

Perception, Action and Control

Work following two main lines of research – targeting instrumental and communicative actions – will continue. Experiments are planned to study the mechanisms that integrate visuospatial and perceptual...
and mental health, incorporating three dimensions in a fully integrated approach: pharmacology, genetics and neural processes.

Recently described proxy measures of grid-cell like activity will be used to understand the common neural mechanisms of how the brain stores episodic memories and helps us to navigate. In another research programme, the functional role of brain oscillations in memory formation will be investigated.

**Brain, Networks and Neuronal Communication**

The role of oscillatory brain activity will be investigated using multimodal approaches employing combinations of MEG, EEG, TMS and fMRI. In particular the role phase of the brain oscillations will be investigated using these technique and cross-frequency analysis. Brain-computer interfaces will be used to investigate the role of oscillatory brain states on perception and memory online.

Slice-multiplexed imaging, which allows the simultaneous acquisition of multiple slices of data, will be used for functional and diffusion-weighted imaging. Perfusion imaging of the territories of selected arteries will be established and used to assess the degree to which these territories match the boundaries of various functionally defined regions.

New methodology will be developed for use in analysing multi-subject data with respect to functional and structural brain connectivity in health and disease. The hierarchical organisation of functional connectivity patterns will be investigated with the goal of defining more specific targets for biomarker development.
The human brain is a dynamic, self-organizing system, whose potential for adaptation – which is rooted in the genetic profile – is expressed through interaction with the environment. Research at the Donders Centre for Neuroscience (DCN) takes place at various levels and deals with the interrelationships between genes, molecules, neurons, networks of neurons and the behaviour of the whole organism.

The DCN, which brings together inter-disciplinary basic and clinical research groups from the Faculty of Science and Radboud University Nijmegen Medical Centre, is organized around the four research themes of the Donders Institute. The strength of the centre lies in the way it combines a broad repertoire of skills, experimental facilities, and expertise for basic and clinically applied research on cognitive neuroscience. Exploiting this interdisciplinary drive, the DCN aims at providing mechanistic accounts in diverse cognitive and affective domains e.g. attention, memory, and anxiety, with a special focus on their genetic underpinnings. This knowledge is used to understand vulnerability for and pathophysiology of neuropsychiatric disorders such as Alzheimer’s disease, stroke, depression, and attention deficit disorder. Ultimately, this research will not only lead to fundamentally new insights into how the brain works; it will also lead to new diagnostic and therapeutic approaches. Besides their research, scientists at the DCN use their expertise and skills to train students, researchers, and physicians active in the field of neuroscience.

Awards and acknowledgements

• Prof. Bas Bloem obtained an FP7 grant with Prof. Marcel Olde-Rikkert.
• Prof. Jan Buitelaar received a ZonMw grant with Prof. Rutger Engels (BSI) and a large FP7 grant on compulsivity disorders with Jeffrey Glennon.
• Dr Jurgen Claassen received a research grant from ISAO to investigate the relationship between hypertension and Alzheimer in animal models, with Dr Amanda Kiliaan; and a grant from Alzheimer Nederland to explore the effects of sleep and wakefulness on the development of Alzheimer pathology, with Dr Marcel Verbeek.
• Rick Helmich received the Susanne Klein-Vogelbach-Prize for his paper in Ann Neurol. on Parkinson.
• Dr Judith Homberg was awarded a NWO/ZonMW Topsubsidie for addiction research and a fellowship from the European College of Neuropsychopharmacology. Finally, Judith was awarded the Young Investigator Prize of the European Behavioural Pharmacology Society.


### Staff

- Prof. B.R. Bloem (o)
- Prof. J.H.L.M. van Bokhoven (o)
- Prof. J.K. Buitelaar (o)
- Prof. A.R. Cools (o)
- Prof. R. Cools (o)
- Prof. B.G.M. van Engelen (o)
- Prof. G.S.E. Fernandez (o)
- Prof. A.C.H. Geurts (o)
- Prof. C.C.A.M. Gielen (o)
- Prof. H.J. Kappen (p)
- Prof. R.P.C. Kessels (o)
- Prof. J.M.J. Kremer (o)
- Prof. M.M.Y. Lammens (o)
- Prof. H.A.M. Marres (o)
- Prof. G.J.M. Martens (o)
- Prof. M.W.G. Nijhuis-Van der Sanden (o)
- Prof. P.H.E. Tiesinga (o)
- Prof. K.C.P. Vissers (o)
- Prof. M.J.P. Wensing (o)
- Prof. R.A. Wevers (o)

#### Tenured

- Full Professors: 10.5 FTE
- Associate Professors: 8.6 FTE
- Assistant Professors: 18.2 FTE
- Researchers: 14.1 FTE

#### Non-tenured

- Researchers: 45.8 FTE
- Doctoral candidates: 93.8 FTE

### 2011 Research Report

- Willemijn Leen was awarded the Ariëns-Kappersprijs for her publication on Glucose transporter-1 deficiency syndrome.
- Prof. Gerard Martens and Dr Jasper Visser/Prof. Bas Bloem received a grant from the Stichting Internationaal Parkinson Fonds on “Understanding adaptive neuroplasticity in Parkinson’s disease”.
- Prof. John Van Opstal received two research grants from NWO and one from Advanced Bionics (Switzerland) with Prof. Ad Snik.
- A Frye stipendium was awarded to Petra Spies.
- Prof. Dick Stegeman and Dr Ivan Toni obtained a Netherlands Organisation for Scientific Research (NWO) Middelgroot grant for the renewal of the Donders laboratory for non-invasive brain stimulation.
- Dr Marcel Verbeek received a grant form the Alzheimer’s Drug Discovery Foundation to investigate cerebrospinal fluid biomarkers in frontotemporal dementia.
- Dr Bart van de Warrenburg received a grant from the Royal Dutch Society for Physical Therapy and the Biemond prize for best lecturer.
- Dr Jasper Visser received an NWO Veni-grant for his research on brain development in Lesch-Nyhan disease.
- Dr Rick Helmich received the Susanne Klein-Vogelbach Prize for his paper in *Annals of Neurology* on Parkinson.

### Collaboration

DCN researchers cooperate with several research institutes on campus including IGMD, NCEBP, NCMLS, IMM and ICIS, and with colleagues at virtually all Dutch universities.

### International

- Universities of Würzburg and Freiburg, Germany
- Applied University Biberach, Germany
- Max Planck Institutes in Berlin, Dresden, Göttingen, Munich Leipzig & Tuebingen, Germany
- University of Bergen, Norway
- University of Edinburgh, UK
- University College London, UK
- Universities of Rouen and Nice, France
Results

Perception, Action and Control

Multisensory integration in complex environments.
Prof. John van Opstal and Drs Denise van Barneveld studied audio-vestibular and visual-vestibular integration in human eye-movement experiments, demonstrating that sensory-motor spatial updating incorporates all of the signals related to self motion (whole body and eye-in-head) only when the sensory signal (visual flash or auditory noise burst) provides unambiguous information about target movement relative to the eyes or head.

Motor control in Parkinson’s disease
Prof. Bas Bloem discovered that an inability to ride a bicycle has important diagnostic value in patients with Parkinson’s disease. Profs. Bas Bloem and Ivan Toni also identified the pathophysiology underlying resting tremour in patients with Parkinson’s disease, and clarified the role of the brain-stem locomotor centre in gait disability among Parkinson patients.

Dopamine and serotonin in decision making
Prof. Roshan Cools and her group were successful in setting up pharmacological fMRI and patient protocols to study dopamine and serotonin’s role in Parkinson’s disease, depression, pathological gambling, ADHD, psychopathy and borderline personality disorder. The results demonstrate the critical role of dopamine and serotonin in the motivational control of decision-making and begin to elucidate its neural mechanism of behavioural control.
Effects of military combat on neural underpinnings of fear
Together with collaborators from the military hospital in Utrecht, Prof. Guillén Fernández and his team investigated neural activity and connectivity related to fear in Dutch soldiers prior to and after their maiden deployment to Afghanistan. Compared to non-deployed soldiers, combat troops showed increased brain sensitivity to threatening stimuli after returning home. It appeared that the cognitive control processes which mitigate the brain’s fear response were most affected in those soldiers who felt particularly threatened during their deployment.

Acute stress causes brain-wide network reset
Dr Erno Hermans, Prof. Guillén Fernández, and their team discovered a brain-wide reorganization of functional activity and connectivity in individuals who had undergone an acute stress-induction procedure. They found that this resetting is governed by central noradrenaline. Such an instantaneously occurring resetting of the network allows a prompt and complex behavioral response that is highly adaptive in dangerous situations.

Non-coding RNA associated with Intellectual Disability (ID) Disorders
By means of genome-wide array analysis, Dr Armaz Aschrafi – in collaboration with Dr Tijitske Kleefstra and Prof. Hans van Bokhoven – detected overlapping deletions in the genomes of ID patients. ID patients also displayed significantly altered expression of the non-coding RNA “miR-137” and its validated targets. The data suggest that these patients represent a novel syndrome that is caused by non-coding RNA. Ongoing research on this microRNA (which is also implicated in schizophrenia) will be to further delineate the precise role of this RNA molecule during synaptic plasticity using a subset of incorporated molecular neurobiology techniques.

The molecular basis of psychiatric neurodevelopmental disorders
Prof. Gerard Martens and his group linked differences in genetics, epigenetics and expression to molecular pathways responsible for behavioural phenotypes of a rat model displaying schizophrenia-related features.

Developmental control of brain realization
Using a variety of functional techniques, Dr Sharon Kolk and her team have discovered molecular determinants involved in the development of the prefrontal cortex and in the formation of various projections to target areas in the prefrontal cortex. Since layer formation in the prefrontal cortex seems to be disturbed in a number of neurodevelopmental disorders, including schizophrenia and autism, these results may help to understand the aetiology of neurodevelopmental disorders and contribute to future gene therapy strategies based on the identified factors.

Genetics of movement disorder
Dr Bart van de Warrenburg found a new genetic risk factor for both Parkinson’s disease and amyotrophic lateral sclerosis, suggesting that neurodegenerative diseases share a specific genetic susceptibility.

Eating disorders, depression and suicidal behaviour
Dr Tamas Kozicz and his group showed that chronic stress causes depression while acting in a sex-dependent way on the hypothalamic-pituitary-adrenal (HPA) axis, limbic system and Edinger-Westphal (EW) nucleus. They also demonstrated that the obesity factor leptin reduces the electrical firing by the EW nucleus. On the basis of these data they have set up a model for the neural basis of sex-dependent depressive and eating disorders.

Neurite outgrowth pathways are over-represented in genetic findings in dyslexia and ADHD
Prof. Barbara Franke, together with Prof. Jan Buitelaar and Dr Geert Poelmans developed integrated theoretical networks of genes and proteins involved in dyslexia and ADHD. They found that <50% of the candidate genes for these disorders also fit into the theoretical molecular networks involved in neurite outgrowth and neuronal migration. These models are an important step towards understanding the aetiology of such disorders.

Alzheimer genes affect brain volume of young, healthy volunteers
Prof. Barbara Franke and Prof. Guillén Fernández found that genes which increase the risk of Alzheimer’s disease in older people also affect brain volume in young, healthy people. These findings were part of the Brain Imaging Genetics (BIG) study. The authors were able to show that the genes reduce the volume of those structures that are the first to be affected in Alzheimer’s disease. These studies provide important clues about the mechanisms by which genes contribute to this devastating disease.

Brain Networks and Neuronal Communication
Promedas and Bonaparte: Computational Neuroscience in society
Prof. Bert Kappen and co-workers built Promedas (PRObabilistic MEDical Diagnostic Advisory System), the world most complete medical diagnostic advisory system (with UMC Utrecht and Promedas BV) and Bonaparte, unique software for matching the
Key publications


DNA of missing people (together with the Dutch Forensic Institute). This system was successfully employed in the spring of 2010 to identify victims of a plane crash in Libya.

**Better Brain Computer Interface performance by ‘surprise’**

In the Braingain project, the Kappen group developed an adaptive Brain Computer Interface (BCI) method. The output of the BCI provides a surprise response in the subject when it disagrees with the subjects intention. This surprise is measurable as a so-called error potential. The group demonstrated that this signal can be used to improve the performance of the BCI.

**To know how the brain can be stimulated from outside**

Prof. Dick Stegeman and Dr Thom Oostendorp developed a highly precise head-brain model to calculate how current induced by non-invasive techniques such as transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (TDCS) is distributed in the various brain structures and what the significance is of discovering the precise anatomy and physical properties of head and brain tissues.

**Optogenetic method to study mechanisms for cortical oscillation**

In a revolutionary experiment, optogenetics stimulation of different cell types was used to determine which cell type was responsible for generating gamma (30-80 Hz) oscillations. This experiment provided support for a mechanism that was inconsistent with anatomical data. Prof. Paul Tiesinga developed a computational model to explain this paradox in terms of the electrophysiological properties of pyramidal cells thus paving the way for more incisive optogenetic studies of network mechanisms for cognition.

**Societal impact**

- Media appearances and contributions to the general public/society.
- Prof. Bas Bloem frequently appeared in the media, and ended up in third place in the Duynstee award for 2011 (media ranking, Radboud University Nijmegen). Highlights include media coverage of a Lancet paper on cycling in Parkinson’s disease, and Bloem’s election as National Healthcare Hero of 2011.
- Prof. Hans van Bokhoven was interviewed for the autism news website SFARI.org about the analysis of chromatin signatures in the brains of patients with autism and for the Hersen Magazine Hersenstichting on mental retardation in flies. He also appeared twice in Hoezo? Radio: “The question of the Week”.
- Prof. Jan Buitelaar was interviewed by national and international newspapers and radio about the effects of an elimination diet on ADHD.
- Dr Jurgen Claassen was interviewed by TV Gelderland and local radio on cerebral hemodynamics and the relationship between sleep and Alzheimer’s disease. Interviews appeared in three magazines issued by Alzheimer Nederland and ISAO.


Dissertations: 41
Scientific publications: 648
Professional publications: 1
Patents: 2
Director: Prof. Paul Tiesinga

Paul Tiesinga has been a full professor of Neuroinformatics at the Faculty of Science since 2009. He is an expert in constructing models of the visual cortex, which he uses to study mechanisms for attention and stimulus selection and to develop experimental tests of these mechanisms, using optogenetics techniques. He also develops methods for analysing neuroscientific data in order to extract neural correlates of cognitive processes and to develop biomarkers for psychiatric diseases.

To maximize translation of fundamental research outcomes and thereby increase valorisation, there will be further integration of the clinical research activities at the UMC with the more fundamentally oriented research on cognition. DCN will achieve this through three methodologically defined clusters, where researchers will be housed in close proximity, enabling formal and informal interaction, thus increasing internal coherence and enabling increased exploitation of existing technology and expertise.

- The idea behind the integrated translational platform is to cluster animal research into brain plasticity (e.g., development, adaptation, memory, and aging) covering behavioural, invasive in-vivo and in-vitro studies into the neural and genetic underpinnings of brain plasticity.
- The clinical research platform is designed to bring together the research of different clinical departments (e.g., Neurology, Psychiatry, Geriatrics, and Rehabilitation) and to integrate clinical neuroscience with translational research, cognitive neuroimaging, and genetics research at the Donders Institute.
- The aim of the neurophysics platform is to coordinate fundamental research in systems neuroscience and will provide the other platforms with the necessary quantitative experimental and theoretical techniques. For instance, machine-learning approaches will be used to determine the link between genetic profiles of patients and the resulting endophenotypes;

Future research

DCN aims to promote further cross-collaboration among the four themes of the Donders Institute:

- language & communication;
- perception, action & control;
- learning, memory & plasticity;
- brain networks & neuronal communication.

• Prof. Barbara Franke appeared in the national television programme “Pavlov” to talk about the aetiology and genetics of ADHD.
• Dr Judith Homberg was interviewed by “Psychology Magazine” and NWO.
• Prof. Gerard Martens and Dr Judith Homberg were interviewed by the magazine Natuurwetenschap & Techniek (NWT).
• Prof. John van Opstal appeared in NRC and Volkskrant newspaper editions on his monkey experiments. He and Dr Martijn Agterberg performed on television in the popular scientific programme Pavlov (with his sound-localization setup).
• Dr Sebastiaan Overeem appeared on BNR radio to talk about his research on Parkinson and powernaps.
• Prof. Paul Tiesinga was interviewed by NRC Handelsblad and local television on his role in the Future and Emerging Technology (FET) Flagship pilot project entitled Human Brain Project.
• Dr Marcel Verbeek was interviewed by het “Reformatorisch Dagblad” on the research on Tyrosine Hydroxylase Deficiency syndrome.
• Dr Lu Xu was interviewed by De Gelderlander about her work on leptin and obesity.
• ParkinsonNet was elected “Parel der Parels” by ZonMw.
• Prof Bert Kappen and coworkers built the Probabilistic Medical Diagnostic Advisory System (ProMedas), the world’s most complete medical diagnostic advisory system (with UMC Utrecht and Promedas BV) and Bonaparte, unique software that is used to match the DNA of people who are missing with remains (in cooperation with the Dutch Forensic Institute). This approach is receiving a great deal of attention from numerous forensic institutes. The group has developed unique control methods that are employed by leading robotic groups worldwide and is discussing the application of these methods to controlling the US electrical power grid with Los Alamos National Laboratories.
• The Department of Clinical Neurophysiology/Neurology, which leads the world in the use of ultrasound for successfully diagnosing neuromuscular diseases, organizes two workshops a year to pass on this knowledge to clinical departments.
• Prof. Jan Buitelaar and colleagues demonstrated that a restricted elimination diet was effective in significantly reducing the symptoms of ADHD in about 60% of patients.
• Dr Marcel Verbeek and his team identified novel markers in cerebrospinal fluid, which can be used to identify patients suffering from Lewy body dementia.
computational neuroscience approaches will be used to build multi-scale models to link the consequences of these genetic factors at the cellular level to the disease symptoms.

Another major goal for the future is to use quantitative techniques that translate results from the clinical research platform into animal models for use in the integrative translational platform. With genetic and imaging techniques, the dynamics of local circuits can be perturbed, and the resulting neural activity measured at single cell resolution, while simultaneously observing their effect on cognitive processing.
Institute for Genetic and Metabolic Diseases

At the Institute for Genetic and Metabolic Diseases (IGMD) scientists working in a range of disciplines engage in research on rare 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 diagnosis, treatment and follow-up. Researchers working within this theme develop and clinically evaluate innovative, non-invasive functional imaging and monitoring techniques such as 2D and 3D Echography, NMR spectroscopy, Near Infrared Spectroscopy and radioisotope imaging (PET and SPECT). The ultimate goal is timely detection of tissue damage in patients (prenatal to adult) with cardiac, cerebral, liver, vascular and pancreatic disorders.

Molecular gastro-enterology and hepatology
This aim of researchers working within this theme is to achieve a comprehensive understanding of 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 rare disorder, providing a unique opportunity to study human cystogenesis. Researchers in this translational programme identify key intracellular signalling pathways in PCLD in order to find potential therapeutic targets that can be tested in clinical trials. A second research line involves preventing complications associated with severe intestinal failure.

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). In parallel with developing novel analytic techniques, the research group applies a broad range of biochemical, genetic and cell biological methods to identify new disease entities, improve current diagnostics and better understand pathophysiological mechanisms, aspects that are crucial for future therapeutic strategies.
Healthy ageing / healthy living
Understanding the process of healthy ageing as well as the role of exercise and activity in senescence are the main topics of this research programme, which covers human in-vivo approaches all the way 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.

Hormonal regulation
Research within this theme focuses on patient care and research on adrenal diseases. This work takes place in the recently established Radboud Adrenal Centre (RAC) – a centre of expertise for the diagnosis and treatment of adults and children with adrenal diseases. The four main areas of interest are hyper/hypocortisolism, congenital adrenal hyperplasia, pheochromocytoma and primary aldosteronism.

Iron metabolism
This research is designed to arrive at a full understanding of iron metabolism, in particular by identifying and characterizing novel factors that might mediate dysregulation of iron homeostasis in some of the world’s most prevalent diseases, including anaemias, rheumatic diseases, haemochromatosis, bacterial and malarial infections, cardiovascular disease and hepatic iron overload associated with alcohol abuse, hepatitis C and the metabolic syndrome. A key achievement was 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 theme 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 aim is 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 studying 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 disorders

Within this theme the regulation of the physiological development of the kidney is studied in order to better understand the pathogenesis of kidney disorders. The aim is to be able to diagnose and ultimately cure or prevent them. These disorders include both acquired and inherited forms of kidney disease. Research projects are carried out at 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. The core components of the Institute are clinical departments (Paediatrics, Nuclear Medicine, Gastroenterology & Hepatology, Human Genetics, Neurology, Physiology, General Internal Medicine, Endocrinology, Cell biology and Pharmaco-toxicology), which provide access to patients and clinical material and have dedicated research laboratories. In addition there are the laboratory of Clinical Pharmacy and of Genetic, Endocrine and Metabolic diseases.

The RUNMC has several technology platforms (see also: www.ncmis.eu/technology-platform/) including: the Animal Facility, the Microscopic Imaging Centre, Micro-array Facility Nijmegen, the Nijmegen Proteomics Facility, the Centre for Molecular and Biomolecular Informatics (CMBI), the Clinical Research Centre Nijmegen, and the GMP facility.

Collaboration

Researchers from IGMD are involved in a wide range of regional, national and international networks and collaborate with groups at, for example, Harvard University, NIH, and Mayo Clinic in the USA, the Karolinska Institute in Sweden, the Medical Research Council, and the University of Birmingham in the UK and the Max Planck Institute on Aging in Germany.

Researchers in the Functional Imaging group participate in the EU FP7 network “Beta Image” and researchers engaged in Genome Disorders participate in a FP7 Project, for technological innovation of high throughput diagnosis of genetic disorders.

Prof. J. Smeitink coordinates the Centre for System Biology and Bioenergetics, in which 35 Radboud research groups with diverse backgrounds work together to model mitochondrial energy production, distribution and expenditure in the context of human disease. Several IGMD researchers working on renal disorders participate in the Biokid consortium of Biomedical Materials Program, in the European Network for the study on Orphan Nephropathies and in two large research consortia that were recently launched by the Dutch Kidney Foundation.

Dr R. Masereeuw (Renal disorders), together with Dr P. Murray (University of Liverpool, UK), Dr B. Bussolati (University of Turin, Italy), Prof. C. Werner (Leibniz Institute, Dresden, Germany), Dr P. Winyard (University College London, UK), Prof. E. Levchenko (KU Leuven, Belgium), Prof. N. Gretz (IMT, Heidelberg University, Germany), Prof. B. Dekel (PSC Research Institute at the Sheba Medical Center, Israel) and four industrial partners were awarded a EU FP7 Marie Curie Initial Training Networks grant worth €3.7 million to collaborate on a project entitled “NephroTools”.

Associate Professor Chris de Korte received a Vici for research on the use of ultrasound in patients with cardiovascular diseases. De Korte plans to design 3D ultrasound equipment that will provide better images of cardiovascular disorders. See picture p. 82.
Awards and acknowledgements

Dr C. de Korte of the Functional Imaging Group was awarded a €1.5 million Vici award. He will develop and evaluate the next step in 3D ultrasound imaging for improving image quality in cardiovascular diagnosis and facilitating functional imaging.

Dr J. Veltman of the Genomic Disorders Group was awarded an ERC Starter Grant of €1.5 million. He will use this grant during the next five years to investigate the role of de novo mutations in intellectual disability.

Dr K. Renkema and Dr M. Wilmer were awarded a Kolff career stimulation award by the Dutch Kidney Foundation. Dr J. Gerhold received a long-term EMBO fellowship and Dr A. Hoischen a Veni award.

Several young IGMD researchers received Young Investigator awards and poster prizes from various learned societies, including the Dutch Society of Nephrology, the Dutch Society for Inborn Errors of Metabolism, the Society for Paediatrics and the Euroglycoscience Forum.

Research results

Using cis-regulatory mapping combined with exome sequencing, Dr A. den Hollander identified mutations in a gene encoding Male-Associated Kinase as a cause of autosomal recessive retinitis pigmentosa. In a second study she showed that this strategy is generally applicable to a range of retinal diseases by identifying mutations in a ciliary protein that are associated with retinal dystrophies with early macular involvement.

An important finding by the group led by Prof. J. Smeitink and colleagues from Helsinki was the identification of FGF-21 as a new biomarker for muscle-manifesting mitochondrial disease in adults and children. Measurement of FGF-21 concentrations in serum might be feasible as a first-line diagnostic test and thus reduce the need for muscle biopsy. Dr R. Rodenburg et al. identified a mutation in C2orf64, which causes impaired cytochrome c oxidase assembly and mitochondrial cardiomyopathy.

Prof. D. Swinkels and Prof. F. Sweep determined age and gender-specific serum hepcidin reference ranges and biochemical correlates (ferritin) in the general population. These data bring the application of hepcidin as a diagnostic biomarker a step closer.

Whole exome-sequencing technology, applied by Prof. H. Brunner, Dr J. Veltman, Dr B. de Vries, and others in the Genomics group, resulted in the identification of mutations associated with rare diseases. Important findings were the disruption of teashirt zinc finger homeobox 1, which is associated with congenital aural atresia, somatic mutations of IDHI in metaphyseal chondromatosis, loss of SMOC-1 causing Waardenburg Anophthalmia syndrome, mutations in ASXL1 causing Bohring-Opitz syndrome, mutations in IMPAD1, which are associated with Chondrodysplasia, and disruption of CEP152 in Seckel syndrome. Prof. B. Franke et al. showed that the Alzheimer’s gene SORL1 is associated with hippocampal volume in young, healthy adults.

An important advance was made in understanding the molecular mechanism of cyst formation in polycystic liver disease. A study by Prof. J. Drenth et al. demonstrated that, in patients with a PRKCSH mutation, over 76% of the cyst showed somatic second-hit mutations, suggesting that loss of the wild type allele is an important step in cyst formation. In a large collaborative study, Prof. J. Drenth showed that Telaprevir significantly improved rates of sustained virological response in patients with previously treated HCV infection.

Dr W. Koopman, working together with researchers from other IGMD groups, combined advanced 3D computer modelling with experimental data to quantify protein diffusion inside the mitochondrial cell compartment. In contrast to the current beliefs, they demonstrated that intra-mitochondrial protein diffusion is substantially impeded and that the mitochondrial matrix is only 1.5 to 2-fold less viscous than water. This suggests that cell-controlled changes in the internal nanostructure of mitochondria can be used to regulate intra-compartment reaction dynamics.

Important contributions by the Nijmegen Proteomics Facility were made to the study of molecular mechanism of anaerobic ammonium oxidation and to the study of the evolution of a new enzyme for carbon disulphide conversion using an acidothermophilic archaeon.

Prof. R. Wevers’ group contributed to the important observation that heterozygosity for a loss-of-function mutation in GALNT2 improves plasma triglyceride clearance in man, thus establishing GALNT2 as a lipid-modifying gene.

The Renal disorders group identified mutations in CYP24A1 associated with idiopathic infantile hypocalcemia (Prof. J. Wetzels and Prof. R. Bindels et al.) and risk HLA-DQA1 and PLA2(2)R1 alleles in idiopathic membranous nephropathy (Prof. J. Hoenderop and Prof. F. Sweep).

Prof. C. Tack and colleagues made an advance in understanding the pathogenesis of diabetes. They described the effect of acute hyperglycaemia on human cerebral glucose metabolism and how hyperglycemics activates caspase-1 and TXNIP-mediated IL-1beta transcription in human adipose tissue.

Societal impact

Members of the IGMD participate in a number of governmental advisory boards, including the Dutch Health Council, and in numerous national and international patient organizations. They frequently promote research at meetings involving the general public as well as at conferences and other forums. The Institute actively encourages collaboration between commercial companies and academia.
Key publications


Dissertations: 26
Scientific publications: 714
Dr E. Morava and Dr D. Lefeber – guest editors of the Journal of Inherited Metabolic Disease – have compiled a special volume on Congenital Disorders of Glycosylation. Dr D. Lefeber was invited by the SSIEM Academy to organize a highly-ranked workshop on biochemical aspects of the Congenital Disorders of Glycosylation. This international organization provides expert training on different groups of metabolic diseases.

Prof. J. Smeitink and S. Koene (MD), published “Mitochondrial Medicine, a clinical guideline”. This richly illustrated booklet (free of charge ) with contributions from many international experts, describes clinical signs and symptoms, mitochondrial syndromes, diagnostic tools and treatment options. This booklet has so far been distributed in Europe, Asia, the USA and Brazil.

The third IGMD Excellent Student Conference was organized. This research education programme is designed for talented medical and biomedical master students. Enrolment in the programme includes additional research activities (20 hours/month) coordinated by a mentor scientist and includes a translational research project.

Future research
Researchers working on IGMD themes will continue to elucidate the pathophysiology of specific rare diseases in an attempt to develop novel diagnostic methods and innovative forms of treatment.

Some examples of new projects: Investigating whether an effective treatment for the hereditary form of kidney cysts is possible (Prof. J. Drenth, Kidney Foundation grant); Investigating whether disturbances in the calcium phosphate metabolism cause kidney damage and increase the risk of cardiovascular disease (Prof. R. Bindels and Prof. J. Hoenderop, Kidney Foundation grant); Identifying genetic causes for inherited blindness and age-related macular degeneration, unravelling protein complexes in retinal degeneration and Usher syndrome and developing functional retinal imaging techniques (Prof. F. Cremers et al., Foundation Fighting Blindness USA grant); A study of treatments for mitochondrial disease (Prof. J. Smeitink, Eureka Eurostars project); De novo genetic variants in embryonic development and early lethality (Dr A. Hoischen, Veni grant); Investigating how the cell coordinates the combination of mitochondrial and nuclear encoded subunits in complex I assembly (J. Nouws, ESN grant); Do mitochondrial lipid-microdomains play a role in mtDNA maintenance, organization and dynamics?” (Dr J. Gerhold, EMBO fellowship); Using whole exome sequencing identify gene defects in congenital anomalies of the kidney and urinary tract (Dr K. Renkema, Kolff career stimulation grant); Finding the genetic defect that leads to the metabolic MEGDEL syndrome (Dr E. Morava et al., Dutch Brain Foundation grant); Evaluating the potential of human kidney stem/progenitor cells for use in drug discovery and regenerative therapy programmes. (Dr R. Masereeuw, EU Marie Curie ITN grant); Fundamental and clinical aspects of cinacalcet in familial hypocalcaemia and neonatal hyperparathyroidism (Prof. P. Deen and Prof. A. Hermus, IGMD PhD grant); Characterizing and validating the molecular imaging of transplanted islets in animal models of diabetes (Prof. M. Gotthardt and Prof. C. Tack, IGMD PhD grant); Genetic and molecular investigations in metabolic cutis laxa syndromes (Dr M. Mohamed, Mozaiek grant); Protecting renal function by supporting the gate keepers: new methods for stimulating renal drug transporters (Dr M. Wilmer, Kolff career stimulation grant).
The principal aim of the Research Institute for Oncology is to promote innovations in translational research in oncology and to reduce the morbidity and mortality rates of cancers. Researchers in several disciplines work together to unravel the pathology of tumours, develop new diagnostics and therapeutic strategies, and improve standards of care.

The Institute – one of six research institutes within the Radboud University Nijmegen Medical Centre – was founded in 2008 to co-ordinate and strengthen research in oncology and oncology-related topics. Built on a long-standing tradition and the strong reputation of existing research groups, the Institute operates in close collaboration with the Radboud University Centre for Oncology (RUCO).

The key principles of the Institute are:

- Research is both patient-centred and relevant to patient care
- Research is arranged in themes that are multidisciplinary and offer added value beyond existing structures
- Close collaboration with other University research institutes such as NCMLS and NCEBP is considered essential.

The institute’s research themes are:

**Theme 1. Hereditary cancer and cancer-related syndromes**
Researchers who work in this theme study the causes and early detection of hereditary cancers and other cancer-related syndromes, develop improved methods for detecting specific forms of hereditary cancer, and study health care and the psychosocial aspects of these conditions.

**Theme 2. Age-related aspects of cancer**
Cancer has characteristics that vary among age groups. Researchers working in this theme investigate the causes of cancer in young patients, the age-related pathology of tumours (and its consequences), the need for specific approaches for specific age groups (including pharmacology), develop programmes for early clinical trials in children, and adapt treatments for elderly patients.

**Theme 3. Translational research**
In recent years, research advances in the biology and genetics of cancer have led to novel diagnostic, prognostic, and therapeutic approaches. Research within this theme is designed to integrate state-of-the-art genetic and genomic information and tumour imaging and phenotyping (including invasive and metastatic properties) with novel targeted treatment options such as epigenetic, metabolic, and immunologic (vaccine-based) approaches directly to the level of pre-clinical and clinical trials. Researchers cooperate closely with their colleagues who are working within the other themes.

**Theme 4. Quality of care**
The criteria for measuring health care include Quality of Life, cost effectiveness, clinical decision-making, and implementation-
related issues (which are covered largely by the NCEBP). The new knowledge and tools that this type of research yields will be used to improve all aspects of care for cancer patients.

Theme 5. Aetiology, screening, and detection
Research within this theme encompasses the genetic and lifestyle-related causes of non-Mendelian-inherited forms of cancer and the role of these factors in prognosis. A second focus is the efficacy and effectiveness of policies for screening cancers (in the general population) and for routine follow-up care (within the clinical population).

In 2011, the first Science Day at the Research Institute for Oncology was organised. This event provided an opportunity to meet with colleagues and discuss new ideas and was received with high enthusiasm. In the coming years, this event will be expanded to include new, theme-oriented mini-symposia. Due to an imbalance among the sizes of the current themes, the themes will be redefined in 2012.

Research facilities
The Institute supports both technological and non-technological platforms that are crucial to its research and serve the needs of other research institutes, including the microscopy centre, functional and molecular imaging, medical technology assessment, genomics and proteomics, bioinformatics, and biostatistics. The following multi-institutional platforms are both used and supported: Imaging, including PRIME (the Preclinical Imaging Centre, which was established in 2011); High-throughput genomics; Proteomics; Clean-room facilities; A unit for the clinical application of new drugs; A unit for psychosocial research tools; Biostatistics; The microscopy centre; The Central Animal Facility; Bio-informatics; The Centre for Minimal Invasive Treatment (Mitec); Databases and biological banks of cancer patient groups such as PSI and the Comprehensive Cancer Centre Netherlands (IKNL).

Collaborations
Researchers from the RIO collaborate with many other centres, including the Comprehensive Cancer Centre Netherlands (IKNL) and the National Reference Centre for Breast Cancer Screening, both for more than 20 years; The MD Anderson Cancer Center, Houston, TX, USA, in collaborative projects relating to the genetics of urological cancers. In 2011, Prof. Peter Friedl was named the Section Chief of “Molecular Imaging” at the MD Anderson Cancer Center in a newly created position. He will develop molecular
Awards and acknowledgements

In 2011, the achievements of a number of scientists within the Institute were recognised by national and international organisations. The Institute was very successful in acquiring competitive research funds from the Dutch Cancer Society (KWF) as well as from the Netherlands Organisation for Scientific Research (NWO).

- Dr E. Waanders received the ASH Abstract Achievement Award at the annual meeting of the American Society of Hematology.
- Drs C. van Gaal received a Merit Award of the American Society of Clinical Oncology (ASCO) in Chicago for her abstract entitled “Anaplastic lymphoma kinase in rhabdomyosarcomas”.
- Dr M. Jongmans and Dr H. Arts received the Young Investigator Award from the European Society of Human Genetics.
- Prof. J. Barentsz received the Wertheim Salomonson Medal from the Dutch Society of the Netherlands.
- Prof. dr M. Ritskes-Hoitinga received two prizes, one for the “Gold Standard Publication Checklist” as the most significant contribution to Laboratory Animal Science and one for the Animal protection form “Lef in het Lab”.

- Dr J. Lesterhuis received the 2011 Best Thesis Award from the Dutch Society for Immunology with his thesis entitled “Dendritic cells in cancer immunotherapy”.
- Dr G. de Jong was awarded the Woldering Prize by the Dutch society of Nuclear Medicine for her PhD thesis entitled “Adjuvant radioimmunotherapy in experimental colorectal cancer”.
- Drs A. van der Waart won the Best Presentation Award at the Dutch Tumour Immunology Meeting.
- Drs J. Middelbeek won the Best Laptop Presentation Award at the first Science Day at the Research Institute for Oncology.
- Prof. Bart Kiemenej received a large EU grant to study the pharmacogenesis of renal cell cancer.
- Drs W. Norde received one of the first Bas Mulder Awards for 500K Euros from the Dutch Cancer Society (KWF) for his project entitled “Releasing the brake on anti-tumour immunity”.
- Prof. A. Speckens, Prof. J. Prins and Drs M. van der Drift received a grant from Alpe d’HuZes for their project entitled “Mindfulness-based stress reduction (MBSR) for patients with lung cancer and their partners: a randomised controlled trial”.
- Dr Nicole Blijlevens, in close collaboration with Prof. Edmond Rings and Dr Wim Tissing from UMC Groningen, received a KWF grant for her project entitled “Preserving the gastrointestinal tract for feeding during chemotherapy-induced mucositis”.
- Drs N. Kniijn received a KWF scholarship for junior doctors for her project entitled “Pathways of metastasis: the role of lymph node metastasis”.
- Dr M. te Loo received a grant from ZonMw for a project entitled “Relevance of germline genetic variations for treatment response to pediatric osteosarcoma”.
- Dr A. Boleij was awarded an NWO Rubicon grant for her project entitled “Bacteroides fragilis toxin isotypes in colon carcinogenesis: host immune responses and epithelial cell signaling”.
- Drs R. Schoffelen received a Radboud University Nijmegen Frye Scholarship to perform her innovative research on pretargeted
radioimmunotherapy, a new treatment for colon cancer, in the group led by Dr G. Sgouro at Johns Hopkins University (Baltimore, D.C.).
• The Stephen G. AYA Cancer Research Fund received 50,000 euros for sarcoma research, collected as a private initiative during the “Dam tot Dam loop”.

Research results
Scientists at the Institute have characterised mutations and deletions in a number of genes for their potential to improve diagnostics or provide predictive value in treating cancer. The group led by Dr B. van der Reijden characterised BRE as a new prognostic factor in acute myeloid leukaemia, which was published in Blood. The group led by Dr M. Lijtenberg, Dr K. Kuiper and Prof. N. Hoogerbrugge published a study in American Journal of Gastroenterology that described novel mutations in EPCAM in Lynch Syndrome-associated extracolonic tumours. The groups led by Prof. N. Hoogerbrugge and Dr F. van Leeuwen – in collaboration with the group led by Prof. A. Geurts van Kessel and Dr R. Kuiper – have characterised a gene mutation in acute lymphoblastic leukaemia that will help children with this mutation receive adapted and improved treatments beginning in 2012. The group led by Prof. C. Cremers and Prof. H. Marres published a study in Clinical Cancer Research showing that inherited head and neck paraganglioma syndromes are also associated with mutations in a previously uncharacterised human gene that is now called SDHAF2, and reported that this is the long-sought “imprinted” PGL2 gene. The European consortium of Prof. B. Kiemenev published a study in Human Molecular Genetics reporting the identification of variants in another gene (SLC14A1) that increase the risk of urinary bladder cancer, possibly by affecting the production of urine.

The groups led by Prof. B. Kiemenev and Prof. N. Hoogerbrugge published in European Journal of Human Genetics the risk for developing cancer in patients with Noonan syndrome. The groups led by Prof. J. de Vries and Prof. W. Oyen reported in Proceedings of the National Academy of Sciences of the United States of America the use of the [18F]FLT-PET method as a sensitive tool to study the kinetics, localisation and involvement of lymphocyte subsets in response to vaccination, which allow for the early discrimination of responding from non-responding patients in anti-cancer vaccinations and can facilitate individualised decision-making for physicians.

The group led by Dr H. Tjalma published in Clinical Infectious Diseases a meta-analysis study on the clinical importance of Streptococcus galloyticus infections in colorectal cancer patients. Dr J. Lesterhuis – in collaboration with the group led by Prof. J. de Vries – reported in Journal of Clinical Investigation the effect of cytotoxic cancer chemotherapeutics on immune inhibitory pathways. The group led by Dr H. Dolstra reported in Blood that PD-1/PD-L1 interactions contribute to impaired T cell function in cancer patients who relapse after receiving an allogeneic stem cell transplant. The group led by Dr R. Hermens reported in Journal of Clinical Oncology an important study on the use of explicit quality indicators to assess the Quality of Care for patients with non-Hodgkin’s lymphoma in the Netherlands.

In a review article in Nature Reviews Clinical Oncology, Dr J. Bussink, Prof. J. Kaanders, Prof. W. van der Graaf and Prof. W. Oyen discussed the use of PET-CT for planning radiotherapeutic treatment and for monitoring therapy response in solid tumours. In Cell, Prof. P. Friedl and Dr S. Alexander published an important review article entitled “Cancer invasion and the microenvironment: plasticity and reciprocity”, which defined and shaped the field of cancer invasion.

Societal impact
Cancer is a major health problem in developed countries and places enormous physical and mental burdens on patients and their families. Improving the prevention, diagnosis, and therapy of cancer, as well as improving psycho-social assistance, is therefore essential. Researchers at the Institute serve as active members of various national (Dutch Medical Oncology Society, Netherlands Foundation for the Detection of Hereditary Tumours, Biobanking and Biomolecular Resources Research Infrastructure, Dutch Haematology Society, Dutch Federation of University Medical Centre’s Committee for Child Oncology, Dutch Society for Chirurgic Oncology, and the KWF committee Alpe d’HuZes) and international (Scientific Council, International Agency for Research on Cancer, the Trial Steering Committee of SELENIIB, World Institute of Pain, EORTC, ECCO, and the editorial boards of several cancer journals) advisory boards.

Some of the new appointments of RIO members in the important national and international oncological societies and communities are: Prof. Han van Krieken became president-elect of the European Society of Pathology; Prof. Henri Marres became a member of the UEMS-ORL in the Head & Neck Oncology section. Prof. Wim Oyen was appointed as the chairman of the Oncology Committee of the European Association of Nuclear Medicine. Prof. Leon Massuger was appointed as a board member of the European Organisation for the Treatment of Trophoblast Disease (EOTTD). Dr Robert Takes became a secretary of the International Head and Neck Scientific Group and a chair of a study group led by NWHT. Dr Carlijn Hooijmans, Dr Marlies Leenaars and Prof. Merel Ritskes-Hoitinga became members of the Methodology Advisory Board of SABRE. Prof. Judith Prins was appointed to the Scientific Committee for Social Oncologic Research at the Dutch Cancer Society and became a member of an advisory board for projects within Pink Ribbon.

Dr Nicole Bijlevens became a member of the Efficiency Committee for Sarcoma Research, collected as a private initiative during the “Dam tot Dam loop”.

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In a review article in Nature Reviews Clinical Oncology, Dr J. Bussink, Prof. J. Kaanders, Prof. W. van der Graaf and Prof. W. Oyen discussed the use of PET-CT for planning radiotherapeutic treatment and for monitoring therapy response in solid tumours. In Cell, Prof. P. Friedl and Dr S. Alexander published an important review article entitled “Cancer invasion and the microenvironment: plasticity and reciprocity”, which defined and shaped the field of cancer invasion.
Key publications


Other contributions to society in 2011 included the following: Prof. Winette van der Graaf and Prof. Judith Prins in close collaboration with Radboud Reshape and Innovation Centre, receiving a Alpe d’HuZes/KWF subsidy for the project entitled “Online support Community AYA4 for adolescents and Young adults with cancer in The Netherlands: a modern tool in the 2.0 era”; Prof. Bart Kiemeney wrote the report “Kanker in NL tot 2020. Trends and prognoses” for the Dutch Cancer Society KWF; Prof. Jelle Barentsz contributed to the 2011 European Guidelines for Prostate MRI; Dr Rosella Hermens contributed to the book “Leerboek kwaliteit en veiligheid in patiëntenzorg” with the chapter “Kwaliteitsverbetering en implementatie in de praktijk”, and together with Prof. Nicoline Hoogerbrugge, she contributed the chapter “Praten over medische kansen en risico’s: Genetisch is profetisch?” to the book “Praten over medische kansen en risico’s…?”; Prof. Wim Oyen, Prof. Henri Marres and Prof. Hans Kaanders acted as guest editors of the Quarterly Journal of Nuclear Medicine and Molecular Imaging, compiled a special volume on the Head & Neck Oncology theme.

Future research

Within the first theme, the research focus of the Institute will involve all aspects of hereditary cancer in select cancers such as renal cancer, breast cancer, and colorectal cancer. Research on cancer in children will focus on detecting pathways of leukaemogenesis in ALL that may serve as targets for novel treatment approaches, detecting variants in genes that are relevant for cytotoxic drug metabolism (thus affecting the outcome and toxicity of conventional chemotherapy), and optimising immunotherapy for treating children with cancer. Areas of research funded by the Stephen G. AYA Cancer Research Fund will include genetics, epidemiology, pharmacokinetics, predictive factors, and late effects of treatment, psychosocial, and quality-of-life issues.

Researchers conducting translational research will strive to achieve new insights into cancer-related target genes and pathways; anti-cancer nano-vaccines in the patient’s immune system; the associations between genetic variants and cancer susceptibility, prognosis, and response to therapy; diagnosis through molecular analyses, including the potential for personalised therapies; the efficacy of functional imaging with respect to diagnosis, prognosis, and therapy using the Preclinical Imaging Centrum PRIME, which opened in 2011; 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.

With respect to quality of care, researchers will track cancer patients from the onset of their care in order to link physician-reported outcomes to patient-reported outcomes and quality indicators. This will enable researchers to identify relevant factors that affect behaviour and care and to identify the influence of these factors on illness and survival.

Using screening detection and aetiology, researchers will collect new data for the efficacy and effectiveness of diagnostic and prognostic biomarkers for cancer, diagnostic and prognostic imaging modalities for cancer, cancer screening in the general population and routine follow-up policies for cancer patients, as well as new data on constitutional and lifestyle/environmental risk factors that affect cancer.
The Nijmegen Institute for Infection, Inflammation and Immunity (N4i) brings together 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 research focuses on four themes that link Infection, Inflammation and Immunity.

**Theme 1. Pathogenesis and modulation of inflammation**
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: recognition of pathogens by the host; inflammasome activation and cytokine responses during infection and auto-inflammation; the pathogenesis of infection by bacteria (e.g., pneumococci, staphylococci, meningococci, Coxiella) and viruses (picornaviruses, denguevirus); developing molecular imaging tools for visualizing infection and inflammation; mechanisms of tissue damage; mechanisms related to common multifactorial inflammatory diseases (COPD, psoriasis and eczema); therapeutic interference with pattern recognition and signalling; strategies for preserving mucosal integrity in cancer chemotherapy; developing tools for monitoring inflammation and response to treatment.

**Theme 2. Invasive mycoses and compromised host**
Within this theme invasive fungal infections are studied in relation to sophisticated medical treatments given to immune-compromised and frail patients. Research focuses on understanding host defence mechanisms, in particular: the recognition of fungal pathogens by the host; the immuno-genetics of fungal infections; immunotherapy of fungal infections; exploring the epidemiology and management of invasive fungal infections; designing better diagnostics and therapies for invasive aspergillosis, candidemia, and other invasive fungal infections; exploring the epidemiology, mechanism and consequences of resistance against antifungal drugs.

**Theme 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 issues are addressed: clinical development of vaccines and drugs for treating malaria; the pathogenesis and host defence against 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 in Indonesia; optimal anti-HIV and anti-TB treatment in resource-poor settings and in children.

**Theme 4. Auto-immunity, transplantation and immunotherapy**

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: phenotypes of auto-immune diseases of the skin; prediction of the course of chronic inflammatory rheumatic diseases and response to treatment; initiating the autoimmune response, the mechanisms of tissue damage, and optimal treatment strategies in SLE; developing biomarkers to monitor immune status and immunosuppressive treatment efficacy; immunological tolerance after transplantation and transfusion, as well as in relation to infection and autoimmunity; exploring the use of dendritic cells, regulatory T cells and NK cells for autoimmune diseases and transplant-related immunotherapy; optimizing immunosuppressive drug treatment in transplantation and auto-immune diseases; designing new immunostimulatory drug treatments; developing vaccines against pneumococci and *Plasmodium falciparum*; assessing the severity of psoriatic phenotypes and response to treatment.

**Research facilities**

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) providing access to patients and clinical material, and dedicated research laboratories (those directly connected to the clinical departments as well as the laboratories of Medical Microbiology, Clinical Pharmacy, Medical Immunology and Tumour Immunology). Furthermore, the RUNMC has technology platforms for its research institutes (see also: www.ncmls.eu/technology-platform/), *i.e.*: the Central Animal Facility, the Microscopic Imaging Centre, the Micro-array Facility Nijmegen, the Nijmegen Proteomics Facility, the Centre for Molecular and Biomolecular Informatics, the Clinical Research Centre Nijmegen, the GMP facility, and the Malaria Unit, with state-of-the-art facilities for breeding parasites and mosquitoes.

**Collaboration**

The research at NAi takes place within national and international research networks that focus on infection, inflammation and immunity. Apart from collaborations with outstanding laboratories in the western world, researchers at NAi also engage in fruitful
Prof. J.W.M. van der Meer received the Hijmans van den Bergh Medal. This gold medal is awarded by the Dutch Association for Internal Medicine every five years for very special life-time achievements in internal medicine. He received the award for the quantity as well as very high quality of his work, involving the three core areas of academic expertise simultaneously and in combination with major managerial tasks and policy positions.

Prof. R. de Groot received the Edgar Doncker Prize for Pediatrics for his impressive academic career as a medical specialist, his commitment to children, whether sick or healthy, and for his inspiring support of many young researchers.

At the celebration of its 88th Dies, Radboud University Nijmegen awarded an honorary doctorate to N4i Prof. C. Dinarello. His exceptional, worldwide renowned, work includes succeeding in unravelling the role of inflammatory mediators and establishing new paradigms of health, resulting in new treatments.

Prof. P. van de Kerkhof became an Honorary Member of the Austrian Society for Dermatology und Venereology (ÖGDV) and the chairman of the International Psoriasis Council. Dr J. van Ingen received the Gertrud Meissner Award from The European Society for Mycobacteriology. He received this award for his contribution to improving the diagnosis and treatment of tuberculosis.

Prof. M. Netea was awarded the 2011 N4i Senior Award, for his contributions to the study of infection, immunity and inflammation in N4i, his collaboration with many other top researchers and his prestigious publications. The N4i Junior Award for the best dissertation of 2010 was awarded to Dr Bart Ferwerda for his research on evolutionary changes in natural immunity.
Research results

Dr F. van de Veerdonk et al. elucidated autosomal dominant Chronic mucocutaneous candidiasis (CMC) by next-generation sequencing, showing that mutations in the CC domain of STAT1 underlie CMC and lead to defective Th1 and Th17 responses.

Prof. R. Sauerwein and his group demonstrated that immunity to infection with Plasmodium falciparum can be induced experimentally in volunteers by bites of infected mosquitoes and concomitant administration of chloroquine. In a Lancet paper, they described that this artificially induced immunity lasts longer than natural immunity, opening up new avenues for malaria immunisation.

Children in contact with smear-positive tuberculosis patients are at high risk of being infected and contracting TB. Dr R. van Crevel and colleagues proposed a new approach, which differs from current WHO recommendations, for treating these children. They showed how to apply and evaluate this approach within TB control programmes.

Prof. M. Netea’s group demonstrated the key role of the inflammasome in obesity and insulin resistance and in the cytokine responses following activation of NOD2 in Crohn’s disease-associated ATG16L1 polymorphisms. They also shed light on the controversial interplay between redox status and inflammasome activation.

Dr F. van de Veerdonk, Dr L. Joosten and collaborators reported that anti-CD20 antibody rituximab reduces the Th17 cell response in RA patients, which provides an explanation as to why B cell-based strategies used to treat autoimmune diseases work. Close collaboration between the groups led by Prof. P. van Riel, Dr L. Joosten and Prof. W. van den Berg resulted in additional findings about rheumatoid arthritis. They described successful implementation of a treat-to-target strategy designed to achieve remission. They also demonstrated the destructive role of MyD88 and the protective role of TIR-containing adaptor inducing interferon β in IL-17-dependent arthritis and demonstrated the involvement of the “alarmins” S100A8 and S100A9 in osteoarthritis. In collaboration with Prof. D. Swinkels, they showed that serum hepcidin and, to a lesser extent, urine hepcidin, Ret-Hgb, and RBC-Hgb, are potentially useful for detecting iron deficiency in patients with active inflammation.

Dr J. van der Vlag’s group achieved a breakthrough in understanding the development of diabetic nephropathy (DN). In mice, they showed that heparanase plays a crucial role in developing DN as well as its potential as a therapeutic target.

In a large collaborative study on systemic sclerosis (SSc) Dr T. Radstake found the association of a rare polymorphism in Toll-Like Receptor 2 with an SSc phenotype and increased production of inflammatory mediators and the association of the IL12RB2 gene with SSc in Caucasian populations.

Prof. I. Joosten and colleagues reported a severe allergic reaction of a 6-year old patient during a platelet transfusion. The donors were found to have eaten peanuts in the evening prior to donating blood. Together with European counterparts, Prof. D. Swinkels found that the iron status of a donor liver predicts which patients can stop taking immunosuppressive drug medication. This study may have important implications for liver transplant patients.

Major comments and reviews were published in top journals, including the New England Journal of Medicine and Nature Reviews in Immunology.

Societal impact

Infectious diseases are a major reason for morbidity and mortality worldwide. Inflammation and immunity not only underlie infectious diseases but also play a major role in other diseases studied within N4i. Researchers are actively involved in national and international organizations such as the Royal Netherlands Academy of Arts and Sciences (KNAW), its Young Academy, Academia Europaea, the European Academic Scientific Advisory Council (EASAC), the Health Council of the Netherlands, the Centre for Infection Control (Cib), ZonMw committees, the European and Developing Countries Clinical Trial Partnership, the Dutch Working Party on Antibiotic Policy (SWAB), the European Society of Clinical Microbiology and Infectious Diseases (ESCMID), the Dutch Working Party on SLE and several other professional societies.

Profs. Van der Meer and Netea received a Radboud Science Award for translation of research results in a school project on “trained immunity”.

Nowadays, hospitalised patients are commonly infected with resistant strains of Aspergillus fumigatus, as was shown by the group led by Prof. P. Verweij. To monitor this resistance, the Ministry of Health has designated the Department of Medical Microbiology as a reference laboratory.

Prof. J. Schalkwijk and IMM Prof. F. Rutjes received a Life Sciences Pre-Seed Grant (worth €250,000) from the Netherlands Genomics Initiative. The grant is intended to facilitate a start-up to further develop a new class of antibiotics.

Prof. J. van der Meer, together with seven other prominent Dutch scientists appealed in an opinion paper in “de Volkskrant” for investment in innovative scientific research. Unlike in Germany, the Dutch government appears unwilling to understand the need for this kind of investment in order to, ultimately, keep under control the aging-related increase in medical care costs.

In a comment in The Lancet, Dr F. van Kuppeveld and Prof. J. van der Meer reviewed the flawed role of the xenotropic murine leukaemia (MLV)-related virus in chronic fatigue syndrome.
Key publications


In November Prof. A. van der Ven and colleagues completed a five-year IMPACT programme (prevention, control and treatment of HIV among injecting drug users in West Java) with an excellent rating by the EU programme committee.

The Kilimanjaro Clinical Research Institute was opened by the Tanzanian Minister of ‘Science and Technology’. Intensive cooperation with Van der Ven’s group provided the basis for this unique research institute that focuses on evidence-based interventions for poverty-related infectious diseases (see www.kcri.ac.tz).

**Future research**

N4i continues to provide a platform for cross-fertilization in multidisciplinary research on infection, inflammation and immunity. Areas for future collaborative research include: the role of pattern recognition and inflammasome activation in infection and inflammation disorders, natural immunity to infection in human evolution, resistance to antifungal drugs and the implications for clinical medicine, exploring the pathophysiology of major pathogens (e.g. pneumococci, staphylococci, malaria parasites) 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, exploring the correlates of protection in poverty-related infections, and the role of apoptosis-induced auto-antigen modifications in the initiation of autoimmunity.

Examples of new projects are: viral hijacking of host cell factors and membranes for replication organelle formation (Dr F. van Kuppeveld, Vici grant); investigating the role of plasmacytoid dendritic cells in systemic sclerosis (Dr T. Radstake, ERC Starter grant and Zenith grant); investigating the influence of intestinal microflora on the phenotype and the arthritogenic capacity of auto-reactive T cells (Dr S. Abdollahi, NWO Veni grant); unravelling the importance of the various Interleukin-1 family members in the defence against infections (Dr F. van de Veerdonk, Veni grant); exploring how cells sense viruses (Dr M. Langereis, Rubicon grant); identifying the genes responsible for both the susceptibility and the outcome of bacterial infectious diseases (Prof. P. Hermans et al., EU FP-7 grant); the biology of genetic risk factors for psoriasis and the role of the skin microbiome in inflammatory skin diseases (Prof. J. Schalkwijk and Dr P. Zeeuwen, ZonMw TOP grant); investigations on preserving the gastrointestinal tract for feeding during chemotherapy-induced mucositis (Dr N. Blijlevens, KWF grant); investigating the contribution of two newly identified genetic risk factors in psoriasis (Dr P. Zeeuwen, National Psoriasis Foundation USA grant); research on developing new blood tests for colorectal cancer based on bacterial infections (Dr H. Tjalsma, Digestive Diseases Foundation grant); identifying the genetic determinants involved in Streptococcus pneumoniae pathogenesis (Dr A. Zomer, Marie Curie Fellowships); exploring the function of TR as an azole resistance mechanism in human and plant pathogenic fungi (Dr E. Sneiders, ESCMID grant); and screening libraries of small molecules for compounds with antiviral activity against Dengue virus (Dr R. van Rij, ESCMID grant).
The NCEBP comprises four closely interrelated research programmes. Each programme consists of 3 or 4 research themes. The programmes and themes are listed below.

**Epidemiology and Evaluation (Prof. Bart Kiemeney)**

Theme: Molecular epidemiology (Prof. Bart Kiemeney)

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 focuses on targeting various types of cancer, but other multifactorial diseases, e.g. 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, also issues related to diagnostic, prognostic and intervention research.

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

Healthcare interventions can 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 endpoint. 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. Appropriate methodologies for such evaluation are developed and tested.

Theme: Infectious diseases and international health (Dr Rob Baltussen)

The main goal here is to improve health in both low and high income countries by developing the base of evidence necessary for decision-making. To this end, the research activities of clinical, public health
and economic disciplines are integrated. These research activities focus, respectively, on 1) poverty-related diseases, 2) public health and health systems in developing countries, and 3) general infectious diseases. At the same time the theme invests in building capacity, i.e. training local researchers to conduct research independently, in certain low-income countries.

Clinical Research (Prof. Sander Geurts)

Theme: Human reproduction (Prof. Jan Kremer)
Advances in knowledge, an increase in demand for interventions, a growing awareness of the possibilities for prevention, diagnosis and therapy have made Human Reproduction a booming research area. Relevant questions include the aetiology and prevention of reproductive and developmental disorders, as well as the safety, effectiveness, and patient-centeredness of reproductive and obstetric care.

Theme: Human movement and fatigue (Prof. Sander Geurts)
Many neurological, orthopaedic and oncological diseases affect movement ability and physical fitness and may cause excessive fatigue. By analyzing biomechanics, motor control and physical activity, as well as their interaction with cognition and emotion, this research is designed to disentangle the generic determinants from disease-specific determinants of musculoskeletal impairments, movement disability, reduced physical fitness and fatigue. Both mechanistic and clinical research questions are addressed.

Theme: Cardiovascular diseases (Prof. Gerard Rongen)
The main aim covered by this theme is to achieve greater understanding of the pathogenesis of cardiovascular disease. The focus is on the mechanisms and consequences of vascular injury. This theme covers 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
Prof. Andrea Evers does research on innovative psychological diagnostic knowledge and interventions in physical disorders. She initiated the Radboud Expert Centre for Psychology & Medicine. This institute’s work focuses on demonstrating the connection between the psyche and physical processes. The aim is to use the knowledge thus acquired to develop new treatments. See picture p. 100.

Nijmegen Centre for Evidence-Based Practice

Factors – are investigated. Regulation of vascular tone in health and disease is another important research topic.

Patient-centred Interventions (Prof. Andrea Evers)
Theme: 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, diagnosis and treatment of diseases, rehabilitation, supporting patients and palliative care.

Theme: Psychological determinants of chronic illness (Prof. 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 sub-themes: ‘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.

Theme: 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 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.

Theme: Nijmegen Alzheimer Centre (Prof. Myrra Vernooij-Dassen)
The Nijmegen Alzheimer Centre (NAC) develops and evaluates support programmes in order to improve directly the quality of care and quality of life for people with dementia, and for their families. NAC contributes to fundamental knowledge on Alzheimer’s disease.

Quality of clinical practice (Prof. Michel Wensing)
Theme: Implementation science (Prof. Michel Wensing)
The emphasis here is 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.

Theme: 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.

Theme: 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.

Theme: Quality of nursing and allied healthcare (Prof. Theo van Achterberg)

Challenges covered by this theme include the search for scientific evidence to support clinical practice and professional development. While medical care is focused on the diagnostics and treatment of diseases and their cure, nursing and associated healthcare focus on disease prevention and the consequences of illness and disease for functioning, activities and participation.

Research facilities

Within the NCEBP, databases, ICT networks, registries and clinical research facilities are of the utmost importance because of the Centre’s 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 application designs (E-health, E-coach and Radquest) to improve the medical and psychological care of people with somatic conditions.
- Databases and biobanks of general population samples (The Nijmegen Biomedical Study), or of specific patient groups, e.g. congenital malformations; cancer (AGORA), cancer (PSI and Comprehensive Cancer Centre, the Netherlands, IKNL); rheumatoid arthritis (PSI and DREAM); pharmacogenetics of inflammatory bowel diseases; poverty-related infections in Indonesia and Tanzania; integrated DNA-phenotype-MRI-cognition databases and biobanks of ADHD in children (NeuroIM-AGE cohort) and in adults (IMpACT cohort); autism in children (BOA cohort); Primary Care continuous morbidity registration, including reasons for encounter (a database which is unique worldwide), and of patients visiting their general practitioner.
- The PRIDE (PRegnancy and Infant DEvelopment) Study: a prospective project to collect data among a large cohort of pregnant women in order to study a broad range of research questions related to maternal and child health.
- The NCEBP has access to a clinical research centre comprising a wide variety of human in vivo models that can be used for “proof-of-concept-studies” (translational research), a research laboratory for toxicological biomarker development and validation and a consultation facility for statistical genetics.
- A unique multidirectional balance perturbation platform the ‘Radboud Falls Simulator’ to study human postural control at the limits of stability.
- The ‘Koploper programma’ is an innovative approach to health care innovation, in which professionals in primary care, public health and the hospital jointly develop new approaches to care.
- The Minimal Invasive Technology expert Centre (MITEC) (in collaboration with the University of Twente) for evaluation of innovations.

- The PRIOR (Poverty Related Infection Oriented Research) network of the Department of Internal Medicine, with academic institutes in Tanzania and Indonesia, is very productive in terms of high-quality research and capacity building in these countries.

Collaboration

Twelve regional hospitals collaborate in DREAM (Dutch Rheumatoid Arthritis Monitoring) to stimulate clinical research and quality of care, in particular pharmacotherapy, with patients suffering from rheumatoid arthritis. Radboud University Nijmegen Medical Centre and Twente University are the leading centres. For Oncology research, the NCEBP collaborates with the Comprehensive Cancer Centre, the Netherlands (IKNL), MD Anderson Cancer Center, Houston, TX, USA, a number of international groups in the field of genetics of bladder cancer, the Foundation for the Detection of Hereditary Tumors (StOET) in Leiden and the National Expert and Training Centre for Breast Cancer Screening in Nijmegen, and with Wageningen University. In primary care and public health, the NCEBP collaborates intensively with the Ministry of Health, Welfare and Sport, the National Institute for Public Health and the Environment (RIVM), the National Health Services Research Centre (NIVEL) and the World Organisation of Family Doctors (WONCA). It is also partner in the Dutch Consortium of service providers for persons with intellectual disabilities (“Sterker op eigen benen”). The NCEBO is a partner in the National Biobank initiative (String of Pearls Initiative, PSI) organized by the Dutch Federation of University Medical Centres (NFU) with the purpose of creating a research infrastructure for future studies of eight selected diseases. The Centre also works with the national hub of existing biobanks (BBMRI).

The NCEBP collaborates with university centres all over the world (IRUN partner: the University of Münster, Universities of Heidelberg, Bradford, Leuven, Leicester, Newcastle, Ottawa, Lodz, Manchester, Frankfurt, Pennsylvania, Adelaide, Bandung, Pittsburg, Kilimanjaro) but also with the European Union/ECDC, the World Health Organization, UNESCO, the Center on Birth Defects and Developmental Disabilities, foreign Centres for Disease Control and Prevention and deCODE Genetics, Reykjavik, Iceland.

The NCEBP also collaborates with numerous public and private organisations in the EU 7th Framework Programmes EuroTARGET, IMPACT, AFRESH, TICD, EUWISE, TACTICS, TLEM-Safe as coordinator or participant.

Awards and acknowledgements

- Dr Maroeska Rovers received the Maarten Kappelle Foundation prize.
- The article “The Gold Standard Publication Checklist” by Hooijmans et al., was awarded prizes by the Dutch Animal Protection Association (‘De Lef in het Lab prijs’), and the Swiss Laboratory Animal Science Association SGV.
- Karin Neeleman – van der Steen MSc received a prize for best Research Platform Presentation of the American Physical Therapy Association.


Dr Betsie van Gaal received the Rosemary Crow Award from the European Academy of Nursing Science (EANS) and the International Journal of Nursing Studies.

ParkinsonNet has been given the ZonMw ‘Most prestigious Pearl Project’ award.

Prof. Roy Kessels received the Betto Deelman Award 2011, Netherlands Neuropsychology Foundation (Stichting Neuropsychologie Nederland, SNN).

For his research in psychiatry Prof. Jan Buitelaar received a special award at the Annual Meeting of the Dutch Society of Psychiatry.

Dr Chris de Korte received a Vici grant for the study of ultrafast 3D ultrasound imaging: the next level for cardiovascular diagnosis.

Dr Niels Riksen received the award of the Novartis Foundation of Cardiovascular Excellence.

Research results

In 2011, a total of 69 PhD-theses were successfully defended. Two of them were of outstanding quality (cum laude):

- Dr R. Helmich: ‘Cerebral reorganization in Parkinson’s disease’.
- Dr N. Voermans: ‘Neuromuscular features of Ehlers-Danlos syndrome and Marfan syndrome, expanding the phenotype of inherited connective tissue disorders and investigating the role of the extracellular matrix in muscle’.

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In total, more than 1450 peer-reviewed papers were published by NCEBP researchers. Some highlights are listed below.

- Prof. Bart Klemeny’s group identified another gene (SLC14A1) that increases the risk of urinary bladder cancer, possibly as a result of urine production.
- Prof. Dorine Swinkels’ group reported for the first time the distribution and reference values for serum hepcidin in the population.
- NCEBP’s analyses of the Dutch primary care system have been interpreted as best practices in the United States. Innovative studies in chronic illness care were published, offering proof of the concept of social network analysis in healthcare settings.
- Dr Katja Aben showed that nephrectomy in patients with metastasized renal cell cancer improves prognosis.
- Dr Carel Bron’s PhD thesis showed the efficacy of comprehensive treatment of myofascial trigger points (MTrPs) in shoulder muscles. Dr Hanneke Kalf concluded in her PhD research that training Parkinson patients to swallow is more effective than medication to reduce drooling.
- Implementation of a patient safety programme aimed at frequently occurring adverse events led to a decrease of such of 43% in hospitals and 33% in nursing homes.
- The “No Use is Disuse” study among boys with Duchenne Muscular Dystrophy showed that assisted bicycle training, involving use of the legs and arms, substantially delays the functional deterioration normally seen in these children. This challenges the common belief that exercise is detrimental in those suffering from muscle diseases.


Dissertations: 69
Scientific publications: 1492
In 2011 the NCEBP was evaluated by an external evaluation committee chaired by Prof. André Knottnerus, chair WRR (Scientific Council for Government Policy). Both the institute and each of the four research programmes were rated excellent on ‘quality’, ‘productivity’ and ‘societal relevance’. ‘Vitality and feasibility’ was considered very good. Two of the four research programmes were considered to be world leading.

- A major breakthrough was the discovery of DGKK genetic variants that increase the risk of hypospadias.
- In the research line “psychobiology for somatic conditions” (Prof. Andrea Evers), evidence was found that corresponding psychophysiological factors affect physical symptoms of itch and pain. In addition, it was shown that cognitive behavioural treatments resulted in altered psycho-physiological functioning in chronic pain patients.
- Dr Tim Olde Hartman showed that better training of general practitioners in reassuring patients with medically unexplained physical symptoms will improve the quality of care.
- Prof Roy Kessels published the first controlled results on the applicability of different learning strategies for cognitive rehabilitation in Alzheimer dementia.
- Prof Jan Buitelaar, Dr Nanda Lambregts-Rommelse and colleagues reported that a restrictive elimination diet was very effective in reducing symptoms of ADHD.
- Research in Ghana reported that increasing enrolment among the poor in health insurance is a very effective way to improve patterns of utilization. The best way of improving enrolment is to identify the poor through means testing and exempting them from premiums.
- In the research line “psycho-oncology” researchers reported in a series of papers that distress in the diagnostic phase of cancer is a major problem and anxiety levels are surprisingly high. During and after medical treatment, cancer patients often struggle to fit the multitude and complexity of advice from health professionals into their everyday life. Both cancer patients that are disease free and advanced cancer patients facing death do not significantly differ in attitudes and emotions toward death and an afterlife. For both groups, active coping strategies and acceptance were beneficial in terms, of quality of life, depression, and hopelessness, whereas avoiding coping strategies and venting of emotions were not. The perception of time among cancer patients that are free of disease and advanced cancer patients is significantly different and is related to distress.

**Societal impact**

NCEBP researchers have made a significant contribution to national and international guidelines and reports on societal and scientific institutes or committees. Particularly noteworthy are the following: The report ‘Kanker in Nederland tot 2020. Trends en prognoses’; the performance indicators for primary care that are used for contracts and pay for performance systems, an evidence-based guideline for the treatment of pain in trauma patients in pre-hospital care; evidence statements for physiotherapists (one for children with motor handwriting problems and one for physio-therapeutic intervention in patients with breast cancer); Advice to the Minister of Health, Welfare and Sports on expanding the possibilities for scientific research for patients with dementia; Dementia, the medical specialist guidelines; and the implementation of the Dutch version of the Motor Function Measure (MFM).

The ParkinsonNet coordination centre will be structurally financed by Zorgverzekeraars Nederland, the association of Health Insurers in the Netherlands, to become a national institute for quality of healthcare in Parkinson’s disease.

The Development Centre for Speech-Language Technology (OSTT) received an innovation grant from the Netherlands Association for Medical Rehabilitation (Revalidatie Nederland) for the development of a digital outpatient facility for patients with communicative disabilities. The leading role in national statements on freezing of human oocytes and on moral contra-indications for fertility treatment resulted in numerous publications and interviews in many lay media.

In 2011, some highly valued conferences, symposia and master classes were organized for example: ‘Methodology and Ethics’; ‘Beyond Usual boundaries’; ‘Solidarity versus market’; ‘E-mental health for somatic conditions’ the master class ‘Researching Implementation of Complex Interventions’ (supported by the European Science Foundation, the Researching Complex Interventions Network and by ZonMw); Initiation and Opening of the ‘Radboud Expert Centre for Psychology & Medicine’; ‘Information market for the general public on World Alzheimer Day’.

NCEBP researchers actively participated in numerous scientific and societal boards and committees:

- Guideline committee ‘Otitis Media with Effusion’ of the Dutch Institute for Healthcare Improvement (CBO) on the development of the Dutch physiotherapy guidelines for low back pain and cardiac rehabilitation and for the treatment of complaints of arm, neck and shoulders (chair), Guideline Development Group “International Guideline Prevention and Treatment of Pressure Ulcers” (chair), National working group dementia, Guideline committee Dementia, European Task Force for development of guidelines for treatment of hyperlipidemia
- National ethics committee on human experimentation
- Health Council (many researchers)
- Dr Niels Riksen was appointed as member of the Young Health Council
Researchers were members of the following: the Advisory Board for the Ministry of Health, Welfare and Sports, on revision of the law on concessions for chronically ill and handicapped people; the Board of the International Organisation for Physical Therapists in Pediatrics (IOPTP); the Participators’ Board of the Netherlands Perinatal Registry, and the Advisory Board of the Johanna Kinderfonds; the Board of Directors of the International Psychogeriatric Association; the Netherlands Behavioural Medicine Foundation; the Advisory Board of the Dutch Cancer Foundation; the Board of the Dutch Association for Psychodermatology (NVPD); the Advisory Board of the Dutch Skin Foundation.

Future research
In the next few years, NCEBP will intensify the interaction with the clinical research institutes in order to improve the quality of translational and clinical research. The institute will continue to invest in research facilities such as biobanks and large networks. The focus of the research will increasingly be on personalized medicine and patient-centred interventions.

The ageing of the Dutch population will create enormous quality and efficiency challenges for the care of geriatric diseases. Diagnostic, prognostic, treatment efficacy and cost-effectiveness research will therefore become increasingly important. In this context, the recently launched research line ‘evidence-based surgery’, a niche in clinical research, will provide unique opportunities. Progress in the ‘primary’ prevention of chronic disease is best achieved through implementation of existing knowledge than by gaining new knowledge on risk factors. Consequently the focus of the Epidemiology and Evaluation programme will shift from aetiology research to prognostic/predictive and quality of care research. Patient-oriented research will be supported by an investment in the standard collection and the maintenance of large biological databanks such as the new ‘Radboud Biobank’. More attention will be paid to pharmacogenetics studies based on these ‘biobanks’.

The Clinical Research programme will further improve the quality of translational and clinical research by increasing interdisciplinary collaboration and focusing on human movement, reproduction and cardiovascular disease. The main aim of the Patient-Centred Interventions programme is to strengthen its multidisciplinary research by integrating all NCEBP research projects in patient-centred interventions. Continued investments will be made in translational research and common structural research facilities within the laboratory, population-based cohorts and healthcare organizations.

Health services research and applied biomedical research are increasingly important scientific activities for RUMC. With the ageing of the population, innovative approaches are needed to match medical needs with costs. The Quality of Clinical Practice programme aims to strengthen its scientific and societal outputs, in line with NCEBP’s dual mission. The societal output will involve establishing strategic links with a wide range of relevant stakeholders and research groups and by increasing the volume of short-term advisory projects. The scientific ambitions will focus on increasing innovation in research. With reference to the quality of clinical practice, long-term collaborations with specific clinical groups will be developed with the aim of continuing the high number of high-impact publications in areas such as infectious diseases, oncology, surgery, and primary care. Investments will continue in the NCEBP’s large international network in order to draw in countries that are not yet included.
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 fundamental research and education. The NCMLS also aims to advance innovation in translational research, based on integrating diverse areas of scientific expertise within the molecular and medical sciences.

NCMLS is a leading multidisciplinary research school in the field of the molecular mechanisms of disease and particularly in molecular medicine, cell biology and translational research. NCMLS accommodates research groups from Radboud University Nijmegen Medical Centre and the Faculty of Science at Radboud University Nijmegen. Research is focused along seven main research themes, all dealing with understanding the molecular basis of disease. More detailed research theme descriptions can be found via www.ncmls.eu.

1 Infection & Inflammation (Dr Frank van Kuppeveld)
This theme covers two important areas of biomedical research:
A Infectious diseases: The focus lies on the role of the innate immune system in pathogen recognition and host defence (against fungal, bacterial and viral infections), on pathogen-host interactions, vector biology, anti-microbial drugs and development of drug-resistance, vaccine development and the role of pathogens in the development of (chronic) inflammatory diseases.
B Inflammatory diseases: The aim is to identify disease mechanisms that encompass both the innate and adaptive immune system and the identification of modifier genes and post-translational modifications, including auto-antigens, to explain the tissue specificity of these conditions such as rheumatoid arthritis, systemic sclerosis, gouty arthritis, psoriasis-, and systemic lupus erythematosus.

2 Immune Regulation (Prof. Gosse Adema)
This theme covers immunological and haematological research in three major biomedical fields:
A Molecular and functional analysis of normal and malignant blood cell development and immune control: the theme includes analysis of dendritic cells, regulatory T-cells and natural killer cells and aims at defining regulatory circuits effective in tolerance and immunity.
B Immunotherapy of cancer: development and clinical application of vaccination and imaging strategies for solid and haematopoietic malignancies and their micro-environment.
C Organ transplantation: development and clinical application of novel immune monitoring and intervention approaches in kidney transplantation.
Staff

Prof. G.J. Adema (o)
Prof. J.O. Barentsz (o)
Prof. J.H.M. Berden (o)
Prof. W.B. van den Berg (o)
Prof. R.J.M. Bindels (p)
Prof. R.P. Bleichrodt (p)
Prof. O.C. Boerman (o)
Prof. J.H.L.M. van Bokhoven (o)
Prof. R.E. Brock (o)
Prof. H.G. Brunner (o)
Prof. P. Buma (p)
Prof. C.E.L. Carels (o)
Prof. F.P.M. Cremers (p)
Prof. P.M.T. Deen (o)
Prof. J.M.A. van Deursen (o)
Prof. J.P.H. Drenth (o)
Prof. W.F.J. Feitz (o)
Prof. C.G. Figdor (o)
Prof. P.H.A. Friedl (o)
Prof. J.M.D. Galama (o)
Prof. A.H.M. Geurts van Kessel (o)
Prof. W.J. de Grip (e)
Prof. A. Heerschap (o)
Prof. P.W.M. Hermans (o)
Prof. J.C.M. van Hest (o)
Prof. L.P.W.J. van den Heuvel (o)

Prof. L.B. Hilbrands (o)
Prof. J.G.J. Hoenderop (o)
Prof. P.M. Hoogerbrugge (o)
Prof. N. Hoogerbrugge-van der Linden (o)
Prof. J.A. Jansen (o)
Prof. J.A. Jansen (p)
Prof. J.M.J. Kremer (o)
Prof. J.H.J.M. van Krieken (o)
Prof. B.J. Kulberg (o)
Prof. N.H. Lubsen (p)
Prof. L.F.A.G. Massuger (o)
Prof. J.W.M. van der Meer (o)
Prof. G.J. Meijer (o)
Prof. L.A.H. Monnens (o)
Prof. M.G. Netea (o)
Prof. G.J.M. Puijning (o)
Prof. C.J.A. Punt (o)
Prof. A.E. Rowan (p)
Prof. F.G.M. Russel (o)
Prof. F.P.J.T. Rutjes (o)
Prof. R.W. Sauerwein (o)
Prof. J.A. Schalken (p)
Prof. J. Schalkwijk (o)
Prof. J.A.M. Smeltink (o)
Prof. D. van Soolingen (e)

Prof. J.N. Spelbrink (o)
Prof. S.E. Speller (o)
Prof. H.G. Stunnenberg (o)
Prof. P.E. Verweij (o)
Prof. A. Voss (o)
Prof. G. Vriend (o)
Prof. I.J.M. de Vries (o)

Tenured
Full Professors 32.7 FTE
Associate Professors 16.1 FTE
Assistant Professors 19.9 FTE
Researchers 21.4 FTE

Non-tenured
Researchers 119.2 FTE
Doctoral candidates 178.8 FTE

3 Regenerative Medicine & Microenvironment (Dr Toin van Kuppevelt)
Within this theme, two main topics are addressed:
A Regenerative medicine: tissue-engineered constructs, based on extracellular matrix molecules, polymers and effector molecules, are designed and fabricated, and analysed in vitro and in vivo.
Smart organ-specific bioscaffolds are prepared in such a way that they provide appropriate signals to the cells to proliferate, migrate or differentiate. Focus here is on ceramics, calcium phosphates, collagens, glycosaminoglycans and effector molecules (e.g. growth factors and cytokines) in relation to a selected number of tissues, viz. cartilage/bone, skin, kidney and blood vessels and urogenital organs.
B Microenvironment in health and disease: the focus here is on collagens, glycosaminoglycans, matrix metalloproteinases and a number of effector molecules (e.g. BMPs, TGF beta). The role of these components in cancers, nephropathies and degenerative cartilage diseases is studied in vitro as well as in vivo. Strategies to restore homeostasis in deranged and disease-associated microenvironments are pursued, including the use of glycomimetics.

4 Energy & Redox Metabolism (Prof. Martijn Huijnen)
Researchers in this area aim to improve our understanding of the principles of (biochemical) adaptation to energy and redox stress, in order to better define healthy responses within the normal physiological range and the pathophysiological thresholds for diseases whereby mitochondrial function or energy transfer pathways are compromised. This research contributes to the wellbeing and treatment of mitochondrial disease patients and other conditions in which energy metabolism is compromised. Research is concentrated in three areas:
A ‘imaging’ of ATP/ADP/AMP and NAD(P)H concentration and fate with existing and novel biosensor reporters;
B ‘imaging’ of metabolite fate with MRS and MRI;
C the use of new strategies to follow mitochondrial shape and activity as well as cellular metabolic state and viability. The integration of “4-D” imaging and simultaneous recording of the behaviour of small molecules and macromolecular assemblies and cellular organelles is an important challenge.
Membrane Transport & Cell Dynamics (Prof. Joost Hoenderop)
Membrane transporters are involved in a whole range of diseases in organs such as brain, muscles, kidney, intestine, liver and bone. The ultimate aim of our research in this area is to provide a molecular basis for the understanding, diagnose and ultimately cure of inherited and acquired diseases of transport proteins, such as channelopathies. Transport proteins currently studied within this theme are sodium (or hydrogen) and potassium ATPases, aquaporin water channels, transient receptor potential channels, organic anion and cation transporters, ATP-binding cassette (ABC) transporters and sodium co-transporters. Research integrates fundamental and clinical studies conducted at the genetic level (gene defects, polymorphisms), molecular level (transport and associated proteins), cellular (established model systems, isolated and transfected cells) and organism (conditional) knockout models) levels. In addition, new tools will be developed and implemented in order to tackle the outlined scientific goals, including real-time imaging, large scale screening assays at the mRNA and protein level, application of small interference RNA libraries, conditional knockout models, bioinformatics and functional analysis at the molecular level.

Genetic & Epigenetic Pathways of Disease (Prof. Hans van Bokhoven)
Under this theme researchers aim to unravel the molecular basis of cell behaviour resulting from the genetic and epigenetic code contained in the nucleus in the context of health and disease. Basic and clinical research is combined to unravel the molecular pathways and cellular processes in specific (hereditary) tumourigenic pathways in normal and pathological conditions of development, in particular of the nervous system. Members of this research group are engaged in technology development ranging from single molecule studies of reconstituted model chromatin through to the elucidation of epigenetic marks on a genome-wide level and the implementation of Next Generation Sequencing (NGS) in fundamental research as well as in a diagnostic setting.

Chemical & Physical Biology (Prof. Jan van Hest)
The structure and function of proteins and their complexes play crucial roles in virtually all NCMLS research projects.
A At the molecular level researchers in this subtheme work on optimally exploiting the potential of molecular and biomolecular chemistry to modify, design and mimic proteins and their building blocks with the aim of modulating and analyzing their activities and properties in the cellular and subcellular environment. This is best illustrated by the following examples: (i) novel bio-orthogonal conjugation methods to study and interfere with biological processes; (ii) stimulus-responsive cell-penetrating peptides; (iii) use of non-proteinogenic amino acids in the diagnosis and treatment of disease; (iv) mimicking cellular synthetic processes in microenvironments; and (v) hybrid cell systems: incorporating synthetic components into living cells.
B This subtheme includes the elucidation of protein structure and protein-protein interactions at the cellular and multicellular level. Research topics are: (i) post-transcriptional events in gene expression; (ii) cellular signalling pathways; (iii) (de)activation mechanisms of tyrosine kinases and tyrosine phosphatases; (iv) external control of cellular proliferation and differentiation; and (v) molecular probing of vascular pathology and angiogenesis.

Prof. Henk Stunnenberg coordinates the BLUEPRINT research project, which focuses on the human epigenome. Under his direction, 41 research institutes and companies in Europe will collaborate in order to discover the ‘operating instructions’ for our genes. The project is in receipt of an EU grant worth €30 million.
Research facilities

Research facilities available to members of NCMLS may be grouped in the following categories:

**Animal models:** These are of great importance to molecular life scientists for biomedical research. The NCMLS has excellent links to the Central Animal Facility (CDLF) for expert advice and access to facilities for animal testing. NCMLS 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 septicemia and malaria (P. falciparum).

**Genomics:** DNA sequencing and micro-array technology for gene expression profiling are rapidly becoming standard everyday laboratory tools. The Microarray Facility Nijmegen is one of the core facilities of the RUNMC. The Department of Human Genetics 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. Next-generation Genome Sequencers (Roche 454 FLX Titanium and Solexa) are operational in the Departments of Human Genetics and Molecular Biology.

**Molecular imaging:** Imaging at the cellular and subcellular 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 of biological specimens utilizing light microscopy (bright-field, confocal and fluorescence), conventional scanning and transmission electron microscopy, and sophisticated digital imaging. The facility is available for researchers within and outside the NCMLS. NCMLS also offers access to other techniques such as, Atomic Force Microscopy, Flow cytometry, FRET and FRAP. PRIME: is the Preclinical Imaging Centre of Radboud University Nijmegen Medical Centre. This centre has state-of-the-art equipment for small animal imaging: MRI (7 Tesla, 11.7 Tesla), PET/CT, SPECT/CT, bioluminescent imaging and in vivo multi-photon microscopy.

**Proteomics:** The growing availability of genomic sequence information, together with improvements in protein characterization by mass spectrometry, greatly facilitates protein research. The Nijmegen Proteomics Facility (NPF) was established in 2004 to exploit these opportunities. The state-of-the-art proteomics facility offers fundamental technological tools in proteomics research and makes them available for academic and industrial researchers, both within and outside Radboud University Nijmegen and Radboud University Nijmegen Medical Centre. Equipment available includes 2D-electrophoresis, SELDI-TOF and Mass spectrometry (MALDI-TOF, MALDI-LTQ and nano-LC-LTQ-FT MS).

**Translation research and cellular therapy:** A Good Manufacturing Practice (GMP) facility with clean rooms is used for translational research e.g. immunotherapeutic cell therapy and stem cell transplantation. In November 1997 the Departments of Tumour Immunology, Medical Oncology and Haematology collectively initiated the application of dendritic cell-based anti-cancer vaccines in melanoma patients.

Molecule-2-Man (www.molecule2man.eu)

The NCMLS is an active participant in Molecule-2-Man (M2M), an innovative multidisciplinary imaging platform strategically located at the University and UMC St Radboud, which both have a long history of interdisciplinary research, education and healthcare. M2M is built on the strengths and proven track record of leading Nijmegen institutes: Molecules and Materials, Molecular life-sciences, Cognitive Neuroscience and Medical Sciences. Its aim is to reinforce existing local and national infrastructures by concentrating expertise and facilities in order to create a top European health technology campus in Nijmegen, which will implement and advance imaging technologies from the molecular level to entire organs and the human body itself (i.e. from molecule to man) and take translational research from the laboratory into the clinic (from bench to bed). M2M provides an ideal platform for exchange of knowledge and for access to state-of-the-art instrumentation. It also facilitates collaboration with research institutes, small and medium-sized enterprises and larger companies.

Collaboration

NCMLS is a multiparty collaboration between specialist medical groups from RUNMC and a number of groups from FNWI, linking fundamental and clinical science (i.e. from molecule-to-man approach, see inset). This multi-disciplinary nature of NCMLS ensures not only a high quality of research within the field of Molecular Life Sciences, but also offers superior quality education programmes at BSc., MSc. and PhD levels. Technological development together with excellent research and education are the key motivators for local collaboration.

NCMLS is allied with the IMM and the Donders Institute, providing a solid platform for the integration of chemical synthesis, nanoscience and neuroscience with molecular life sciences. NCMLS has daily interactions with members of the RUNMC clinical institutes, viz. the IGMD, RIO and N4i. Nationally, NCMLS has contacts with other Dutch UMC’s and universities as well as Dutch public-private partnerships such as the Biomedical materials (BMM) program, TI-Pharma and the Center for Translational and Molecular Medicine (CTMM). NCMLS has several academic and industrial partners in this context. In addition, the NCMLS is actively involved in national programmes/associations, such as the Dutch Program for Tissue Engineering (DPTE), the Netherlands Proteomics Centre, Centre for Societal Genomics (CSG), and Netherlands Genomics Initiative (NGI). Internationally NCMLS has interaction with researchers world-wide in both individual projects as well as multi-partner programmes, such as EU FP6/7. Since 2011 the NCMLS has contributed to PhD workshops in the International Research Universities Network (IRUN).
Key publications


Nijmeegen Centre for Molecular Life Sciences


Dissertations: 48
Scientific publications: 939
Patents: 2

Research results

An external evaluation committee under the chairmanship of Prof. Hans Clevers, Hubrecht Laboratory, visited the NCMLS in 2011. The findings of the Committee on all aspects of research, education, management and recruitment were very positive, ranking NCMLS as very good to excellent in terms of productivity, quality, feasibility and societal relevance for each of the seven research themes. The coming years will be quite exciting and the NCMLS has the ambition of further establishing a European top institute with a dynamic & ambitious environment.

In 2011 there were 42 PhD theses defended, of which 3 were cum laude, and 900 peer-reviewed publications in top scientific journals. A selection of key publications across the NCMLS thematic areas is shown in the red box. In 2011, a number of large prestigious (consortium) grants have been obtained.

- For the oncoming 4½ years, Prof. Henk Stunnenberg (Dept. of Molecular Biology) will be the coordinator of BLUEPRINT, a unique EU-FP7 High Impact Project involving an international consortium comprising 41 leading European universities, research institutes and industrial entrepreneurs. The project has a total budget of close to €40 million and aims to further the understanding of how our genes are activated or repressed, in particular in blood cells of both healthy and diseased individuals. BLUEPRINT will generate at least 100 reference epigenomes and study them to advance and exploit knowledge of the underlying biological processes and mechanisms in health and disease.

- Prof. Peter Hermans, Dr Michiel van der Flier and Prof. Ronald de Groot (Dept. of Paediatrics) together with international colleagues have been awarded €62 million to undertake a large-scale genomic study to identify the genes, and biological pathways they control, which determine susceptibility and severity in life-threatening bacterial infections of childhood in Europe and globally.

- Dr Timothy Radstake (Dept. of Rheumatology) as part of an international consortium has been awarded an U.S. CORT grant (€8 million) to improve our understanding of early diagnosis, treatment and pathogenesis of systemic sclerosis. There is no effective therapy for this serious condition. The present project aims to increase understanding of early diagnostic markers and to detect patients with a rapidly progressive course. In addition, this research is set up to improve understanding of the aetiology of the disease.

- Dr Roos Masereeuw (Dept. of Pharmacology and Toxicology) together with international colleagues were awarded a EU FP7 Marie Curie Initial Training Networks grant of €3.7 million for the NephroTools project. NephroTools aims to harness the potential of human kidney stem/progenitor cells for use in drug discovery and regenerative therapy programmes.

- Dr Alessandra Cambi (Dept. of Tumour Immunology) together with international colleagues were awarded a EU FP7 STREP grant of €3 million for their NANO-VISTA project. The goal of
NANO-VISTA is to exploit novel concepts of photonic antennae to develop a new generation of bionanophotonic tools for ultra-sensitive detection, nano-imaging and nanospectroscopy of biomolecules, both in-vitro and in living cells.

- Dr Teun Bousema (Dept. of Medical Microbiology) has been awarded two large subsidies from The Bill & Melinda Gates Foundation. First a Grand Challenge grant (USD 1 million) to determine whether targeted interventions can indeed lead to local elimination of malaria. Secondly, together with a colleague from the London School of Hygiene & Tropical Medicine, Teun Bousema has been awarded $2.5 million to characterize the human infectious reservoir for malaria at sites in Burkina Faso and Kenya. In Nijmegen, molecular and serological tools will be developed to support these efforts.

- The Foundation Fighting Blindness (FFB) USA has awarded Nijmegen researchers (Prof. Frans Cremers and Dr Ronald Roepman from the Dept. of Human Genetics, Prof. Hennie Kremer (Dept. for Ear, Nose & Throat) and Dr Anneke den Hollander from the Dept. of Ophthalmology), a USD 1.8 million centre grant for the period 2011-2016. Researchers at the new centre – the Radboud University Nijmegen Research Center for Studying Retinal Degenerative Diseases – will study topics covering genetics, cell biology, retinal imaging, and gene therapy of inherited retinal dystrophies.

- The NIGRAM consortium, a joint research effort between researchers of the Free University Amsterdam, UMC Groningen and RUNMC (Profs. René Bindels & Joost Hoenderop, Dept. of Physiology), have been awarded € 6.5 million by the Dutch Kidney Foundation. The project will investigate better treatment and prevention strategies in chronic kidney disease.

- The US National Institutes of Health (NIH) has awarded $ 1.4 million to Dr Gert Jan Veenstra (Dept. of Molecular Biology) for research to identify functional elements in the genome of Xenopus, an important model system for embryogenesis. This award is the second R01 grant awarded to Veenstra by the US National Institutes of Health.

- ZonMw have awarded € 675,000 TOP grant to Prof. Joost Schalkwijk and Dr Patrick Zeeuwen (Dept. of Dermatology) to study the biology of genetic risk factors for psoriasis that they recently identified. In addition, they will study the role of the skin microbiome in inflammatory skin diseases in collaboration with Prof. Michiel Kleerebezem (NIZO/WUR).

Societal impact

Various members of the NCMLS are funded by (inter)national patient-orientated non-profit organizations, such as the Kidney Foundation, Dutch Cancer Society, the Diabetic Foundation, and the Rheumatoid Arthritis Foundation. Clinical groups such as Berden, Netea, Punt, de Witte, Kullberg and Smeitink are in daily interaction with patients and their relatives at RUNMC, have close ties with patient organizations and are involved in public and strategic policy. NCMLS researchers are actively involved in enhancing disease diagnosis, prevention and treatment as can be seen from the following examples:

- In November 1997, the Departments of Tumour Immunology, Medical Oncology and Haematology collectively initiated the use of dendritic cell-based anti-cancer vaccines in melanoma patients. To date, more than 250 patients have been treated with this experimental form of therapy. In the 2010 annual report from the Central Committee on Research Involving Human Subjects (CCMO) on new Cellular Therapy studies, of the 9 studies approved 5 were in oncology. Of these, 4 were from Nijmegen (3 DC vaccination studies - 2 in melanoma and 1 on colorectal cancer).

- Prof. F. Cremers, Prof. H. Kremer and Dr A. den Hollander have developed mutation screening microarrays for LCA, RP, USH etc., resulting in more accurate diagnosis and prognosis of disease, in collaboration with Asper Biotech, Estonia. These screening platforms are very important for identifying patients who are eligible for gene-replacement therapies, such as for the genes ABCA4, CRB1, and RPE65. The latter is already in phase II clinical trials.

- Clinicians and researchers from the Departments of Biochemistry and Paediatrics are involved in biochemical and clinical research of children with mitochondrial defects. Clinical, cell-biological and cell-physiological data from children with mitochondrial complex I deficiency are collated to understand the clinical presentation of mitochondrial dysfunction, treatment and cellular biochemistry/pathology.

- Clinicians and researchers from the Departments of Physiology, Nephrology, Pharmacology & Toxicology and Human Genetics are pioneering research into the molecular mechanisms that underlie hormonal-mediated regulation of ion transport processes in kidney and small intestine. NCMLS is one of the two centres for patients with congenital nephrogenic diabetes insipidus (NDI) around the world. Research on congenital NDI is at the forefront and our recent discoveries on V2R agonists/antagonists are advancing treatments.

- The importance of molecular life-sciences-related research in society is given emphasis in NCMLS educational programmes and in the research institute as a whole. The training of researchers in life sciences is of great importance for society since they will form the new generation of scientists and biotechnology entrepreneurs that will develop novel treatments and diagnostics.

Future research

The following prestigious Veni, Vidi and Vici grants (NWO), as well as ERC grants (EU), awarded to members of NCMLS form the basis for important future research.

- Prof. Carl Figdor (Dept. of Tumour Immunology) has been awarded an ERC Advanced Grant of €2.5 million. The project, entitled "PATHFINDER Mimicking pathogens: an integrated nano-medicine approach to develop intelligent cancer vaccines" will investigate new nano-vaccines in the patient’s immune
system against cancer. It is expected to lead to major advances in tumour immunotherapy.

- Dr Timothy Radstake (Dept. of Rheumatology) received an ERC Starting grant to investigate the role of plasmacytoid dendritic (pDCs) cells in systemic sclerosis (SSc). The project CIRCUMVENT is designed to provide proof of concept for the role of pDCs in SSc and to open new avenues for therapeutic targeting of this disease.

- Dr Joris Veltman (Dept. of Human Genetics) received an ERC Starting grant to investigate the role of de novo mutations in intellectual disability. The project DENovo will furthermore provide critical knowledge on the frequency and consequences of de novo mutations in our genome and help to establish medical genome sequencing as a routine diagnostic approach.

- Prof. Wilhelm Huck (Dept. of Physical Organic Chemistry) received a Vici award for his project “Picolitre droplets as artificial cells”. It is the broad aim of this research to construct an experimental platform to elucidate the influence that the particular physiochemical conditions commonly found in living systems have on model complex biochemical reactions.

- Dr Frank van Kuppeveld (Dept. Of Molecular Microbiology) received a Vici award for his project entitled “Viral hijacking of host cell factors and membranes for replication organelle formation”. Frank van Kuppeveld will investigate the role of novel host factor candidates – identified by using a genome-wide RNAi screen – in the formation, architecture, and function of replication organelles, using virological, molecular, biochemical, and microscopy techniques.

- Dr Alexander Hoischen (Dept. of Human Genetics) received a Veni grant for his research proposal entitled “NOVEL - De NOvo genetic variants in embryonic development and early lethality”. Alexander Hoischen aims to pinpoint crucial genes in human developmental by identifying mutations that cause embryonic lethality, resulting in pregnancy loss.

- Dr Pedro San-Cristobal (Dept. of Physiology) received a Veni grant for his research proposal entitled “Salt matters”. Pedro San-Cristobal will explore the role of a novel salt transporter at cellular and human levels. The outcome will improve the treatment of arterial hypertension.

- Dr Frank van de Veerdonk (Dept. of General Internal Medicine) received a Veni grant to study host defence against Gram-positive bacteria and fungal pathogens.

- Dr Joost te Riet (Dept. of Tumour Immunology) received a Veni grant for his research proposal entitled “Mechanotransduction at the immunological synapse”. Joost te Riet aims to unravel how ALCAM-CD6 interactions mechanically stabilize the immunological synapse (IS) between dendritic cells and T cells under physical stress.

- Dr Shahla Abdollahi-Roodsaz (Department of Rheumatology) received a Veni grant for her research proposal entitled “Gut feeling matters: intestinal flora remotely controls joint pathology”. Shahla Abdollahi-Roodsaz aims to investigate the influence of intestinal microflora on the phenotype and the arthritogenic capacity of auto-reactive T cells.
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 encourage joint research in order to enhance our understanding of interactions between different life forms, 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 ways in which cells, organisms and ecosystems are adapted to stress. The research done in most groups is wide-ranging, while clear research goals provide excellent opportunities for interdisciplinary collaboration.

The availability – and excess – of water will be the main global environmental problems in the 21st century. Water shortages are likely to increase in many parts of the world, while many flood plains will increasingly suffer from flooding at certain times of the year. In addition, poor water quality is challenging human populations and natural ecosystems alike. Organisms and ecosystems adapt 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.

Research programmes:

Ecological research
Traditionally the stress response and adaptation of ecosystems has played a central role in most of the ecological 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
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. 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. 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 of how and why individuals respond to environmental stressors the way they do and identifies the ecological and evolutionary opportunities for and constraints to adaptation.
Research facilities
The IWWR has nine research groups, all of which are located in the Huygens Building, where they have state-of-the-art modern laboratory facilities – and a central analytical service. The equipment used includes:
- Light microscopy and electron microscopy facilities for detailed analysis of the ultrastructure of micro-organisms, animals and plants
- Extensive molecular biological facilities, such as quantitative RT PCR, RNA interference and in-situ hybridisation techniques for analysis of single cells up to 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
- A Solanaceae collection and greenhouses.

Collaboration
Research is conducted in close collaboration with over one hundred national and international research groups, research institutes, companies and governmental organizations. An important novel form of collaboration is with non-governmental organizations (NGOs), in this case those involved in nature and environmental protection. This collaboration takes place at Natuurplaza on the University campus.

Awards and acknowledgements
- Dr Boran Kartal (Microbiology) was awarded a Netherlands Organisation for Scientific Research (NWO) Veni grant for research on the biochemical processes in ammonium oxidizing bacteria.
- Dr Boran Kartal (Microbiology) was awarded the van Leeuwenhoek price for most talented post doc by the Royal Netherlands Society of Microbiology
- Dr Katharina Ettwig (Microbiology) was awarded the Westerdijk price for the best PhD thesis by the Royal Netherlands Society of Microbiology
- Peter van Dam (Plant Genetics) won the 5th RijkZwaan Plant Sciences Award
- Mark Huijbregts en Ad Ragas (Environmental Sciences) were appointed as professors at the Open University

Research results
The IWWR microbiologists investigated the molecular mechanism of anammox bacteria with a wide range of methods. They were able to show that hydrazine is made of ammonium and nitric oxide,
Involving by a new multiheme enzyme: the hydrazine synthase. Furthermore, they resolved the crystal structure of a new carbon disulfide hydrolase that was isolated from an archaeon, which inhabits the hot acidic Solfatara field in Italy. The researchers used mutant studies to show that the CS₂ hydrolase had a tunnel-like substrate entrance. Both studies were published in Nature. The applied aspects of anaerobic methane and ammonium oxidation were investigated with co-cultures of anammox and Methylomirabilis oxyfera bacteria. Under laboratory conditions, these two bacteria could be grown together while simultaneously removing methane, ammonium and nitrite. Together with the aquatic ecologists at the Institute, the methane cycle in Patagonian peatlands was studied using both molecular and biogeochemical methods.

The plant geneticists at IWWR are finalizing an analysis of the C- and D lineage MADS-box genes: in contrast with other species, Petunia has retained more copies of these genes, while surprisingly they have all maintained the same basic set of functions, with some additional (minor) ones. The geneticists are preparing materials to be analyzed by NG sequencing in the Meiosys project and in the miRNA project.

The Ecogenomics group found that there are significant variations among populations of Solanum dulcamara in terms of Colorado Potato Beetle resistance. In collaboration with the Free University in Berlin, it was found that there is significant variation when it comes to the ability to induce defensive protease inhibitors in this species. Both drought and flooding significantly affect the base level of protease inhibitors, which can also influence insect resistance. Ongoing collaboration with scientists at the Trace Gas Facility at the IMM has resulted in novel insights into the breakdown of glucosinolates and the resulting volatile organic compounds released after root herbivory on Brassica species.

The plant ecologists at IWWR examined how differences in shoot elongation by the riverine plant species Rumex palustris translated into fitness consequences, finding that elongation benefits the plant only under a certain range of flooding regimes. Population models were extended to include the degree of dispersal of propagules and applied to spreading invasive plant species. Recent results by the molecular ecologists at IWWR, which link inbreeding depression to epigenetics, were highlighted in an article in Science.

A paper in Endocrinology written by researchers working on thyroid research in the Organismal Animal Physiology group epitomizes their innovative studies on plasma membrane thyroid hormone transporters. Researchers in the bone research line (SMARTMIX) published an article on osteoclasts in zebrafish bone as targets for drug screening in osteoporosis research in the prestigious journal Bone. Transgenic zebrafish with Osterix-GFP constructs are used to quantify osteoblast activity. In Faseb Journal a paper appeared on an epithelial calcium channel that is crucial in bone and general calcium physiology. Studies of Organismal Animal Physiology on welfare in fish included large-scale stress (i.e. transport) studies with eel, catfish and sole.

Seven PhD students in the Environmental Science group defended their theses. In rivers, exotic fish species were shown to be more tolerant to temperature than native specimens, explaining recent...
invasions. Polar and temperate zooplankton was found to be equally sensitive to mineral oil, allowing existing risk assessment procedures to be applied in future oil exploration in the arctic region. Eco-labelling of products and activities was boosted by the appointment of Mark Huijbregts as a professor at the Institute. Prof. Huijbregts addressed the issue of scientific underpinning in his inaugural speech.

Scientists from the Aquatic Ecology and Environmental Biology group were able to unravel a number of exciting new plant-environment interactions, including the extreme oxygenation of peat by vascular plants in pristine Patagonian peatlands, thus nullifying methane emission to the atmosphere. In addition, a novel tool was developed to not only diagnose water quality problems, but also estimate and predict internal eutrophication in aquatic systems. Together with the Environmental Sciences department, it was shown that megaherbivores are vital for the resilience of tropical seagrass systems (in relation to eutrophication).

The animal ecologists at IWWR took part in a publication on an ecological, molecular biological and physiological approach in combination with a suitable model organism (Caenorhabditis elegans) to test ecological and behavioural hypotheses about the mechanisms that differentiate between aggregation and solitary behaviours. A paper by Toos van Noordwijk et al., which was published online in 2011, has been highlighted by the Faculty of 1000.

**Societal impact**

A pilot plant study, which showed that M. oxyfera and anammox bacteria can together remove nitrogen compounds from wastewater, had considerable impact on the application of this process in full-scale plants. Based on these and other findings an ERC Proof of Concept grant was awarded to investigate this application further. Furthermore, new waste-water treatment plants based on both M. oxyfera and anammox can now be designed to remove nitrogen from industrial and municipal waste streams more cost effectively.

The Petunia system and especially the transposable element insertion technology is used by several companies to identify candidate genes for traits like drought – or cold tolerance or resistance against specific diseases like Botrytis.

The plant biologists at IWWR have continued to collaborate with Agrico Research on potato plants and with Nunhems B.V. and Enza Seeds on tomato plants. The latter has led to the filing of two patent applications on drought tolerance and on increased fruit size in tomato plants.

The results obtained by research in the Ecogenomics group may be used by breeding companies researching natural resistance factors in crop plants, for example resistance to Colorado Potato Beetle. Their research on water stress-induced responses in S. dulcamara will help breeders in their search for stress tolerance in crops such as tomato, potato and eggplant. The Institute’s relationship with breeding companies and vegetable growers will be strengthened by the presentation of IWWR research at the 2012 Floriade World Horticultural Expo in Venlo, the Netherlands.

Fish welfare, which is receiving increasing attention in Western societies, is central in the research on aggression in catfish and on stress-coping strategies in salmon, sea bass and sea bream. The documentary ‘De Wilde Keuken’ (national TV, VPRO), which addressed the issue of fish welfare and stress in aquaculture, was broadcast twice in 2011. The Dutch AVRO broadcasting company will address fish welfare in aquaculture and sport fishing in a documentary early in 2012, including research at IWWR.

Researchers at the Aquatic Ecology and Environmental Biology group cooperate closely with their spin-off company B-Ware. Two major Aquatic Science Innovation Programmes were carried out in 2011, including the first successful large-scale use of iron in lakes for combating eutrophication. In addition, a major NWO-STW grant enabled two PhD students and one postdoc (RU-UU-UvA) to start working on the application of new peat formation as natural capping for landfill areas (eco-technology).

Volunteers throughout the Netherlands took part in the Garden Bird watch 2011 in January. This is the biggest bird watch in the Netherlands and it has scientific value. For example, biologist Chris van Turnhout, who is affiliated with the SOVON Dutch Centre for Field Ornithology, received his doctorate in March 2011 for research using bird watch data.

The population models of the IWWR plant ecologists are increasingly used to understand fluctuations of numbers of wild species and help manage these species. The models, which are versatile, can be used for plants and animals (birds) alike. Together with partners in Natuurplaza – BirdLife Netherlands and others – application of the models will be used to give a scientific basis to the Red List of endangered species. In addition, the core expertise of the group is applied in a new European consortium that was established to optimize crop production.

**Future research**

The microbiologists at the IWWR will continue to investigate the role of anaerobic methane and ammonium oxidizing bacteria in marine and freshwater ecosystems, both in laboratory bioreactors and natural oxygen-limited ecosystems. The fate of methane in various wetland and volcanic ecosystems will be assessed using stable isotopes as well as molecular and environmental genomic methods. The cellular structure of various bacteria will be investigated with state-of-the-art electron microscopy. New high-
throughput sequencing methods will allow more rapid analysis of expression data under fluctuating environmental conditions.

The plant geneticists at IWWR will focus on the involvement of microRNAs in floral organ definition and on the relationship between chromosome structure and recombination frequencies. Insertion libraries containing over 100,000 transposon insertions are nearly available for interested parties. The group will also contribute to developing the new model system *Solanum dulcamare* with a molecular-genetic analysis of natural accessions.

Ecogenomics research will further focus on interactions between multiple stresses in *Solanum* dulcamara and *Brassica* species. Within this topic, the main focus will be on the molecular and physiological integration of plant responses induced by above-ground and below-ground herbivores, as well as integrating insights from transcriptome analysis.
herbivore-induced and water-induced stress responses. The aim is to intensify collaboration with several groups in IWWR and IMM as well as abroad (including with the Free University in Berlin, Germany and the University of Rennes in France).

The research carried out by plant molecular physiologists is designed to explore biodiversity, to maintain it (e.g. in a conservation project in collaboration with the Experimental Garden and Gene Bank of IWWR), and to use it to identify new traits that allow plants to adapt to their environment. The plant’s responses to a range of environmental cues will be studied in collaboration with colleagues at the Institute.

The research in the Organismal Animal Physiology group will focus on fish welfare. The group will use zebrafish as a model for studying vitamin-D (calcitriol) physiology and immunity, adult zebrafish for studying calcium physiology. Researchers are conditioning fish using positive rewards as a tool to suppress stress and avoid aggression in fish and microbiota – in the intestine and gill basket – as well as biofilter systems in aquaculture. This work is done in collaboration with the Microbiology group led by Prof. Jetten.

New work by the plant ecologists will scale up knowledge of traits and individuals to the resilience of populations and communities under conditions of climate change. West European grasslands and the tropical rainforest are the focus of attention. In addition population models of birds will be constructed, together with data from Natuurplaza and other partners.

In the Environmental Science group, efforts will continue to be devoted to integrating different methodologies for environmental assessment. Overarching scaling principles linking molecular mechanisms to ecosystem effects, species sensitivity distributions covering different stressors, and stochastic techniques covering uncertainties and variability will be applied by various research teams. Two PhD students will start developing models for the fate and accumulation of nano-particles based on recently acquired empirical data.

The Aquatic Ecology and Environmental Biology group will further intensify their work on biogeochemistry-ecology interactions in a variety of wetland ecosystems subjected to global changes, including climate change, land use change, water pollution and air pollution. New state-of-the-art equipment designed to measure carbon fluxes (gaseous and dissolved organic) will enable novel research on climate change in peatlands.

The animal ecologists at IWWR will strengthen their cooperation with Natuurplaza in conservation biology. Both applied science as well as more fundamental processes will be involved in several studies that will be undertaken together with the NGO.
The aim of the Institute for Molecules and Materials (IMM) is to conduct research and train undergraduate and graduate students in functional molecular structures and materials. There is an emphasis on understanding and controlling complexity in order to design new functionality based on these structures and materials.

In physics, chemistry and chemical biology 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 directions.

On the one hand, achieving an advanced understanding of complexity involves the study of the smallest building blocks and using them incrementally to build larger and larger systems. In this way the structure and functions of atomic nuclei, atoms, and molecules have been investigated and analysed. Combined experimental and theoretical work has extended our knowledge of the behaviour of these systems.

On the other hand, continuous efforts are undertaken to study macroscopic systems with well-known properties or to analyse the constituents of a large system that by itself have been investigated extensively. Examples include many-body problems in physics and in the life sciences that are tackled in experiments that will improve our understanding of systems on a cellular and sub-cellular scale.

The major challenge for the IMM is to understand complexity and functionality in the areas where these directions meet, i.e. the fields of Nanoscience and Chemical Biology. This interdisciplinary field, at the interface between chemistry and physics, is advanced by 19 research groups organized along three main research methodologies: 1) Synthesis and growth, 2) Spectroscopy and characterization, and 3) Theory and simulation. The main objectives of the institute are expressed in three fundamental research questions:

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

• How does the process of self-organization of complex systems work?
  An advanced understanding of self-organization in complex molecules and nano-sized materials bridges the domain of relatively well-understood atoms and small molecules and more complex macromolecular and supramolecular structures.
Research facilities

The national and international position of the IMM is enhanced by the availability of a number of large-scale experimental research facilities, including:

• A High Field Magnet Laboratory (HFML) for continuous fields up to 33 Tesla, and with funding to achieve 38 Tesla in 2012 and 45 Tesla in 2014.

• A Large-Scale Facility for high-resolution liquid NMR (Nuclear Magnetic Resonance) and a Solid-State NMR Facility for advanced material science, including an 850 MHz proton NMR instrument.

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

The answers to many unsolved problems in cellular and subcellular systems lie in the behaviour and interplay of individual biomolecules and biomacromolecules. Research focuses on unravelling the fundamental properties of biomolecules in complex environments.

• A Scanning Probe laboratory (NanoLab) with a broad range of Scanning Tunnelling Microscopy (STM) and Atomic Force Microscopy (AFM) techniques.

• A Trace Gas Facility for the application of laser diagnostics in biology and medicine.

• A Free Electron Lasers for Infrared Experiments (FELIX) facility. The terahertz laser (FLARE) is under construction and the infrared lasers (FELIX/FELICE) from FOM Institute Rijnhuizen will move to Nijmegen in 2012.

On 26 September 2011 the FLARE laser produced its first terahertz pulses at a wavelength of 700 micron. The first experiments are planned for 2012. Other special facilities include:

• A Solar Cell Research Facility for the application of dedicated processing and analysis equipment in solar cell research, including a clean room and an outdoor calibration facility.

• A computational facility for electron structure calculations of materials, to help design new materials and structures based on first principle quantum mechanical calculations.

• A Thin Film Growth Laboratory, in which materials and thin films can be grown with atomic precision.
Collaboration
There are a large number of collaborations between the IMM research groups and research groups at other universities and institutions worldwide. At the university level, external collaboration takes place within the International Research Universities Network (IRUN). The aim of IRUN is to further improve the quality of research and teaching at the universities involved. Within the network, the exchange of researchers, lecturers, and students is encouraged and facilitated.

Existing collaborations of the IMM with other universities include the Katholieke Universiteit Leuven in Belgium on single molecule spectroscopy. This collaboration involves the exchange of PhD students and post docs as well as the use of the special laser equipment at the two locations. Several of the organic chemistry groups at IMM collaborate with the University of Barcelona.

Within the field of graphene research, the groups at the IMM led by Profs. Katsnelson and Maan collaborate closely with Profs. Geim and Novoselov of the University of Manchester. There are also strong links between the IMM and the Fritz Haber Institute of the Max Planck Society in Berlin (Prof. G.J.M. Meijer). Prof. Katsnelson works closely with scientists at the University of Uppsala.

On 7 July 2011 an agreement between the Radboud University Nijmegen (RU) and the Foundation for Fundamental Research on Matter (FOM) on the relocation and the 10-year exploitation of the free electron lasers ‘FELIX and FELICE’ was signed officially. These lasers are complimentary to the FLARE laser being constructed at NCAS (Nijmegen Centre for Advanced Spectroscopy) in the framework of the NWO-BIG grant programme for large-scale research facilities, and the combination of these free electron lasers with the high field magnet laboratory (HFML) offers great opportunities for unique research.

On 23 August 2011 the partnership agreement between RU and FOM to jointly run the HFML and to promote materials research with high magnetic fields was signed by the RU president and the FOM director. This agreement strengthens the cooperation between RU and FOM on the operation of the HFML as a national and international research facility. The HFML is committed to generating the highest available continuous magnetic fields, making them available to external qualified users, and performing its own research program. The partners aim to tripling the exploitation of the HFML during the coming years.

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The EU-FP7 project on the European Magnet Field Laboratory (EMFL) investigates all legal, financial, organisational, and employment issues required for a Founding Agreement for the EMFL signed by the three partners (Radboud University Nijmegen, Helmholtz Zentrum Dresden-Rossendorf (HZDR), and le Centre National de la Recherche...
Scientifique (CNRS) in Grenoble/Toulouse), plus any other stakeholders that may be identified. The EMFL kick-off meeting was held at the Radboud University Nijmegen on the 1st of March 2011 and was attended by about 50 participants.

**Awards and grants**

In October 2011 a prestigious ERC Advanced grant of €1.6 million was awarded to Prof. Nolte for a research project on the development of ‘molecular machinery’ which can constantly produce reactions on a long molecule. A Netherlands Organisation for Scientific Research (NWO) Vici grant was awarded to Prof. Huck for using picoliter droplets to mimic the chemical environment within cells and to Prof. Van Hest for studying hybrid polymer systems. Profs. Rasing and Katsnelson obtained a FOM Grant in 2011 for a project on non-equilibrium magnetism on the time scale of exchange and spin-orbit interactions. Dr. Christianen and Dr. Engelkamp (in the group led by Prof. Maan) received an ECHO grant from NWO and Prof. de Groot received an ECHO grant together with Prof. Palstra (RUG). In the framework of TA-COAST program (NWO, Ministry of EL&I, and private partners), project proposals from Prof. Buydens, Dr. Harren, and Prof. Kentgens were granted for a total of €1.8 million.

In 2011 NWO has granted 19 research schools in the Netherlands with 800 k€ each to educate young talented researchers. The Graduate School for Molecules and Materials (GSMM) proposed by the IMM is one of these schools. The grant is part of the Graduate Program of NWO that aims to promote the development of PhD schools in the Netherlands. The GSMM provides an attractive and challenging environment for talented young researchers. The students will develop a broader view on Nanoscience and Chemical Biology, and they will have more freedom than usual to shape their PhD projects. The Graduate School allows IMM to keep and attract talented master students for PhD projects.

**Research results**

Research highlights are presented below under the three main themes of the institute.

**Electron-correlated systems**

Profs. Katsnelson and Basolino and colleagues have studied the melting of graphene by Monte Carlo simulations. As the simplest two-dimensional (2D) membrane, graphene is a natural benchmark for the understanding of physics in 2D. The melting temperature estimated from these simulations is 4600 deg. Celsius, the highest melting temperature for any known material at zero pressure.

Researchers from the High Field Magnet Laboratory headed by Prof. Maan have demonstrated the formation of molecular assemblies of a specific chirality from achiral porphyrins through the application of a proper combination of rotational and magnetic levitation forces. Chiral molecules can occur in two forms that are distinct from each other, solely by being their mirror images. For reasons that remain unknown, life is homochiral. This work represents the first example of enantioselection by a falsely chiral influence. *(Nature Chemistry).*

The continuing demand for increasing the speed of information storage and manipulation has triggered an intense search for ultra-fast ways to manipulate spins in a magnetic medium. Prof. Rasing and his colleagues have recently discovered a magnetization switching mechanism that might boost the magnetic recording rates of magnetic bits to unprecedented speeds in the terahertz range. These new results demonstrate that the speed of magnetic recording and information processing devices might be improved by two to three orders of magnitude. *(Nature)*

In the NanoLab headed by Prof. Speller, self-assembled monolayers of metal porphyrins on a solid/liquid interface have been studied using Scanning Tunnelling Microscopy (STM). The STM measurements revealed that there was hardly any reorganization of the low-density monolayers.

Prof. Kentgens and his group have revealed the helical backbone structure of polyisocyanodipeptides with solid-state NMR. The backbone conformation of polyisocyanides has been a subject of discussion for several decades despite multiple theoretical and experimental efforts. With solid-state NMR, the relative orientation of different chemical moieties was inferred by determining the relative orientation of anisotropic nuclear interactions. *(J. Am. Chem. Soc.)*

**Self-organizing systems**

Water has a strong effect on the reactivity of dissolved hydrophobic organic molecules, e.g. via so-called ‘on water’ reactions. Prof. Huck and his group have investigated ‘on water’ conditions using a biphasic microfluidic platform. In this way ‘on water’ conditions were generated with precisely defined oil-water interfaces, allowing for systematic probing of the influence of the water surface on the chemical reactions.

The Applied Materials Science group of Dr. Hageman and Prof. Vlieg has achieved epitaxial growth of GaN (gallium nitride) on a (001) diamond surface. Two preferential growth orientations of GaN layers on the diamond surface caused by the incompatible four-fold symmetry of the substrate and the hexagonal symmetry of the GaN contact face have been revealed. The possibility of growing single crystalline GaN layers on diamond substrates holds great promise for the development of high-power GaN-based devices such as semiconductors.

Prof. Vlieg and colleagues have grown insulin and lysozyme crystals under conditions resembling those in space microgravity experiments using their innovative ‘Ceiling Crystallization Method’. The ceiling
Institute for Molecules and Materials

Key publications


crystals grow to large sizes with perfect edges and diffracted microfocus X-rays beyond current world records. Application of the ceiling method to membrane proteins that are the most difficult crystallizing macromolecules will be pursued in the near future.

Prof. Nolte and colleagues have investigated catalytic reactions in the confined space of a virus capsid. A characteristic feature of the living cell is its crowded environment and this causes a coupling of chemical reactions in space and time. The experimental results show that the confinement in a capsid makes the enzyme molecules more efficient with regard to the reactions they have to catalyse.

Dr. Harren and co-workers (in the group led by Prof. Parker) have developed a sensor for detecting nitric oxide in exhaled air using quantum laser technology. This new technique opens the way for non-invasive monitoring of inflammation of the respiratory system.

The study of molecular gels has recently become an area of great interest in the fields of supramolecular chemistry and material science. The group led by Prof. Rowan reports extremely rare two-component-based super-hydrogelation of perylene derivatives with melamine. Upon excitation these gels exhibit an exceptionally high fluorescence emission, which is normally fully quenched in water.

The group led by Dr. Groenenboom has performed an extensive theoretical study on the imidogen radical (NH), one of the most attractive candidates for cold-molecule experiments. The study shows that the collisional properties of magnetically trapped molecules differ significantly from those of atoms, thus encouraging the development of novel experiments under an ultra-cold regime.

Biomolecular systems

The group led by Prof. Van Hest has found a way to control the shape transformation of polymeric vesicles. There is a wide interest among scientists in employing polymeric vesicles as nanocarriers for medical purposes (drug delivery). It is expected that this ‘controlled shape transformation’ will be found suitable for discovering the relation between the shape of the nanocapsules and the degree of cell-uptake. (Angewandte Chemie)

Prof. Pruijn and his group have visualized the cross-linking activity of transglutaminase, an enzyme which catalyses the cross-linking of (poly)peptides to proteins, using click chemistry. This click chemistry-based method represents an attractive complementary method for the detection of transglutaminase activity and may help to shed more light on the role of this enzyme in different biochemical and/or pathological processes.

Prof. Rutjes and Dr. Van Delft and their group have developed an organophosphorus catalyst, using biomass instead of materials from crude oil, for improving biomass chemistry. The atomic composition of biomass is very different from that of crude oil,
and for this reason more waste products are normally formed (phosphine oxides) during reactions. The new catalyst minimizes these concomitant problems of biomass chemistry, making it cheaper and environmentally more benign.

The group led by Prof. Buydens is collaborating with 35 different research groups in Nijmegen in the framework of the Centre for Systems Biology and Bioenergetics. These groups are working together to model mitochondrial energy production, distribution and expenditure in the context of human disease. The Buydens group is providing the means and methods to analyse the large amount of obtained biochemical and live-cell microscopy data using chemometrics.

Prof. Wijmenga and his group have employed Neutron magnetic resonance spectroscopy (NMR) as a robust and reliable technique for the analysis of complex (biological) mixtures. A new method for quantitative ‘pure shift proton NMR’ at low concentrations was developed by this group. This method should provide a new way for pure shift fingerprints of compounds to be used to identify and quantify the compounds/metabolites present in complex (biological) mixtures.

**Societal impact**

The valorisation of knowledge through university research and the societal impact of science are becoming increasingly important as indicators of scientific success. There are formal cooperative arrangements with major companies in the Netherlands, including DSM, Philips, NXP, MSD, Solvay, Unilever and AkzoNobel. In addition, the research infrastructure of the IMM has resulted in business relations with medium-sized technology-oriented enterprises in the Nijmegen area.

The IMM has been actively involved in bridging the innovation gap, as is demonstrated by the many spin-off companies, such as Chiralix, Encapson, FutureChemistry, Mercachem, ModiQuest, Noviotech, ReRa Systems, SensorSense, Sphere Fluidics, Spinnovation, SynAffix, Syntarga, Synthon, TeraOptronics, and Tf2 Devices that have been successfully established in the past decade. Together they have generated some 800 jobs in the region and many IMM graduates now find their first employment there.

In 2011 the Dutch technology foundation (STW) awarded three Valorisation Grants to IMM spin-offs: TeraOptronics, SynAffix and Noviotech. With these grants, researchers can take a step forward in their newly founded businesses. The aim of a Valorisation Grant is to develop innovative high-tech entrepreneurship based on knowledge developed within the university.

Dr. Harren (in the group led by Prof. Parker) has obtained a STW grant for the development of a sensitive mid-infrared Fourier Transform Spectrometer (FTS) for chemical analyses. A new generation of FTSs will be developed for real-time, reliable spectral analysis of complex chemicals mixtures. In collaboration with industrial partners, the analyser will be deployed in a wide range of potential applications, such as real-time industrial process control, environmental and workplace monitoring, biological and medical diagnostics, and security applications.

A ‘Life Sciences Pre-Seed Grant’ of 250 k€ from the Netherlands Genomics Initiative has been awarded to Profs. Rutjes and Schalkwijk (RUNMC). Pre-Seed grants are intended to facilitate business opportunities for start-ups, in order to exploit ideas and technologies from fundamental research. The grant is used to further develop a new class of antibiotics invented by the participants.

On 13 October 2011 the first ‘Centre of Excellence’ for Organic Chemistry in the Netherlands was launched, together with the official opening of the Innovation Lab in Nijmegen. Both are the result of a longstanding cooperation between the Technical University Eindhoven and Radboud University Nijmegen. The Centre of Excellence focuses on research, education, and innovation. The Innovation Lab hosts a number of highly innovative spin-off companies.

**Future research**

A continuing challenge is provided by the €25 million grant from the national investment in large infrastructures (NWO-BIG) in 2006 for the Nijmegen Centre for Advanced Spectroscopy (NCAS). This grant enables IMM to construct a new 45 Tesla hybrid magnet for the HFML and a Free Electron Laser for research using Terahertz radiation (FLARE). FLARE 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. The new hybrid magnet will provide new research opportunities based on the latest magnet technology. FLARE will also be used for experiments in the high magnetic fields and thus create experimental conditions that are unique worldwide.

In 2011 two agreements between RU and FOM were signed: one on the relocation of the free electron lasers FELIX/FELICE to Nijmegen and another one on the joint running of the HFML. In 2012 the move of the free electron lasers and associated staff to Nijmegen will be prepared. Combining FELIX, FELICE and FLARE in a single free electron laser user facility will create great opportunities for physics, chemistry and the life sciences. With regard to the HFML, the partners are determined to obtain the funding for tripling the operational hours of the facility to 3,000 per year in the near future. RU and FOM have already made an additional €31.5 million available for the next decade.
Elias Vlieg has been professor in Solid State Chemistry at the Radboud University Nijmegen since 1998. After a post-doc at AT&T Bell Laboratories, he was a group leader at the FOM Institute AMOLF from 1990-1997. With a background in physics, his profile illustrates the combined chemistry and physics approach of the IMM. His research focuses on understanding crystal growth and, as head of the Applied Materials Science group, on the use of thin film deposition for solar cells and electronic devices. He is vice-president of the International Organization for Crystal Growth.

The national Sector Plan for Physics and Chemistry (SNS) was approved in 2010 with a very positive outcome for Radboud University Nijmegen. Two new initiatives were started in Chemical Biology and Advanced Spectroscopy of functional molecules and materials (Nanoscience). The focus on chemical biology puts chemistry back in the forefront of research at the interface between chemistry and biology. The focus in IMM physics is to strengthen research capacities using the HFML and the FELIX lasers for the study of low-dimensional systems and strongly correlated systems. These new initiatives will undoubtedly produce their first scientific results within a few years.
The Institute for Mathematics, Astrophysics and Particle Physics (IMAPP) conducts fundamental research in mathematics, high-energy physics and high-energy astrophysics, with a special focus 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 department focuses on three interdisciplinary themes, which have well-established links with computer science and physics: Mathematical Physics, Algebra & Logic, and Applied Stochastics. The traditional areas – algebra, logic, analysis, geometry and stochastics – are studied in the context of these themes.

Astrophysics
Researchers in this department focus on observational and theoretical research in two areas of 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.

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 attainable. This includes both accelerator-based and cosmic ray experiments and the theoretical foundations of elementary particle interactions. There is a particular focus on electro-weak symmetry breaking and the Higgs boson as an attempt to gain more insight into the structure of vacuum.

On July 1 IMAPP organized its second IMAPP-symposium “The Arrow of Time” with outstanding speakers Jean Bricmont (Louvain-la-Neuve), Mikhail Katsnelson (RU), Robert Kirshner (Harvard), John Morgan (Simons Center) and Jim Virdee (Imperial College). The speakers gave excellent lectures on recent developments in areas at the heart of IMAPP’s research programme.
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 (Large Hadron Collider [LHC] and Tevatron). The LHC is producing exciting new results. The Institute itself houses two optical telescopes and a radio interferometer, which are used for educational activities – and to encourage public participation. 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, and Algebra & Number Theory), GQT (Geometry and Quantum Theory) and STAR (Stochastics - Theoretical and Applied Research). Mathematical physicists at the IMAPP make a major 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). Astronomical research is carried out within the framework of the top research school NOVA and in association with ASTRON, SRON and ESA. The Nijmegen group co-leads the EGAPS survey, is the expertise centre for cosmic ray detection with LOFAR, and is a member of the LOPES consortium. IMAPP particle physicists and astronomers are joint members of the Pierre Auger Observatory Collaboration in Argentina.

Collaboration with the Institute for Astronomy of the K.U.Leuven was intensified by mutual part-time appointments of Prof. Aerts at RU and Prof. Nelemans at K.U. Leuven.
All researchers at the Institute are members of one of the following Dutch national research schools: Wonder, which is a merger of the former research schools in mathematics MRI, Thomas Stieltjes and EIDMA, OSAF (elementary particles), LOTN (theoretical physics) and NOVA (astronomy) – all accredited by the Royal Netherlands Academy of Arts and Sciences.

Awards and acknowledgements
- Prof. Falcke won the NWO Spinoza prize
- Ms Toonen, MSc, received the Radboud University Frye stipend
- Dr Glebbeek received a Veni grant
- Dr Terwijn was awarded the DIAMANT project ‘Logic and probability’
- Prof. Aerts was elected as a Member of the Royal Flemish Academy of Belgium
- Prof. de Groot received a grant from the Erasmus Life Long Learning Programme for the BND summer school of the Graduate School for Subatomic Physics

Research results
In 2006 the cluster Geometry and Quantum Theory was established as a collaborative venture for mathematicians from Amsterdam, Utrecht and Nijmegen, with a leading role for the latter. The GQT cluster was rated as excellent by an international committee in 2011, and was subsequently extended for two years. The focus is on non-commutative geometry, quantum theory, category theory, representation theory of Lie and quantum groups and Hecke algebras. The research connects with various other groups inside and outside IMAPP. The research in quantum logic and topos theory connects with Algebra & Logic and with computer science. Landsman and co-workers computed the Gelfand spectrum of the so-called ‘Bohrification’ of an arbitrary unital C*-algebra, proving that the latter is spatial. This research line increasingly attracts international attention.

The research in non-commutative geometry has applications to the Higgs mechanism and mass, and links to theoretical high-energy physics. Dr Van Suijlekom’s work focuses on non-commutative geometry in connection with high-energy physics and quantum field theory. The appointment of Dr Solleveld strengthens the research line in representation theory, particularly the theory of Hecke algebras and p-adic groups.

The Department of Algebra & Logic has been greatly strengthened by the appointment of Prof. Moerdijk as Professor of Algebra and Topology. His arrival initiated the Category Theory Seminar, which brings together researchers from Algebra & Logic and Mathematical Physics as well as researchers in computer science. Prof. Moerdijk, together with Prof. Cisinski, has continued to develop his theory of dendroidal sets, an extension of the theory of simplicial sets which forms a convenient framework for studying topological operads and their ‘up-to-homotopy version’. Dr van den Essen and coworkers have managed to prove the Image Conjecture in positive characteristic as well as several sub-cases of the Image Conjecture in characteristic zero. Dr Souvignier has continued his research on group representations and applications in crystallography.

In the Applied Stochastics group, work has been done on large deviations for random walks and dynamical systems, on quantum correlations and locality, and on statistics related to environmental toxicology. A large deviation formalism for the trajectory of the empirical measure was further developed in the context of inter-
The group from IMAPP focuses on the search for the Higgs boson. In one, the so-called WW channel, IMAPP researchers have played a leading role and in another, the ZZ channel they have made important contributions. On the search for new phenomena, the limits for supersymmetric particles have been extended: a large mass range is now excluded. IMAPP scientists have contributed to the channel with one lepton and missing energy which has provided some of the most stringent limits. The publication on this subject was one of the most frequently cited ATLAS papers in 2011.

The DØ experiment saw the completion of the Tevatron programme in 2011, after 26 years of operation and after recording well over 10 fb⁻¹ of data. IMAPP has ramped down its efforts on DØ and is focusing on the search for the Higgs boson in the low mass range. Among the other physics highlights was the observation of an anomalous like-sign charge asymmetry in the di-muon sample, which could be an indication of anomalous CP violation in the B system.

In the Pierre Auger Observatory, José Coppens completed the first PhD on this experiment in the IMAPP group. The first self-triggered detections of radio signals from cosmic rays could be seen. The AERA set-up of 20 stations is operational and has shown correlations with events recorded by surface detectors. The quantitative understanding of the radio signal from airshowers has been much improved and researchers have been able to extract the shower shape parameters from the radio signal. IMAPP thus continues to be one of the leading institutes in the radio effort of Auger. Work on other analyses is noted, with some interesting hints from the shower shape dependence of the anisotropies.

The activities of the theoretical high-energy physics group focused predominantly on particle phenomena. One of the main goals of the LHC is the search for supersymmetric particles. An accurate calculation of the corresponding production cross-section requires the use of a threshold-resummation approach. An appropriate computer code was released that allows accurate predictions, stable to perturbation, for processes like squark-antiquark production. An investigation was begun to find how the polarization of top quarks produced at the LHC can be used to reveal effects from physics beyond the Minimal Standard Model. In the coming years the in-house developed WW-fusion code CAMORRA-CAMGEN will enable a detailed study of possible unitarity-threatening processes at the LHC.

On a more theoretical side, the way loop-integral reduction techniques can be extended from the one-loop to the two-loop Feynman integrals was investigated. In search of a single all-encompassing theory for general relativity and the Standard Model, a possible new candidate, related to non-commutative geometry, was studied in collaboration with the mathematical physics group. Progress was made in generalizing this idea to the supersymmetric Standard Model.
Key publications


Dissertations: 6
Scientific publications: 278

Societal impact

The Institute’s research is related to fundamental questions about the universe and the building blocks of nature. Many results will only produce their full impact in future decades, but they could 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 having influence at the highest political level in matters concerning mathematics and physics syllabuses in secondary education. This is also reflected by the fact that Sijbrand de Jong is the first director of the Radboud Pre-University College of Science. Four members of staff teach in the prestigious honours programme at the University. The Nijmegen Annual Mathematics Tournament and the national Kangarooe mathematics competition, both organized by IMAPP, have significantly improved the popularity and visibility of mathematics among school children.
Director: Prof. Erik Koelink

Erik Koelink has been a full professor of Analysis at Radboud University Nijmegen since 2007. He graduated from Leiden University and has worked at the National Aerospace Laboratory Amsterdam, Catholic University Leuven, University of Amsterdam, and Delft University of Technology. His research focuses on the interaction between the representation theory of Lie algebras and quantum groups on the one hand and special functions on the other, with applications in mathematical physics. He is Chairman of the Board for the Dutch national Masters programme in mathematics.

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The Institute initiated the HiSPARC project, which involves placing air-shower array telescopes on high-school roofs www.hisparc.nl. The Department of Astrophysics organizes monthly observation nights, and has organized the national Astronomy Olympiad.

Future research

With the addition of four high-profile faculty members who have been attracted from the astronomy department in Utrecht, the astrophysics department will undoubtedly broaden and deepen its research, particularly in theoretical and computational astrophysics. It will also intensify its links with the national Space Research Institute (SRON), and NIKHEF in the area of astroparticle physics. New projects will concentrate on short time-scale variability to explore unknown parts of the universe, and the Astrophysics and Particle Physics departments will continue their expansion of the radio detectors in the Pierre Auger Observatory.

In elementary particle physics, an important topic is the structure of the vacuum and the associated Higgs mechanism. The Tevatron collider has provided a unique opportunity to get some first hints of the Higgs boson, with the shutdown of DØ the LHC will take over. In 2012 the LHC will very probably discover the Higgs boson, and either begin to measure its properties, or exclude it over the full mass range. Knowledge of the vacuum has significant implications for our understanding of cosmology. Existing theories are used to develop and implement methods for theoretically calculating measurable observables.

The mathematical physics department will concentrate 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 will have profound implications for the interpretation of quantum physics theories and measurements as well as practical implications for formulating theories.

The research line that combines algebra and logic, with extensions to both mathematical physics and computer science, will be continued. The applied stochastics research will be reoriented in 2012, and will be strengthened in the overlapping area between probability, statistics, physics and applications to e.g. neuroscience, fostering further cooperation with the Donders Centre for Neuroscience. The research of IMAPP will be invigorated by the staff increase due to the Joliot-Curie Fellowship of Dr Haverkorn and the appointment of Dr Caron in the framework of the Sector Plan Physics and Chemistry (SNS). Within this SNS framework, the appointment of a professor in Theoretical High-Energy Physics will further enhance the coherence and the joint research programmes of theoretical physics and mathematics.
Computer systems 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 (such as the OV chip card), television sets, multimedia devices, mobile phones, cars and washing machines, for example. 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, architectures and system alignment. Work at the Institute is inspired by problems encountered in society and in other disciplines. Research within iCIS is organized within three themes:

**Model Based System Development (MBSD)**
The approach used is 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 other application areas.

**Digital Security (DS)**
Researchers develop theories and formal methods, which they use 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. developing notions and protocols for managing and protecting digital identity.

**Intelligent Systems (IS)**
The aim here is to develop and apply intelligent systems that are able to learn knowledge and reason with it, with as a long-term research goal the alignment between computer-based intelligent systems and their users, answering questions such as how to optimally combine knowledge from human experts with 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 an essential part of the work done at iCIS, because developments in computing take place around the globe. Partners include the Dutch Ministry of Internal Affairs for a project on business process reengineering (BPR), ST Microelectronics, Brussels, Belgium (PINPAS), University of Grenoble Joseph Fourier, France (Tarot), RWTHA, Aachen, Germany (Quasimodo, Mobius), Makerere University Kampala, Uganda (NUFFIC), INRIA Microsoft Research Lab Paris, France (Mobius, EU FET), TNO Telecom, Delft, the Netherlands (PEARL), Aalborg University, Denmark (Quasimodo, Artist2) and Océ Technologies, Venlo, the Netherlands (Octopus), the Dutch Foundation for Internet Domain Registration (SIDN), TNO and TILT (University of Tilburg).
Research results

In a collaborative venture between Intelligent Systems and the group led by Ole Jensen at the Donders Centre for Cognitive Neuroimaging, research on brain-computer interfaces (based on covert attention) was carried out. It was shown that, by measuring alpha activity in the posterior visual cortex, one can reliably predict the angle of attention and its eccentricity. On the more theoretical side, novel algorithms were developed to support causal discovery from observational data. In causal discovery, the aim is to learn about the structure of causal processes ("smoking causes cancer") by correlating smoking with the incidence of cancer. As it’s based on standard logic, the algorithm used by ICIS researchers is more intuitive than existing approaches and does not require the pre-computation of network structure, making it less prone to errors.

In collaboration with the group led by Mike Jetten at the Microbiology Department, a new tool for analyzing metagenomics data was developed, providing further insights into the mechanisms used by the anammox bacteria. The results – and the software used – have been made publicly available. The MathWiki project has resulted in new web technology for presenting formal mathematics via the web. The work done in this project was presented at CICM and in the MathWiki workshop at ITP. One of the main results is the integration of the Isabelle proof assistant in wiki technology and the integration of the Automated Theorem Proving for Mizar into the MathWiki. In terms of formalizations, the Coq formalization of exact real arithmetic was completed using type classes. This research is part of the ForMath project, an EU STREP-FET project coordinated by Gothenburg. A Netherlands Organisation for Scientific Research (NWO) project on formalizing the semantics of the C99 standard was also started and a first position paper on it has been published. Dependently typed programming was successfully further developed by ICIS researchers in cooperation with other functional programmers from outside ICIS.

On November 17, 2011 the establishment of the Privacy & Identity Lab (Pi Lab), a new Dutch expertise centre, was announced. This lab is placed in the Digital Security Group and is a collaborative venture between the Netherlands Organisation for Applied Natural Science Research (TNO), Tilburg University and the Dutch Foundation for Internet Domain Registration (SIDN) with Radboud University Nijmegen. The aim is to find better solutions for protecting online privacy and electronic identities. Uniquely, this joint initiative will integrate the technical, legal and socio-economic aspects of privacy and identity.
Key publications


Much of the research in the Digital Security group focuses on smart cards. In the banking world, a first formally verified specification of the leading international standard for electronic payments with bankcards, known as EMV, or in Dutch as ‘het nieuwe pinnen’, was presented at the Theory of Security and Applications conference (TOSCA) in 2011. Also, another widely-used smart card – the HID iClass, which is one of the most popular contactless smartcards in the market – turns out to be insecure. Differential Power Analysis (DPA) is commonly used to (indirectly) obtain information about the secret key used in cryptographic devices. In 2011, ICIS researchers have shown (together with researchers from KU Leuven) that the secret authentication keys used by a CryptoMemory device can be extracted using basic power analysis techniques. This type of card is used by millions of users for vendor-specific electronic payments. In the field of software correctness new insight was gained into classic synchronization problems such as the reader-writer problem. Design errors were found using model checking and a re-entrant formal solution was developed. In the area of quantum computing a new duality result was obtained, which forms the basis for a quantum weakest precondition calculus. Together with researchers from Microsoft, Dr Klaus Kursawe developed a new privacy-friendly protocol for smart electricity metering. This protocol is now being implemented and tested on thousands of meters.

In the section Model-Based System Development, Prof. Frits Vaandrager and Dr Jan Tretmans received an STW grant for the Integrating Testing and Learning of Interface Automata project (ITALIA). This project was set up in order to investigate the design of algorithms, that allow computers to learn complex state diagrams by providing input and observing output. Research was also done on the problem of checking whether a continuous-time Markov chain satisfies a formula in continuous-time stochastic logic (CSL) and an effective approximation algorithm was proposed. A new
A method for combining uncertain knowledge in probabilistic logics based on convolution in probability theory was developed. This method also sheds new light on existing ways to combine uncertainty in probabilistic logics. What’s more, research on intelligent Smartphone-based decision support for patients with chronic diseases, in particular those with COPD and hypertension in pregnancy continued in collaboration with the Radboud University Nijmegen Medical Centre. Another health-care problem that inspires research is comorbidity: the simultaneous occurrence of disorders, mostly in elderly patients. Researchers have developed a new Bayesian-network framework to model multi-level data in order to tackle this problem. In collaboration with the Dutch Navy and the Dutch Coastguard the applicability of the iTask system for defining workflows for crisis management situations was investigated. This has led to a new style of functional programming, called Task Oriented Programming (TOP), with which distributed reactive web-based applications can be defined.

**Societal impact**

The Institute’s impact is evident in various projects designed to improve the quality of software, for instance in the medical domain (decision-support systems for breast cancer screening, system development for electronic monitoring of pregnant women with a high risk of toxaemia, testing ‘mindfulness’) and model checking, together with Océ and ASML. In the HeartClip project, a new fitting paradigm was developed for personalizing hearing aids to the characteristics and preferences of individual subjects. Computer security and privacy are increasingly important issues in a modern information society. The Digital Security group not only addresses these concerns through its research, but also plays an active role in public debate. The group’s expertise in this area is actively sought, especially by various branches of the Dutch government. For instance, Prof. Bart Jacobs was invited to join the National Cyber Security Council, which visited Washington, USA in November 2011. The group which established the PI Lab will advise business and government in making practical use of expertise in privacy & identity in cyberspace. Members of the Digital Security group are also actively involved in issues such as privacy-friendly public transport cards, electronic road pricing, and smart electricity meters and identity cards. Bayesian techniques developed at ICIS are being used to combine data with background knowledge, for instance to localize sources of activity in the brain and to improve the performance of brain-computer interfacing. The institute continued to run CodeYard, an innovative project set up to interest and involve high school students in the Netherlands and Belgium in computer science. The ICIS ‘Web Deduction’ system (www.prover.cs.ru.nl) is used to teach logic in a number of courses at several universities.

**Future research**

Within the section Model-Based System Development research in the ITALIA project will continue. The PI Lab will be officially opened in the spring of 2012. Research will also continue on other projects, including the European FP7 project Quasimodo, the European research project CHARTER, STITPRO (on monitoring pregnant women), the Vici project coordinated by Prof. Heskes, and research on identity-centric security. New collaborative ventures, including those with the Dutch brain bank and within the EU project TACTICS, will be formed. In these projects, ICIS researchers will develop and apply machine learning algorithms to gain insight into the causes underlying brain diseases such as Alzheimer’s disease and obsessive compulsive disorders.
The Institute consists of three departments: Philosophy and Science Studies, Sustainable Management of Resources (DSMR) and Innovation Studies. Researchers in these departments address the following themes: 1) New visions of nature, 2) Societal aspects of emerging life sciences, 3) Sustainability and 4) Managing Innovation.

Department of Philosophy and Science Studies
The focus of research is on philosophical issues involved in developing ‘new nature’, on societal aspects of emerging life sciences and on the communication of science. In 2004 the Centre for Society & Genomics (CSG) was established, 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 key people involved. Its basic aim is to analyse, assess and advance the relation of genomics to the needs of society, aligning scientific with policy and raising the quality of societal debate. The research addresses three main themes: 1) governance of genomics applications, 2) transforming agendas for knowledge production and 3) communication and education. Collaboration with all 15 Genomics Centres funded by the NGI is a core element of the programme. In 2011 the name was changed to Centre for Society and the Life Sciences, to reflect the Centre’s broadened scope, notably at the international level.

Department for Sustainable Management of Resources (DSMR)
An important focus is sustainable water management. Research addresses a 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 in water management has been on the technological mastery of river systems. Today, a more eco-centric approach is emerging. This ecological approach calls for sustainable planning of river basins, involving economic, ecological, societal and spatial planning. Research is carried out on a regional, national and international scale.

Department of Innovation Studies
Researchers in the MICORD (Managing Innovation Collaboration and Outsourcing Research and Development) research programme focus on problems of innovation and collaboration in three sectors of economic importance: food, chemicals and equipment manu-
facturing. Research is conducted in close cooperation with the Centre for Innovation Studies (CIS) of Nijmegen School of Management.

Collaboration
Within Radboud University Nijmegen: Institute for Molecules and Materials (IMM) on biomaterials, Institute for Water and Wetland Research (IWWR) on exotic species, Nijmegen Centre for Molecular Life Sciences (NCMLS) on science education and Centre for Innovation Studies (CIS) on knowledge transfer. ‘Waalweelde’ and ‘Freude am Fluss’ are projects in which various regional partners participate. CSG is a national research centre, the core of which is located at ISIS. The current programme (CSG Next) involves collaboration with six other universities and 16 research centres of the NGI network, but also with societal organizations and companies such as Unilever and DSM.

International collaboration
Department of Philosophy / CSG
CSG collaborates with international partners, notably the ESRC Genomics Network (Lancaster, Cardiff, Exeter and Edinburgh) in the UK. CSG co-edits the online journal Genomics, Society & Policy and is currently consolidating an international network of groups working on research in the ethical, legal and social aspects (ELSA) of genomics to secure future international funding.

DSMR
The FP7-programme BIOMOT involves a collaboration with Universities in Manchester (UK), Leuven (Belgium), Universität Greifswald (UG), ZRC SAZU in Slovenia, CIRPA-La Sapienza (Italy) and Leiden. With the University of Duisburg-Essen (a partner in the IRUN Network) and in collaboration with IWWR, ISIS offers a two-year international Masters programme on Transnational Ecosystem-based Water Management (www.twm-master.com). Together with Chinese, Dutch and German governmental and non-governmental organizations (GOs and NGOs) as well as universities, a knowledge exchange platform has been launched to explore sustainable river basin management (the Healthy Yangtze project). Participants in China are Tsinghua University, the Chinese Academy of Sciences and the National Science Foundation. DSMR is either the 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.

Unveiling of a statue made by Bas van Vlijmen for Dr Marjolein Kriek, who was the first woman to have her entire genome sequenced.
Key publications


Dissertations: 2
Scientific publications: 41
Professional publications: 5

Innovation studies

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

Research results

In the spring of 2011, CSG was subjected to a mid-term review by two committees of international experts. The first committee, chaired by Emmo Meijer, focused on CSG as a Centre for interactive research and communication. CSG was assessed as very good (score: 4). The research was considered to be competitive internationally, making a significant contribution to the field. The second committee, chaired by Douwe Breimer, focused on CSG as part of the genomics research network funded by NGI. This committee concluded that “CSG has been … successful, not only with regard to the number of collaborations with other genomics centres and integration, but also in terms of its results” and that the CSG approach “is a very strong concept that can function as best practice for other research programmes.”

Martin Drenthen and Jozef Keulartz organized the 8th Annual Meeting of the International Society for Environmental Ethics: “Old World and New World Perspectives on Environmental Philosophy”. This conference took place in Berg en Dal near Nijmegen. The ISIS Visions of Nature group published a collective, interdisciplinary volume on the concept of place, aimed at a wider readership, named “Filosofische beschouwingen over plaats: verbondenheid met natuur en landschap”.

In 2011 Prof. Hub Zwart took the lead in establishing an international network of experts in the societal dimensions of the emerging life sciences called LISTEN (Life Sciences, Innovation and Society Network). The goal of this network is to develop international research proposals in response to Calls for Funding proposals and to influence research agendas and future funding opportunities through position papers, conferences and advice. As a first result of the LISTEN initiative, Prof. Zwart acquired funding for an ESF conference series entitled: ‘Towards a sustainable bio-based society: Aligning scientific and societal agendas for Bio-Innovation’, funded by the European Science Foundation.

In September 2011 Prof Wouter de Groot (DSMR) secured a substantial grant from the European FP7 Program with the BIOMOT proposal. BIOMOT is an acronym for “MOtivational strength of ecosystem services and alternative ways to express the value of BIODiversity” and has a budget of €4 million for the coming 4 years. Economic research has shown that biodiversity may have a total economic value running into the trillions of Euros worldwide and hundreds of millions even for ‘minor’ ecosystem services at local levels. Despite this immense value, the European politicians and agencies concerned do not appear to respond swiftly and effectively to prevent further biodiversity
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.

In 2011 the “Delta East” Netherlands Organisation for Scientific Research programme “Urban Regions in the Delta” known as VerDuS) led by Prof Toine Smits and Prof Erwin van der Krabben (Geography, Spatial Planning and Environment Dept.) was awarded grant of €1.2 million for a two-year period. Delta East focuses on sustainable development and use of public transport in the Arnhem-Nijmegen region, and on floodplain management of the Waal river. The idea of addressing these two domains falls under the Framework for Strategic Sustainable Development (FSSD). Apart from the scientific output, “Delta East” will produce two recommendation reports for the Urban Region Arnhem-Nijmegen and the Province of Gelderland to facilitate sustainable development of public transport and floodplain management.

The MICORD programme closed with a conference called InnoTeP (Innovation management in Theory and in Practice).

Societal impact
The innovative, interactive research agendas carried out at ISIS are highly relevant to society and policy-forming. The Centre for Society & Genomics, which hosts the public website www.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 interaction with a variety of stakeholders and developing new tools for interactive research are key features of CSG’s approach. 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. The Department of Innovation Studies also involves partners from industry in developing its research programme.

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 developing a new programme (CSG III), which will involve new themes and new strategic partnerships with research Institutes and industry. In 2012, the DSMR will guide and facilitate the transition process to Sustainability of the Waal between Lobith and Gorinchem in the ‘Waalweelde Duurzaam’ project. In line with the goals of ISIS, these proposals will involve cooperation with a variety of societal partners. ISIS also has a new challenge: to builds its reputation nationally and internationally for academics and students, as well as for public and private partners.
| (c) | Extraordinary chair |
| (o) | Ordinary chair |
| (p) | Personal chair |
| AGIKO | 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 |
| BSI | Behavioural Science Institute |
| CLS | Centre for Language Studies |
| CMIB | Centre for Molecular and Biomolecular Informatics |
| CMR | Centrum voor Migratierecht – Centre for Migration Law |
| CNR | Centrum voor Notariële Recht – Centre for Notarial Law |
| DCC | Donders Centre for Cognition |
| DCCN | Donders Centre for Cognitive Neuroimaging |
| DCN | Donders Centre for Neuroscience |
| DFG | Deutsche Forschungsgemeinschaft – German Research Foundation |
| DFN | Diabetes Fonds Nederland – Dutch Diabetes Research Foundation |
| ERC | European Research Council |
| ESF | European Science Foundation |
| FELICE | Free Electron Laser for IntraCavity Experiments |
| FELIX | Free Electron Laser Infrared Experiments |
| FLARE | Free-electron Laser for Advanced spectroscopy and high Resolution Experiments |
| FOM | Stichting voor Fundamenteel Onderzoek der Materie – Foundation for Fundamental Research on Matter (Netherlands) |
| FP6 ; FP7 | EU Framework Programme 6, respectively 7 |
| FTE | Full-time equivalent for research |
| FTE 1st | Full-time equivalent for research directly funded by government |
| FTE 2nd | Full-time equivalent for research funded by KNAW or NWO |
| FTE 3rd | Full-time equivalent for research funded by other public and/or private organizations |
| HFML | High Field Magnet Laboratory |
| HLCS | Institute for Historical, Literary and Cultural Studies |
| ICIS | Institute for Computing and Information Sciences |
| IGMD | Institute for Genetic and Metabolic Diseases |
| IMAPP | Institute for Mathematics, Astrophysics and Particle Physics |
| IMM | Institute for Molecules and Materials |
| IMR | Institute for Management Research |
| IRUN | International Research Universities Network |
| ISIS | Institute for Science, Innovation & Society |
| IIST | Information Society Technologies |
| ITEA | Information Technology for European Advancement |
| IWWR | Institute for Water and Wetland Research |
| KNAW | Koninklijke Nederlandse Academie van Wetenschappen – Royal Netherlands Academy of Arts and Sciences |
| KWF | Koningin Wilhelmina Fonds – Dutch Cancer Foundation |
| MPI | Max Planck Institute for Psycholinguistics, Nijmegen |
| NCEBP | Nijmegen Centre for Evidence-Based Practice |
| NCMLS | Nijmegen Centre for Molecular Life Sciences |
| NHS | Nederlandse Hartstichting – Netherlands Heart Foundation |
| NISCO | Nijmegen Institute for Social & Cultural Research |
| NROG | Nationaal Regie-Orgaan Genomics - Netherlands Genomics Initiative |
| NWO | Nederlandse Organisatie voor Wetenschappelijk Onderzoek – Netherlands Organisation for Scientific Research |
| N4i | Nijmegen Institute for Infection, Inflammation and Immunity |
| OO&R | Onderzoekscentrum voor Onderneming & Recht – Business and Law Research Centre |
| RST | Research Institute for Religious Studies and Theology |
| Senter | An agency of the Netherlands Ministry of Economic Affairs which is responsible for managing grant allocation in technology, energy, environment, export and international cooperation |
| Spinoza | The most prestigious prize for scientists in the Netherlands who are at the very top of their research profession, awarded by NWO |
| SteR | Onderzoekscentrum voor Staat en Recht – Centre for State and Law |
| STW | Technologiesteding STW – Technology Foundation STW (Netherlands) |
| UMC | Radboud University Nijmegen Medical Centre |
| Veni grant | 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 |
| Vidi grant | 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 |
| Vici grant | Personal grant from NWO awarded over a period of five years to senior researchers who wish to establish their own research group |
| ZonMw | ZorgOnderzoek Nederland NWO Medische Wetenschappen – Netherlands Organisation for Health Research and Development |