

Research Assessment 2019

Donders Institute for
Brain, Cognition and
Behaviour

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Radboud University



Radboudumc

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1. Introduction

1.1 Background

This report presents the assessment of the research conducted at the Donders Institute for Brain, Cognition and Behaviour (DI) in Nijmegen (the Netherlands) in the period 2013-2018. The assessment was performed by an external review committee using the Standard Evaluation Protocol (SEP) 2015-2021. The SEP was drawn up and adopted by the Royal Netherlands Academy of Arts and Sciences (KNAW), the Netherlands Organisation for Scientific Research (NWO), and the Association of Universities in the Netherlands (VSNU). All research conducted at Dutch universities, University Medical Centres, and NWO or KNAW institutes is assessed once every six years in accordance with the SEP. The primary aim of SEP assessments is to evaluate the quality and relevance of academic research and to suggest improvements where necessary. SEP assessments focus on the strategic choices and future prospects of research groups.

Several target groups are served by this assessment:

- The DI scientists and management want to know how the quality of the research, its societal relevance, and its strategy are perceived by independent experts and how these elements may be improved.
- The Board of Radboud University wishes to track the impact of its research policy.
- The Dutch government wants to know the outcomes of assessments in connection with the institution's accountability for expenditure and its own efforts to support an outstanding research system.
- Society and the private sector seek to solve a variety of problems using the knowledge that DI research delivers.

1.2 Members of the evaluation committee

The Executive Board of Radboud University has appointed a nine-member evaluation committee in consultation with the institute. The committee members were selected so that the overall committee profile matched the institute's research and societal domains, as well as the SEP conditions for the composition of evaluation committees.

The members of the assessment committee were:

- Professor Menno Witter, *chair* (Norwegian University of Science and Technology, Norway),
Specialists for Theme 1 (Language and Communication):

- Professor Jeffrey Binder (Medical College of Wisconsin, USA),
- Professor Bernadette Jansma-Schmitt (Maastricht University, the Netherlands),

Specialists for Theme 2 (Perception, Action and Control):

- Professor Matthew Rushworth (University of Oxford, UK),
- Professor Nicole Wenderoth (ETH, Zürich, Switzerland),

Specialists for Theme 3 (Plasticity and Memory):

- Professor Henrik Walter (Charité Universitätsmedizin Berlin, Germany),

- Professor Louise Gallagher (Trinity College, Dublin, Ireland),
Specialists for Theme 4 (Neural Computation and Neurotechnology):
- Professor Karla Miller (University of Oxford, UK),
- Professor Maneesh Sahani (University College London, UK).

Dr Linda van den Berg served as scientific secretary to the assessment committee. Short biographies of the committee members are provided in Appendix 1. The evaluation and recommendations in this report constitute the committee's consensus.

1.3 Procedure

The committee evaluated DI research based on the institute's self-evaluation report and interviews with representatives of the institute during a site visit in October 2019. The committee considered international trends and developments in science and society as it formed its judgement. The self-evaluation report was sent to the committee four weeks prior to the site visit. Among other things, it addressed the mission, strategy (past and future), organization, composition & financing, and targets of the institute and themes, as well as the results achieved in the period 2013-2018 and SWOT analyses.

The site visit programme is listed in Appendix 2. During the site visit, the committee interviewed representatives of the Board of Directors and the Board of Governors, all theme speakers, the coordinator of the Graduate School Donders Institute, societal impact partners from the health domain and the food domain, and several principal investigators (PIs), postdocs and PhD candidates. The discussions with these representatives were open and transparent. The site visit also included a lab tour, where the committee was split in four groups that visited

- PRIME and Functional Genomics Facility, including a video about the Translational Neuroscience Unit,
- Vestibular Chair and Gait Lab,
- Sensorimotorlab and Baby & Child Research Centre,
- MRI Lab, MEG lab, and NIBS Lab.

Assessment of research

The committee made a quantitative and qualitative judgement of the institute and its four research themes based on three assessment criteria:

- **research quality**, i.e., the quality and reputation of the research, the contribution that research makes to the body of scientific knowledge, and the impact of the research results (scientific publications, instruments and infrastructure developed, and other contributions to science),
- **relevance to society**, i.e., quality, impact, and relevance of contributions (advisory reports for policy, contributions to public debates, etc.), targeting specific public or private societal actors,
- **viability**, i.e., the strategy that the institute or theme intends to pursue in the years ahead, the extent to which it can meet its targets in research and society during this period, and the governance and leadership skills of the management.

In addition to the qualitative judgements, the committee assigned scores for each of the assessment criteria. The four possible scores were excellent (=1), very good (=2), good (=3), and unsatisfactory (=4). The scores are explained in more detail in Appendix 4 of this report. The committee is of the opinion that this grading system does not acknowledge the heterogeneity that may exist within the institute and the themes.

Assessment of PhD programme

The committee also considered the supervision and training of PhD candidates at the DI. During the site visit, the committee interviewed several PhD candidates, who were in different stages of the PhD track. In addition, the committee met the coordinator of the Graduate School Donders Institute. The following topics were covered:

- institutional context of the PhD programmes (embeddedness),
- selection and admission procedures,
- programme content and structure,
- supervision and effectiveness of the programme plans and supervision plans,
- quality assurance,
- duration and success rate,
- guidance of PhD candidates to the job market,
- career prospects,
- exit numbers to research, industry, government, or non-profit.

Assessment of facilities, research integrity policy, and diversity policy

The committee evaluated the DI policy regarding research facilities, as well as the state and adequacy of the facilities. The DI asked the committee if the policy regarding the investment and maintenance of research facilities is appropriate to meet the institute's ambitions. In addition, the committee considered the institute's policy on research integrity and the way in which violations of such integrity are prevented. In its judgement, the committee considered how the institute deals with research data, data management and integrity, the transparency of the procedures within the institute, and the extent to which an independent and critical pursuit of science is made possible within the DI. In addition, the committee evaluated the institute's efforts to ensure a diverse staff composition from the junior through the senior scientist level, with regard to topics such as gender, age, and ethnic background.

1.4 The Donders Institute at a glance

The Donders Institute was founded in 2008 to unite scientists who study the brain, cognition, and behaviour at Radboud University (Faculties of Science and Social Sciences), Radboudumc (Medical Faculty), and the Donders Centre for Cognitive Neuroimaging. The institute's mission is to unravel the mechanistic underpinnings of human cognition and behaviour in health and disease. Scientists at the DI perform interdisciplinary research, with the levels of investigation ranging from genetic, molecular, and cellular processes to computational and system-level neuroscience, including cognitive and behavioural analyses in individuals and populations: 'from molecules to minds to population'.

Organization

Since its launch in 2008, research at the DI has focused on four themes:

1. Language and Communication,
2. Perception, Action, and Control,
3. Plasticity and Memory,
4. Neural Computation and Neurotechnology.

More recently, the institute has created five 'Donders Innovation Programmes' to realize its societal ambitions:

1. Health and Healthcare,
2. Food and Cognition,
3. Learning and Education,
4. Neurotechnology and Big Data,
5. Public and Politics.

The research themes and Innovation Programmes are embedded in four collaborating centres:

1. Donders Centre for Cognition (DCC) within the Faculty of Social Sciences,
2. Donders Centre for Cognitive Neuroimaging (DCCN),
3. Donders Centre for Medical Neuroscience (DCMN) within Radboudumc,
4. Donders Centre for Neuroscience (DCN) within the Faculty of Science.

These centres also collaborate with two affiliated institutes, the Max Planck Institute for Psycholinguistics (MPI) and the Centre for Language Studies (CLS). Members of the MPI and the CLS participate in the Donders themes as affiliated scientists. Within the theme structure of the DI, there is an additional horizontal layer of clinical subthemes. These are the five research themes of the DCMN, which were formulated in 2014: Disorders of movement, Sensory disorders, Alzheimer's disease, Neurodevelopmental disorders, and Stress-related disorders. These themes are mainly aligned with the DI themes 2 (Perception, Action and Control) and 3 (Plasticity and Memory).

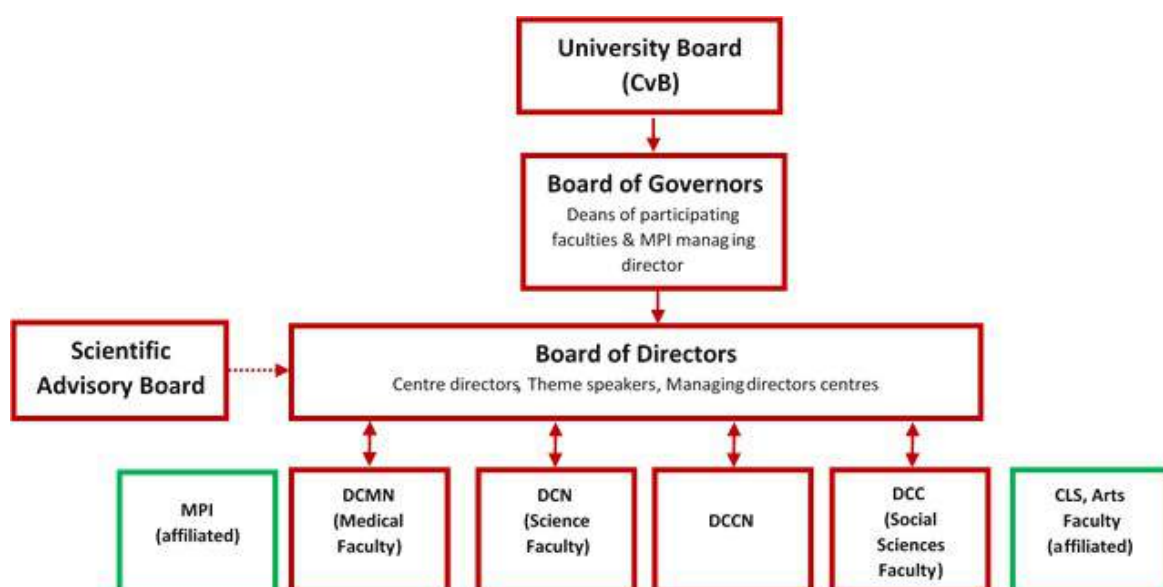


Figure 1: Organogram of the DI management

Management

The organogram in Figure 1 shows the main organizational parties involved in managing the DI:

- **The Board of Directors** leads the institute. It is composed of the scientific directors and management directors of the four centres, the scientific director of the MPI, and four ‘theme speakers’. Professor Harold Bekkering acted as the chair of the Board of Directors at the time of the site visit.
- **The theme speakers** (one for each theme) coordinate theme activities in close collaboration with each other. They represent the theme in the Board of Directors.
- **The Board of Governors** has a supervisory role. It is composed of the deans of the Faculty of Science, the Faculty of Social Sciences, and Radboudumc, as well as the Managing Director of the MPI. At the time of the site visit, Professor Lutgarde Buydens was the chair of the Board of Governors.
- **The Scientific Advisory Board** monitors research progress and offers advice on the research profile and the prioritization of research topics. At the time of the site visit, it was composed of ten international experts.

Staff and funding

In 2018, the DI research staff consisted of 713 employees, representing 444 full-time equivalents (FTE): 73 FTE senior scientific staff members, 137 FTE other scientific staff members, and 235 FTE PhD candidates. The total number of research staff members increased during the evaluation period, from 375 FTE in 2013 to 444 in 2018. This growth is largely the result of a reorganization of Radboudumc research, which has promoted clinical-non-clinical research interaction and has increased the number of PIs involved in the DI. Further details about the DI staff are provided in Table A1 and A2 of Appendix 3. The institute’s total funding amounted to an equivalent of 527 FTE in 2018, 207 FTE of which was direct funding allocated to the DI through the participating institutes/faculties. Further details about funding are provided in Table A3 of Appendix 3.

Facilities

The DI facilities are distributed over the four centres, with equipment reflecting the centre’s specialization. The DCC harbours equipment for non-invasive monitoring of human subjects (e.g., EEG, Virtual Reality Lab, and Brain-Computer Interfacing). The DCCN has imaging equipment (e.g., MEG, EEG, brain stimulation – TMS, tDCS, functional ultrasound – and MRI equipment). At present, the DI has three 3T MRI systems and access to and partial ownership of a 7T system in Essen (Germany). All DI researchers have access to the technology centres of the Radboudumc (which provide technological expertise, equipment, and biobanks) and the wet lab equipment at the DCMN. A Translational Neuroscience Unit has been established, in which a variety of set-ups for animal experiments are shared. Animal imaging is conducted at PRIME, the pre-clinical imaging centre of the UMC. The DCN houses a variety of dedicated laboratories (e.g., the Drosophila lab, histology and confocal microscope labs) and a variety of psychophysics labs (e.g., the vestibular chair, NIRS-EEG). The use of many facilities is available free of charge to DI scientists, whereas the use of other facilities is available for a fixed hourly price.

PhD programme

All PhD candidates who work at one of the four Donders centres are enrolled in the Donders Graduate School (DGS). In 2018, approximately 450 PhD candidates were enrolled in the DGS. The

students are asked to commit to the DGS, follow several mandatory courses, keep track of their training and supervision plan, make use of the PhD Track software, and behave according to the rules of research integrity. In 2015, the DI appointed a dedicated Graduate School Coordinator to organize training and events, monitor PhD projects, and represent the DGS at the university level. The DGS has a PhD Council that consists of two to four PhD representatives from each Donders centre. They organise meetings for PhD candidates on topics such as a motivational toolkit and future career steps. In addition, they advise the Graduate School Coordinator and the Director, organize surveys, act as contact persons for PhD candidates, and produce a monthly newsletter.

Research integrity policy

Every employee at the DI is expected to comply with the Netherlands Code of Conduct for Research Integrity, which includes topics such as scrupulousness, reliability, verifiability, impartiality, and independence. In addition, the institute has implemented several measures to address research integrity, including organizing an annual scientific integrity course (mandatory for PhD students), appointing confidential advisers, and launching several platforms for discussing and managing ethical issues and dilemmas. To promote adequate (FAIR) data stewardship, the institute has appointed four data stewards and developed its own digital system for managing, archiving, and sharing research data (the Donders Repository).

Diversity policy

During the evaluation period, the DI has actively strived to increase its gender diversity. This was done by establishing a dedicated fellowship (Donders Mohrmann Fellowship), organizing awareness sessions, creating a web page with gender-related information, increasing the number of females in the Donders Board (six out of fourteen in 2018), implementing a gender policy in the recruitment procedure, and launching a mentoring programme for DI researchers to support career goals in a gender-friendly manner. The institute aims to continue its efforts to realize proportional employment of both genders at all levels in the years ahead and – in addition – work on increasing the socio-cultural diversity of the institute.

2. Assessment of Donders Institute for Brain, Cognition and Behaviour

Director of the institute: Professor Harold Bekkering

Academic staff in 2018: 444 FTE, 713 persons

2.1 Strategy and targets

Strategy 2013-2018

A crucial element of the overall strategy of the DI is to create an optimal scientific climate to attract, foster, and train top scientists. The institute aims to contribute to advances in the field via a theme-based research agenda. The four research themes were selected at the time of the launch of the DI, in the expectation that they would substantially contribute to the body of scientific knowledge in these fields. The themes should create an optimal environment for high-quality interdisciplinary research. In addition, they should form a platform for synergy around the research topic within as well across themes and create an attractive environment for top scientists. In addition, the DI strives to increase the translational value of its research by engaging with medical, educational, nutritional, and technological societal partners. To this end, the institute launched five Innovation Programmes in June 2017. The topics of the Innovation Programmes were selected because the institute was convinced that it can achieve a strong societal impact in these fields.

Future strategy

For the next six years, the DI has identified two international trends that require strategic attention. The first is the progress in artificial intelligence (AI). The DI aims to exploit the progress in AI knowledge to boost the understanding of the causal relationships between the brain, cognition, and behaviour (i.e., 'Cognitive AI') within its four research themes. Second, societal impact is an increasingly important aspect of scientific research, especially to attract research funds. The DI is strategically exploring the possibilities to reshape its research in order to increase its societal impact.

The committee has identified two routes to improve the overall strategy of the DI. We will briefly summarize our comments and suggestions here and elaborate in section 2.7:

- The strategy is rather broadly defined. It may be helpful to articulate more concrete goals in the institute's strategy.
- Electing one or several benchmark institute(s) may assist the DI in capitalizing on its unique selling points.

2.2 Research quality, societal relevance, and viability

Research quality

Overall, the committee considers DI research as **excellent**, although the scientific quality varies somewhat between research groups. Some groups already are at a world-leading level; others have the potential to arrive there in the near future. During the evaluation period, the institute shifted the

focus of its research output from quantity to quality. As a result, approximately 66% of refereed articles were published in first quartile journals and 286 refereed articles were published in journals with an impact factor of 10 or higher. The staff hold leading positions in international research networks and committees, professional organizations, and evaluation panels. The DI harbours many state-of-the-art research facilities which support the DI's own outstanding research and are available for academic and industrial collaborators, thus further contributing to the advancement of science within and beyond the institute's walls. The thematic focus is the driving force behind the institute's achievements, but the committee would like to stress that cross-theme interactions are important as well.

Societal relevance

The societal relevance of DI research is **very good**. The DI has an enormous potential to have an impact on society. Despite its focus on fundamental research, the institute actively reaches out to societal partners to interact and collaborate. The committee applauds the launch of the five Innovation Programmes which support the institute's efforts to increase its societal impact. The effects of these programmes are expected to become visible at the time of the next evaluation. Taken together, the institute's efforts to increase the societal impact of its research have significantly improved since the last evaluation. However, the institute's societal impact strategy appears to be rather reactive and directed at local partners. The committee encourages the institute to work on the implementation of the innovation programmes and to extend its activities to help society in dealing with the complex issues that it is facing nowadays. Concrete recommendations will be discussed in section 2.7.

The DI asked the committee to pay special attention to the balance between curiosity-driven fundamental research and transformative contributions to society at the DI. The committee would like to start by pointing out that this is a false dichotomy. Fundamental research itself makes an indispensable contribution to society, both immediately by advancing our collective knowledge and understanding of nature and (in neuroscience) ourselves, and in the long term by contributing to technological and medical innovations. Having said that, it is clear that societal impact is of increasing importance in attracting research funding, and that the Dutch government invests heavily in collaborations between science and societal partners. Therefore, the institute has justly identified the increasing importance of societal impact as an important trend to consider in its future strategy. During the evaluation period, the DI has demonstrated a strong commitment to supporting the translation of its research into technological and medical innovations. In addition, the committee applauds the institute's efforts to show society that scientific research is important, both fundamental and applied research. So, the balance appears to be right at present. The committee encourages the DI to continuously monitor the balance between fundamental and applied research, both in terms of the research that is performed and the research funding that the institute attracts. At the same time, it is important for the DI to communicate to the general public and to decision makers that fundamental research is an essential element of its long-term strategy because new knowledge is the foundation for innovation with a measurable societal impact in the future.

Viability

Overall, the committee considers the DI's viability as **very good**. Its main assets are its excellent infrastructure and the collaborative team spirit. The 'Donders brand' has demonstrated its power to

attract talented scientists and research funding alike. The institute's state-of-the-art infrastructure constitutes a magnet for top scientists. The committee is convinced that the DI will remain attractive to top scientists in the next six years. The DI management has successfully realized the 'team science' spirit that it sought and has managed to implement its targets within the complex governance structure of the DI. This is a testimony of the strong leadership skills of the DI management. The collaborative leadership style of the directors is palpable in the collaborative nature of the institute.

The DI asked the committee to pay special attention to the balance between creating a positive and friendly work environment and staying a first-class research institute. The DI is keen to foster an attractive and welcoming environment and – at the same time – push for world-class science. The committee feels that the institute has successfully managed to achieve this balance, possibly positioning itself ahead of the field in recognizing the difficulty of this balance. The DI also mentions inclusivity as a key aspect of its strategy to attract top scientists. The committee fully endorses this view, but feels that there is room to improve the institute's inclusivity, particularly with respect to the institute's diversity policy. This will be discussed further in section 2.6. In addition, the institute should improve the embedding of its postdocs and create a welcoming environment for them as well. The postdocs at the DI receive good support in grant applications, but these young researchers appear to be slightly overlooked in terms of guidance on other topics such as career development and who to contact in case of problems. The committee recommends installing a support programme for postdocs and allocating some budget for postdoc events (section 2.7).

The committee spent a substantial amount of time discussing the governance structure of the DI. This structure is complex, with a three-dimensional matrix of research centres, themes and Innovation Programmes and the five DCMN themes as subthemes within the Donders themes. Theme 1 (Language and Communication) is intertwined with the MPI and the CLS, adding further complexity. Nevertheless, the structure appears to work surprisingly well. The committee learned that the institute is an umbrella structure with no formal authority over human resources and a very limited budget. Though understandable from the perspective of an umbrella structure, the committee is of the opinion that the DI requires more structural financing for staff and seed money to implement its strategy. Such additional funding to implement the excellent and promising strategy is crucial to the viability of the DI.

By launching research themes, the institute has created a flexible system of collaboration within the rigid university structure, promoting interdisciplinary research. The committee applauds this creativity. Although there is excellent interdisciplinary exchange between the PIs, junior scientists seem to stay within the confines of their research centres because the theme structure has no apparent relevance to them. In addition, the current grouping of themes may not be the most efficient in terms of promoting interdisciplinary collaboration and – in the opinion of the committee – does no longer adequately reflect the research that is currently performed at the DI. Therefore, the committee recommends rethinking the current theme structure (section 2.7).

One last comment about viability relates to tenured positions. Due to national legislation, researchers with an ERC or Vidi personal grant automatically progress into a tenure track after they finish the ERC or Vidi project. However, the committee learned that the procedures regarding tenured positions differ between faculties. As a result, DI researchers with prestigious (inter)national

grants may be treated differently. The committee strongly advises to harmonize these procedures across the university (section 2.7).

DCMN themes

The DI also asked the committee to comment on the research quality, societal impact, and viability of the five DCMN (i.e., Radboudumc) research themes. These themes are well-embedded in the Perception, Action and Control theme ('theme 2') and the Plasticity and Memory theme ('theme 3') of the Donders Institute, focusing on specific diseases and translation to patient care. Therefore, more details will be provided in the assessments of these two DI themes (in sections 3.2 and 3.3). In short, the research quality of the DCMN themes ranges from **good** to **excellent**. The societal relevance of the themes is **excellent** because the intensive collaboration between fundamental and clinical scientists results in true clinical impact. The viability of the themes ranges from **good** to **excellent**: although some themes may be too small to make a significant contribution to clinical science in the long term, others are excellently positioned to meet their targets. The committee has particular concerns about the Alzheimer's theme, where the number of involved clinicians may be too small to be internationally competitive. The alignment of the five Radboudumc themes with the DI research is vital to the societal impact and viability of the DI. The committee refrained from providing separate numerical scores for the DCMN themes since it felt that it did not have access to sufficiently detailed information on the individual DCMN themes. These were only presented and discussed within the framework of the DI themes, and the numerical scores would therefore be similar to those provided in Table 1 in section 3.5.

2.3 Research facilities

The committee is highly impressed by the DI facilities, in terms of what is available and in terms of the associated infrastructure (e.g., excellent facilities for research data handling and data sharing and highly competent support staff). The number of support staff members is proportional to the scientific staff numbers (Appendix 3). The institute has high-quality technical support groups, whose members build research equipment and develop methods. The DI scientists appear to be keenly aware of the latest technological developments. The institute builds up financial reserves to replace equipment, which is commendable. The access to the state-of-the-art facilities and associated support is a clear advantage of working in the DI.

Imaging facilities

The committee has a number of specific remarks about the imaging equipment at the DCCN. These facilities appear to be well-organized, with excellent technical support, well-trained support staff, state-of-the-art facilities for research data handling and data sharing, adequate implementation of GDPR regulations, and excellent custom-built equipment. The committee learned that the DI recently applied for funding to establish a 14T system in Nijmegen together with other Dutch imaging partners. This will be a national resource under the administration of the DI. A 14T scanner will obviously be a great asset. The committee learned that there are some bottlenecks in using the existing 7T MRI equipment in Essen because there are legal issues involved in crossing borders with patients (i.e., safety regulations). This may have consequences for the viability of cohort studies and this needs to be addressed. As regards MRI physics, laminar fMRI has been productive in terms of

high-quality published outputs. However, the committee feels that the other areas of MRI physics are also important for the DI's viability (section 2.7).

Animal experiments

DI researchers are actively pursuing alternatives for animal experiments such as organoid systems, organ-on-a-chip, and *in silico* modelling. The committee applauds these initiatives, which are in line with the current international trend to refine, replace, and reduce animal experiments. This trend is pushed by society and supported by the majority of scientists. Having said that, it is the committee's opinion that animal experiments (including those on non-human primates, in particular when future medical applications are intended) are crucial to the advancement of neuroscience. The DI self-evaluation report strongly focused on human systems and behavioural neuroscience. Clearly, these lines of research have been exceptionally successful. There was a noticeable relative absence of any discussion of animal models in the self-report. The DI (and perhaps Radboud University and Radboudumc as a whole) appears to be highly reluctant to communicate about animal experiments with the general public and even with peer scientists. A more transparent and pro-active communication policy is strongly recommended (see section 2.7).

2.4 PhD programme

Institutional context of the PhD programme

The committee learned that all PhD students who work at the DI are enrolled in the Donders Graduate School (DGS). The PhD students that the committee met appeared to feel well-embedded in and welcome at the DI. It may be worth considering creating subthemes within the DGS because the graduate school is very large and – as a result – students may not feel obliged to join events. In addition, the committee encourages the institute to embed PhD students into cross-theme activities (see recommendation about themes in section 2.7).

Selection and admission procedure

The recruitment procedure for PhD students is based on the availability of (external) funding to PIs and usually proceeds via a normal open call, although occasionally, MSc students who worked in a lab will be offered the position. Selection is generally performed by one or more PIs, resulting in an apparent lack of transparency. At present, the DGS is exploring ways to remedy this lack of transparency and improve its recruitment procedure as a means to shorten the duration of PhD tracks. The committee supports this endeavour and encourages the DGS to develop a more formalized admission procedure (section 2.7).

Quality assurance and supervision

PhD candidates have at least two supervisors, and there is a support system consisting of confidants and a peer coaching programme. Although this provides an adequate basis for success, the committee feels that it is very important for junior researchers to be supervised by a panel of researchers with knowledge of and experience in what good supervision entails; the DGS appears to be aware of this.

The DGS monitors the progress of its PhD candidates with a checkpoint system, including a training and supervision plan and annual meetings with the supervision team. One year after the start of the PhD project, the student, the supervision team, and an external advisor (implemented in 2018) have a formal go/no go evaluation meeting. Here, they discuss the feasibility of the project, progress, and expectations from both sides. One year later, the external advisor returns to advise on what can be achieved in the final two years based on the first two years (implemented in September 2019). The students appear to highly appreciate these meetings with the external advisor. The committee applauds these measures, because the meetings with the external supervisor may help PhD candidates to understand what is expected from them. In addition, it allows the candidates to express concerns regarding the feasibility, the supervision team, and the progress of the PhD project. The committee encourages the DGS to run polls among the PhD students before and after the implementation of interventions such as involving external supervisors. This will help the graduate school to evaluate the effectiveness of interventions (section 2.7).

In 2014, the DGS introduced 'PhD Track' software, which provides online dossiers of the PhD students' training, progress, and supervision. The software sends automatic reminders for meetings, annual checkpoint forms to discuss progress, a confidential questionnaire for the PhD candidates, and an evaluation form for the supervision team. The confidential questionnaire concerns the students' opinion on their supervision team and the support they receive. It is only read by the graduate school coordinator. The committee has the impression that the PhD Track system helps to safeguard the quality of training and supervision of PhD candidates at the DI, facilitating early identification of potential problems.

A sense of insecurity about the feasibility of the project and/or living up to expectations is common among PhD students at the DI. This is not unique to the DI: it is also observed elsewhere in the Netherlands and abroad. The DGS has implemented several measures to tackle this problem. For instance, a peer coaching programme was established in 2017. In addition, the graduate school explicitly emphasises that the university regulations do not specify any number of chapters or publications required to complete a thesis. The students that the committee met were aware of this. Although this measure was taken to alleviate the pressure on the students, it may actually promote uncertainty regarding what is expected from them. The committee recommends communicating clear guidelines and organizing resilience training for PhD students (section 2.7).

Programme content and structure

The overall content and structure of the PhD programme seems appropriate. The committee learned that PhD candidates should obtain a total of 30 ECTS (1 ECTS = 28 hours) to receive the DGS Certificate. The students should spend 12 ECTS on attending conferences, Donders Lectures, etcetera. The remaining 18 ECTS should be spent on courses, training programmes, and workshops with an assessment element (e.g., CNS Masters courses, university courses, e-courses). Mandatory events are the Introduction Day, Scientific Integrity Day, and two Graduate School Days. It is not compulsory to obtain a Graduate School Certificate, but most candidates do.

Duration and success rate

Nearly all PhD candidates at the DI have a four-year contract. About 25% of candidates graduate after four to five years, another 25% after five to six years. About ten percent of candidates never

graduate. The average duration of PhD tracks has increased since the last evaluation. The reasons for the long duration include the interval between manuscript approval and formal examination, combining PhD training with clinical training, and maternity leaves and sick leaves. The DGS strives to shorten the duration of the PhD tracks, for instance by improving the recruitment procedure, supervision (e.g., involving an external advisor as described above), and communication, and by reducing the workload. The committee recommends inspecting the duration and drop-out figures in more detail because this will help the DGS to manage these problems (section 2.7).

Guidance to the job market and career prospects

The DGS regularly organizes career events, inviting former PhD students or recruiters. During the Donders Lectures, PhD candidates may have lunch with the speaker in an informal setting, helping them to strengthen their network. The career prospects of the PhD graduates seem to be good, with nearly all of them finding positions in academia, healthcare, business, or teaching one year after graduation. The committee values the DGS' efforts to promote career paths outside academia as an important component of the PhD training and strongly supports the notion that careers outside academia form respectable alternatives.

2.5 Policy on research integrity

The assessment committee considered the DI's research integrity policy and the way in which violations of such integrity are prevented and handled. The DI appears to take deviations from research integrity seriously and to take appropriate actions, which is commendable. In general, the institute appears to foster a good atmosphere, allowing for a critical pursuit of science. For instance, junior scientists appear to feel free to challenge the ideas of their PIs, although this may vary from one PI to another. The institute organizes an annual scientific integrity course, where PhD candidates and other researchers are trained to understand the dilemmas and temptations involved in research integrity. PhD students appear to receive substantial direction on research integrity procedures, but postdocs are experiencing difficulties in navigating the system and locating assistance. The committee recommends including this in a support programme for postdocs (see section 2.7). The DI has built an adequate research data management structure. Research data management is also well-arranged for PhD students. The research data pipeline for the MRI scanners is particularly impressive.

2.6 Policy on diversity

Gender

During the evaluation period, the DI has actively strived to increase its gender diversity. These efforts have resulted in an increase in the percentage of female senior scientists: the percentage of female full professors increased from 15% in 2013 to 22% in 2018 and the percentage of female associate professors increased from 16% to 29% in that period. Hence, progress to redress gender imbalance is demonstrated but slow. However, it is also obvious that the gender imbalance at the postdoctoral researcher and assistant professor level has increased over the years, which might be a result of moving female assistant professors into associate status.

Overall, the DI gender diversity numbers are in line with the gender balance in academic staff across the Netherlands (https://www.vsnu.nl/en_GB/f_c_ontwikkeling_aandeel_vrouwen.html). However, the DI is above the national average for the percentage of female PhD students (64% at the DI, compared to 44% nationally in 2018), suggesting that the DI could reasonably be expected to exceed the national numbers regarding female staff members. The institute appears to be aware of this problem and has committed to address gender imbalance at all career levels, with a clear ambition to start at the level of the DI directors within the next years. The committee thus encourages the DI to continue its efforts to realize proportional employment of both genders at all levels in the next six years.

Measures to promote a family-friendly environment may support the DI's efforts to increase its gender diversity. However, as researchers at the DI receive the standard Dutch social care (e.g., paid maternity and parental leaves) and meetings are always organized during working hours, there seems to be little room for improvement here. Potential additional measures include making PIs individually responsible for including diversity in the hiring policy and a streamlined information system about facilities for families (see section 2.7). In addition, the committee would like to caution against overexerting female scientists by expecting the same individuals to repeatedly engage in a variety of activities to meet diversity requirements.

Other aspects of diversity

The DI has specifically focused on gender diversity in the past six years, neglecting other aspects of diversity such as age, ethnicity & background, socioeconomic status, personality, disability, and LGBT+. The committee strongly encourages the institute to pay serious attention to these topics in the next six years, as signs of inclusivity in their external communication and in the recruitment procedure (see section 2.7).

Diversity in research

Diversity is not only important in terms of research staff composition, it is also an often-overlooked aspect in research itself. The committee interviewed a female Parkinson's patient during the site visit and she specifically commented on gender diversity in research. She remarked that in her experience, research on the specifics of female Parkinson patients is lacking. Interestingly, she also mentioned that there might exist strong differences in care received by male and female patients with a neurodegenerative disease. This is an important signal and the committee acknowledges that traditionally, medical research has focused almost exclusively on Caucasian male subjects. Recently, scientists have started to appreciate that the disease course, drug response, role of hormones, and healthcare needs may differ between genders and ethnicities. These differences should be investigated in detail. Interestingly, there will be an emphasis on the inclusion of gender within research questions and design in future EU funding calls. This will be highly relevant for brain research. The committee recommends addressing this (section 2.7).

2.7 Recommendations for the Donders Institute as a whole

Overall strategy

1. Incorporate measurable goals in the institute's strategy.

The strategy of the DI is rather broadly defined. The committee recommends articulating more concrete and measurable targets for the next six years. For instance, 'six years from now, we want to have three female directors' or 'be the absolute top institute in the field of Parkinson's disease or ADHD' or 'be among the top 10% of institutes with respect to applying AI in patient care'.

2. Elect a benchmark institute.

The self-report of the DI and the site visit presentations lacked a comparison with similar research organizations in the Netherlands, Europe, or elsewhere. What institute does the DI want to be compared to? What is unique at the DI compared to other institutes? Where is the DI leading and where does it want to be leading in comparison to other strong (inter)national research centres? In other words, the institute may use a benchmark comparison to develop a more targeted strategy. Such a benchmark comparison will also be a valuable addition to the next self-report.

3. Run polls to evaluate the effect of interventions.

The committee encourages the DI to run polls before and after the implementation of interventions within the overall management and structure of the institute and/or its activities. For instance, the implementation of meetings with external supervisors to monitor the progress of PhD candidates may be evaluated using polls. Polls could also provide useful baseline data and information when developing initiatives for improving retention where the DI is struggling with diversity. In addition, it would have been useful for the committee to view poll data on staff satisfaction as part of the evaluation process.

4. Organize mental health training for staff.

Mental health problems are common among PhD students, not only those employed at the DI, but also those at other national institutes. This may also hold true for postdocs and junior staff. This is an international trend that is not unique to the Netherlands. It would be good to organize resilience trainings to help the staff deal with the high workload and pressure in science. Similarly, supervisors could benefit from information resources, best practices, and training for responding to mental health issues with supervisees and other early-career researchers.

Research quality, societal relevance, viability

5. Further develop the societal impact strategy.

The institute's societal impact strategy appears to be reactive rather than proactive. The DI may wish to develop a strategy to prepare itself to optimally respond to opportunities ('chance favours the prepared mind'). In this respect, the committee noticed that the strategy is strongly directed at local partners. Although this may be a pragmatic approach that is well-suited to the Dutch societal structure, the committee encourages the DI to continue searching for societal partners not only in the Nijmegen region, but also nationally. During the site visit, a representative of TNO, interacting with the DI in the food and cognition domain, emphasized the larger potential of TNO as a national

partner for collaborations on other relevant societal themes. Building a broader societal network might also be necessary in view of the strong emphasis on societal relevance and applications in the upcoming 'Horizon Europe' funding scheme. In addition, the DI should nourish the link with clinical departments and articulate its societal relevance more explicitly.

6. Develop a support programme for postdocs and strengthen their community.

Whereas the PhD students at the DI are offered a well-organized supervision and support system that emphasizes their importance as an individual and as a group member, postdocs appear to be relatively overlooked. Postdocs are junior researchers that still need some guidance in navigating the university system and locating services and assistance. This pertains to guidance in career development, diversity-related issues, research integrity-related issues, and more. Postdocs from abroad would benefit from guidance in navigating the rules and regulations of the Dutch university funding system and national regulation, as well as in coping with social challenges, which are often opaque to foreign employees. The committee has the impression that the university offers a variety of services to postdocs, but it should be clearer where to find these services.

In addition, emphasizing the postdoctoral community as an important and recognizable group within the DI will likely contribute to increased cross-disciplinary interactions. This is important since the committee noted that the postdocs seem to affiliate themselves mostly with their PI/labs rather than their themes or the DI. Therefore, the committee recommends launching a support programme for postdocs. In addition, it would be good to allocate a budget for postdocs to organize their own meetings (e.g., a 'Postdoc Day'). In summary, a postdoctoral copy of the DGS might be worth considering.

7. Increase the amount of structural funding for the DI.

The institute is an umbrella structure with a very limited budget of only EUR 800,000 per year. The committee is of the opinion that the DI requires more structural funding for staff and seed money to implement its promising strategy. Strategy implementation requires targeted investments and a dedicated budget.

8. Reconsider the current theme organization.

The committee supports the thematic approach of the DI, but recommends promoting cross-theme collaboration by allowing PIs to be affiliated with more than one theme. The recent affiliation of two new memory experts to theme 4 illustrates the fluid border between theme 3 and 4. It would make sense for these PIs to become affiliated to theme 3 *and* theme 4. In addition, the DI may develop ways to involve PhD students and postdocs in cross-theme activities. This is because cross-theme collaboration mainly appears to occur at the senior scientist level and PhD students and postdocs appear to cross themes less easily.

In addition, the current grouping of themes may not be the most efficient in terms of promoting interdisciplinary collaboration and it may not adequately reflect the research that is performed at the DI anymore. The DI may wish to update the current selection and description of the themes as stable elements in the organizational matrix. Is this the most efficient way of organizing DI research or can one consider themes as project groups that emerge for a limited period, aiming for a predefined target? And are the current thematic foci the best ones? There are multiple examples of topics that

cross theme borders. For instance, computational psychiatry emerged as an area of interest in both theme 2 and 3 (and could well connect to theme 4), and ‘language and perception’ and ‘language and social interaction’ could be evident topics for collaboration between theme 1 and 2. A combination of elements of theme 3 and 4 might strengthen the clinical programme on Alzheimer’s disease, and comparable links might emerge upon redefining the themes.

9. Harmonize procedures for tenured positions across the Donders centres.

The committee learned that the procedures regarding tenured positions differ between faculties. It would enhance the homogeneity and transparency of the DI if these procedures could be harmonized across the four Donders centres.

Facilities

10. Build a broader programme in human MRI.

The combination of methodological development and front-line neuroscience in a single institute is a historical strength of the DI, particularly in the DCCN. However, the committee finds the portrayed emphasis within MRI physics on fMRI to be limiting. The committee considers that additional methods for human imaging, such as structural, diffusion, quantitative MRI and metabolism/neurochemistry are also important. This will present new collaborative opportunities across a much broader range of neuroscience groups within and outside of the DI. There are burgeoning efforts to expand MRI physics research, including the recruitment of junior faculty and the planned 14T project, which the committee feels is appropriate and important.

11. Be more open about animal experiments.

It is the committee’s opinion that animal experiments are crucial to progress in neuroscience. The committee therefore encourages the DI, Radboud University, and Radboudumc to support their scientists in actively communicating about animal experiments with the public and peers. Perhaps DI scientists could receive a communication training specifically focused on discussing animal experiments with the general public, and develop some proactive engagement platforms. In this context, it is worth referring to the Concordat on Openness on Animal Research (<http://www.understandinganimalresearch.org.uk/openness/policies-overview/>), which has been especially important in the UK and Spain. This concordat emphasizes the need for proactive explanations of animal research and the importance of university support for such initiatives.

PhD Programme

12. Develop a more formalized procedure for admission to the DGS.

The DI should develop a more formalized and transparent procedure for recruitment of PhD candidates. The selection committee should consist of multiple individuals, including the PI and at least one other experienced supervisor or co-supervisor. To guarantee and anchor consistency of the process and to assure adequate information about the DSG at an early stage, one might consider to always have the PhD programme coordinator or a member of HR present. This is expected to reduce the drop-out percentage as well as the duration of PhD tracks.

13. Clearly communicate what is expected for graduation.

The DGS explicitly emphasises that the university regulations do not specify any number of chapters or publications required to complete a thesis. This is done to alleviate the pressure on the students, but it may inadvertently promote uncertainty as to what is expected from them. The committee recommends actively communicating clear guidelines (e.g., ‘a thesis usually contains two to four chapters of experimental work’) and ascertaining that the DSG guidelines prevail over any other faculty or PI-enforced requirements.

14. Inspect the figures on PhD duration and drop-out in more detail.

The committee recommends inspecting the duration and drop-out figures (particularly late drop-outs, i.e., after more than two years) in more detail. For instance, some students have a 0.8 FTE appointment and others combine their PhD project with clinical training. In addition, maternity leaves, parental leaves, sick leaves, and the interval between manuscript approval and formal examination may also inflate duration figures. It will be much more informative to study the figures after correction for these factors. This can inform the development of a plan to support students to complete within an appropriate timeframe.

Research integrity

15. Maintain and extend the current emphasis on research integrity.

The committee welcomes the presented activities (current and planned) on research integrity and recommends to continue along this line. While PhD students appear to receive substantial direction on research integrity procedures, this might also be a focus point for the postdocs and young PIs at the DI, of course in addition to a continued emphasis on the relevance of research integrity throughout the institute.

Diversity

16. Continue the efforts to improve the gender balance.

The trend in gender balance at full and associate professor level is in the right direction, but the rate of progress remains slow. This issue was raised at several points during the site visit and many DI staff members are aware of this. Additional measures may include making PIs individually responsible for including diversity in the hiring policy and a streamlined information system about facilities for families. The hiring policy should dictate that multiple experienced persons are involved in the selection of new employees and that the selection committee is alerted to the importance of diversity in all aspects, as well as the general guidelines to achieve this. In addition, it may be useful to conduct some internal polling to better understand the diversity issues (e.g., why do women decide to leave academia) and to solicit anonymous feedback from the staff. This can also serve as a baseline for assessing the impact of any interventions.

17. Develop a policy to increase other aspects of diversity

Aspects such as age, ethnicity & background, personality, disability, and LGBT+ have largely not been addressed in the DI’s diversity policy in the past six years. The committee strongly encourages the institute to pay serious attention to these aspects in the next six years, especially because inclusivity is a key aspect of the institute’s strategy (‘The DI has strived to create an optimal scientific climate to

attract, foster, and train the best talents without bias in terms of ethnicity, gender or social background at all levels of seniority.’). Some of these aspects of diversity (age, ethnicity & background, personality) may be formally incorporated in the recruitment procedure; others (disability, LGBT+) may be more amenable for inclusion in the external communication strategy of the institute.

18. Consider diversity in research.

The committee encourages the DI to appreciate diversity in research itself and investigate how various aspects of the healthy and diseased brain may differ between genders, age, and ethnicities. For example, effects of pharmacological treatments may depend on the hormonal situation of the patient, or might be age-dependent.

3. Assessments per theme

3.1 Language and Communication

Theme speaker: Asli Özyürek

Academic staff in 2018: 24 FTE; 35 persons

The Language and Communication theme seeks to understand the complexity and development of the human language faculty and its interactions with other domains of cognition. The central idea is to study the cognitive and neural basis of the language faculty in healthy individuals and in persons with a dysfunction in linguistic and communication skills. The theme explicitly adopts an interdisciplinary approach, aiming to understand interactions between different levels of explanations about the human language faculty. As research of the Language and Communication theme is intertwined with the research at the MPI and the CLS, the committee has evaluated their collaborative work as one combined research unit.

Research quality

The committee is impressed by the **excellent** quality of the research of the Language and Communication theme. The theme's scientific publications in the period 2013-2018 have significantly contributed to the body of scientific knowledge and it is one of the most influential groups in the world in the field of language science. The theme's research on language in relation to other cognitive domains is relatively unique in the world. The committee applauds the innovative work in novel areas such as using language in context, virtual reality studies, ecologically-valid behavioural measurements, turn-taking, non-verbal communication phenomena, genetic studies of language disorders, bilingual processing studies, bilingual learning studies, and high temporal resolution studies with MEG and EEG.

Societal relevance

The committee considers the research of this theme **very relevant** to society. The theme has developed several initiatives to increase its societal impact since the previous evaluation. For instance, it developed a communication app for people with chronic Broca's aphasia, organized children's language festivals ('Kletsoppen'), and created a public outreach webpage with Q&A about language. Taken together, these initiatives – although impressive – are still early-stage. Therefore, the committee encourages the theme to strategically build on these early initiatives. In addition, the committee strongly urges the Language and Communication scientists to invest more in studying the neurobiological underpinnings of congenital and acquired language disorders, such as patients with stroke aphasia or neurodegenerative conditions that affect language. This is a component that might be of increasing importance to funding agencies. It may also be opportune to develop research activities to understand second language learning in migrants, which would be of high societal relevance.

Viability

Overall, the committee rates the viability of the Language and Communication theme as **very good** because of its expertise, innovation, and state-of-the-art facilities. The theme harbours many strong researchers and it has demonstrated its ability to attract funding (e.g., the ‘Language in Interaction’ consortium funded by the NWO Gravitation programme). The theme is small within the DI (24 FTE compared to 218 FTE for the largest theme), which may affect its overall impact on the future DI policy.

It is important to note that the theme smartly capitalizes on its complementarity with the research at the MPI and the CLS. The relationship with the MPI appears to be excellent and of mutual benefit. The Language and Communication theme benefits from the strong reputation and psycholinguistics expertise of the MPI. Scientists at the MPI benefit from the state-of-the-art infrastructure at the DI. For instance, all MPI imaging work is performed at the DCCN and several of its large-scale sequencing studies are performed at the DCMN. The collaboration with the Language and Communication theme allows MPI scientists to integrate a broad range of cognitive domains into their studies. In addition, the theme studies areas of language that are not covered by the MPI. The result is a broad research niche that is nationally unique and internationally at the forefront. Moreover, the Language and Communication scientists teach language science to undergraduate students, who may become PhD students at the MPI in the future.

The relationship with the CLS appears to be more complicated. The connections between the Language and Communication theme and the CLS run partly through the MPI. The committee recommends establishing a closer and more transparent relationship with the CLS, for instance by offering more CLS scientists an appointment at the DI, because this will add to the viability of the Language and Communication theme, likely resulting in an excellent viability score in the future. At present, the Language and Communication theme and the CLS appear to share many research aims, and there is no obvious scientific benefit from limiting interactions between these entities.

Research in the Language and Communication theme has been particularly helped by a large NWO Gravitation grant (‘Language in Interaction’) that has fostered productive collaborations between the DI themes and between the DI and other Dutch research groups. Strategies on how to continue these collaborations after expiration of the grant could be made more explicit.

3.2 Perception, Action, and Control

Leader: Alan Sanfey

Academic staff in 2018: 218 FTE; 363 persons

The Perception, Action and Control theme aims to understand the relationships between the brain and the cognitive mechanisms that underlie perception, action, and its integration. Research within this theme also has a clear clinical focus, with active investigations of neurological, sensory, and psychiatric populations, in an overall effort to understand perception, action, and control in health

and disease. The DCMN (i.e., Radboudumc) themes 'Disorders of movement' and 'Sensory disorders' are aligned with this theme.

Research quality

The Perception, Action and Control theme performs **excellent** research. It is one of the best places to study human cognitive neuroscience in the world and it appears to be the heart of the DI. The theme studies a highly diverse range of topics, ranging from molecular genetics to social cognition. Examples of research highlights are the translational work in Parkinson's disease, the research on the predictive brain (i.e., how prior knowledge modifies perception and decision-making), and the studies of the chemical neuromodulation of higher cognitive function. Many PIs are leaders in their fields and have received prestigious personal grants. There are unique interactions within the theme, for instance between motor neuroscience and language.

Societal relevance

The work of the Perception, Action and Control theme makes an **outstanding** contribution to society. The theme is successfully aligned with the 'Disorders of movement' and 'Sensory disorders' themes at Radboudumc and the intensive collaboration with clinicians greatly adds to the theme's societal relevance. Several very strong clinicians are involved in the theme. The committee applauds the work on cochlear implants and Parkinson's disease, the Nijmegen falls prevention programme, genetics of age-related macular degeneration, gut-brain communication, and neurocognitive mechanisms of eating behaviour in humans. The theme actively engages patients in its research. For instance, they collaborate with the Parkinson's disease patient organization to ensure that patients have a voice in the research agenda and the implementation of research. The translational efforts of the theme are strongly focused on the clinic and health rather than technology.

Viability

With its impressive publication record and reputation, the committee rates the viability of the Perception, Action and Control theme as **excellent**. The theme manages to attract top scientists, who use their personal grants to contribute to the team. The theme's size and the diversity of topics that are studied constitute a strength, but may also prove to be a weakness in the future because of the broad scope and relative lack of focus of the theme. Therefore, the committee supports the theme's initiative to create smaller collaborative networks within the theme (on decision making and computational psychiatry). The theme's strategy may be further improved in several ways:

- The committee noticed a potential discrepancy between how the theme presents itself and the research that is actually going on. The theme presents itself as a human cognitive neuroscience theme and thus, there is a strong focus on research in humans. Animal research is mentioned only briefly in the self-report and it is not explicitly included in the theme's strategy and external communication. The theme's strategy with regard to animal experiments is unclear, although there are clear animal experimental components. In the view of the committee, this theme should seriously consider how to remedy the loss of a strong non-human primate research group, since this approach is considered to be very relevant for the future impact of the group. The committee recommends being transparent about animal experiments because these constitute an essential part of neuroscience (see section 2.7). If animal experiments are allocated to other themes (rodents) or institutes (non-human primates), this should be made

explicit in the strategy in a positive way, thus supporting a strategic choice to focus on human research.

- The strategy should also be clearer about allocating other aspects of research to other themes (e.g., computational work).

3.3 Plasticity and Memory

Leader: Indira Tendolkar

Academic staff in 2018: 137 FTE; 211 persons

The Plasticity and Memory theme studies the mechanistic underpinnings and behavioural consequences of the long-term changes in neural structure and function that underlie brain development and ageing, adaptation, and our ability to learn and remember. The aim is to unravel how neuroplasticity supports development during childhood, adaptation to environmental challenges, and learning and memory throughout the life span. The DCMN (i.e., Radboudumc) themes 'Alzheimer's disease', 'Neurodevelopmental disorders', and 'Stress-related disorders' are aligned with this theme.

Research quality

The Plasticity and Memory scientists perform **very good** research. The committee was struggling with the heterogeneity within this theme in forming its judgment. The research on stress, mental disorders, and monogenetic diseases is very impressive and at the forefront of the fields. In addition, the theme has procured a large amount of EU funding, which testifies to its reputation and research quality. The committee also values the novelty of the research questions that are addressed by the theme. However, the memory research within the theme is not world leading, a top scientist has left, and several prominent memory experts are affiliated with the Neural Computation and Neurotechnology theme ('theme 4') rather than the Plasticity and Memory theme.

Societal relevance

The work of the Plasticity and Memory theme makes an **outstanding** contribution to society particularly due to its very high translational potential which is used appropriately. Many Plasticity and Memory researchers focus on research questions that are relevant to the general public or patients. They have contributed to education programmes and have had an impact on policy. In addition, several impressive clinical developments have been informed by the theme's rigorous studies, which is highly commendable. For instance, the committee is impressed by the theme's ADHD research, which contributed to national guidelines. The example of the relevance and applicability of the DNA-based forensics work is particularly impressive. The theme management strongly steers on clinical impact and the alignment with the DCMN themes works well. The theme has great opportunities for cross-talk between scientists and clinicians and the committee strongly recommends preserving this and building on this strength.

The committee shares the theme's concerns about engaging psychiatrists at non-academic institutions in research (i.e., it is difficult to engage clinicians that work in peripheral psychiatry in

research because there is a lack of manpower at Dutch non-academic mental health institutions due to national resourcing issues). The committee encourages the theme to continue the efforts to expand its collaborations to additional institutions. The theme may want to work on the external communication about its societal relevance because this strength may be articulated more strongly.

Viability

Overall, the committee considers the viability of the Plasticity and Memory theme as **very good**. The theme harbours several top scientists that have a positive and realistic attitude. The Plasticity and Memory scientists that the committee met are open about animal research and successfully combine rodent research with studies in healthy and diseased people, thus truly linking molecules to minds to populations. However, the theme's memory research – a field with fierce international competition – is not very strong. The recent affiliation of two new memory experts to the Neural Computation and Neurotechnology theme ('theme 4') rather than the Plasticity and Memory theme appears to be disadvantageous to the Plasticity and Memory theme. Moreover, the committee is concerned about the relatively limited number of clinician-scientists in the field of Alzheimer's disease. As an important contribution – though in a highly competitive field – an increase is advised. The theme's strength is in research on stress, life course, and gene-environment interactions rather than memory, so a name change and/or reorganization may be appropriate.

In addition, the committee would like to express its concerns regarding the link with clinical research and encourages the Plasticity and Memory theme to nourish its opportunities for clinical translation (e.g., by appointing an impact officer) and to further strengthen the interactions with the clinic through appointments of clinician-researchers. Moreover, the potential of improved interactions and cross-talks with researchers in theme 4 (Neural Computation and Neurotechnology) should be further explored (see also our recommendations about the definition of themes in section 2.7).

3.4 Neural Computation and Neurotechnology

Leader: Tansu Celikel

Academic staff in 2018: 65 FTE; 105 persons

Researchers of the Neural Computation and Neurotechnology theme focus on brain organization and function from a multidisciplinary perspective in order to identify the working principles of brain networks across spatial and temporal scales. They develop novel methodologies and analytical techniques and replicate brain computations in artificial systems.

Research quality

Overall, the Neural Computation and Neurotechnology scientists perform **very good** research. The theme harbours several world-leading scientists, many of whom are listed on the Clarivate Highly Cited Researcher list. Their work on methods for neuroimaging, including both MRI and MEG & EEG, has been highly influential and should be considered 'excellent'. For instance, the theme has developed the FieldTrip software toolbox for MEG and EEG analysis, which has already been cited approximately 3,800 times and has many users worldwide. The development of neuroimaging tools

and technology is well-integrated with primary research, and thus ideally positioned to address research needs at the DI and elsewhere. Other components of the theme are currently rated as 'very good', but the committee felt that they have the clear potential to become world-leading within the next few years. In particular, the grouping of machine learning, AI, and computational neuroscience in a single theme, with a strategic focus on links between AI and neuroscience, holds substantial potential. The quality of the DI's junior PIs in these areas is excellent, and the committee sees immense potential for their progression.

Societal relevance

The committee considers the research of this theme **very relevant** to society. The Neural Computation and Neurotechnology scientists have strong connections with industrial partners, but less with clinical partners. The committee is impressed by the Bonaparte software application which is used to quickly identify disaster victims worldwide. The Neural Computation and Neurotechnology theme clearly articulates its societal output, which is judged as strategically strong. The committee applauds the way the theme presents its societal impact and considers this an example to be followed by the other themes.

Viability

The Neural Computation and Neurotechnology theme has **excellent** viability. Although the research quality is not yet world-leading over the entire range of study domains, the theme consists of a very promising group of young scientists with great potential. The committee is convinced that this theme is excellently equipped to meet its targets in the next few years. The Neural Computation and Neurotechnology scientists presented themselves very well during the site visit and they clearly reap the benefits from aggregating scientists with a more quantitative/computational/theoretical/exact background in one theme.

The committee was particularly impressed by the strong strategic thinking of the theme's management. For instance, the theme has made strong strategic choices regarding its interaction within the DI (i.e., it does not want to become a service unit) and its position in the international scientific field. The committee applauds the decision to focus on AI in the brain. The theme is aware of the 'brain drain problem' (i.e., students with quantitative skills are a recruitment target in the industry) and has embarked in a European university alliance ('Neurotech') to combine resources and offer an attractive training environment for students, and is proposing to engage actively with the ELLIS network currently being established. The committee felt that greater attention needs to be paid to the growing demand for computing resources, which might soon outpace current plans for internally available infrastructure. It may be necessary to seek funding to expand these internal resources substantially, or to explore partnerships with national or international consortia. With regard to imaging technology, the theme is a major asset to the DI because it not only allows the institute to maintain its state-of-the-art infrastructure, but also to extend and improve this infrastructure through dedicated research on data analysis routines. A 14T scanner would further add to the theme's viability, whilst also requiring considerable resources, including finances, recruitment, and a shift in the research focus of some senior researchers.

3.5 Summary in numerical scores

In line with the qualitative judgements of the research described in chapters 2 and 3, the committee has assigned scores to the themes and the institute as a whole. The four possible scores are excellent (=1), very good (=2), good (=3), and unsatisfactory (=4). The scores are explained in more detail in Appendix 4 of this report. The committee would like to note again that this scoring system is not very sensitive and does not allow for heterogeneity in the assessment of subgroups within the themes.

Table 1: Quantitative assessment of four DI research themes and the institute as a whole

Theme	Research quality	Societal relevance	Viability
Language and Communication	1	2	2
Perception, Action and Control	1	1	1
Plasticity and Memory	2	1	2
Neural computation and Neurotechnology	2	2	1
Donders Institute as a whole	1	2	2

4. Response of the institute

We are indebted to the External Evaluation Committee for their critical insight. The committee made a number of important recommendations for which we are very grateful. We are sure these will help us to further foster the research within the Institute, maximize the synergy among Donders themes, enhance our societal impact, improve institutional infrastructure and increase its support for the students, researchers, and staff at the Institute. We will now briefly respond to them, and detail the current and planned actions.

- *Recommendations regarding overall strategy*
 - (1) Incorporate measurable goals in the institute's strategy
 - (2) Run polls to evaluate the effect of interventions
 - (3) Reconsider the current theme organization

The Donders Institute aims to become the flagship Research Institute for Brain, Cognition, and Behaviour within Europe by 2030 (*re. #1*). This goal, albeit being an ambitious one, is within the reach of the Institute in the foreseeable future.

As to its current organisation, the Donders Board has been critically evaluating the organizational structure of the management and research themes in consultation with the DI centres, researchers, staff members and our stakeholders (*#2*). A proposal for the new governance will soon be presented to its Supervisory Board, the Board of Governors.

To ensure that the new organization of the research themes meets the needs of our community and provide a strong basis for cooperation, synergy and growth for the years to come, the DI board has planned (otherwise already conducted) a number of consultation sessions and surveys (*#2,3*). The new theme organization is planned to come in place by early 2021.

- (4) Elect a benchmark institute

The Donders Institute is a multidisciplinary and interfaculty institute that studies the Brain, Cognition, and Behaviour. Organizations similar to the Donders Institute are commonly found in large prominent American Universities, including at Stanford, Harvard, MIT, Columbia, NYU, UPenn and on several campuses of the University of California (Los Angeles, San Diego, Berkeley, San Francisco) among many others. Thanks to philanthropic organizations financially supporting their initiatives, these institutes have resources to centrally support researchers, internally fund critical research projects with seed funds to help facilitate research progress and student education. European institutions tend to be smaller in scale, structurally supported by their parent organizations. Being a European institution with an organizational structure more similar to American universities, selecting a benchmark institute is not a trivial task. Currently, we are performing an in-depth evaluation of the criteria of comparison, measurement methods, standardization of measurement outcomes to create a comparative short-list of institutes in our field. We will be communicating the outcome and the benchmark institute for the DI before the end of 2023.

- *Research quality, societal relevance, viability*

(5) Further develop the societal impact strategy

Our societal impact strategy is rooted in our innovation programmes and closely embedded in our local community. In the coming term, in line with the external evaluation report, we will broaden our outreach, and partner with regional, national and international stakeholders. This is expected to pay dividends in terms of new funding avenues for the Institute given that the upcoming “Horizon Europe” funding scheme has a strong focus on societal relevance.

An example of this strategy is the European University of Brain and Technology (Neurotech^{EU}; www.theneurotech.eu). Through a partnership with eight leading universities in Europe and 250+ associate partners, we aim to transform our societal impact strategy. Going beyond establishing new partnerships, the think tank of the Neurotech^{EU} will allow us to be proactive in our societal impact strategy and shape our research, education and innovation programs.

(6) Develop a support programme for postdocs and strengthen their community

(7) Organize mental health training for staff

Following the recommendation of the external evaluation committee, the Donders Institute has already allocated annual funds to help form the postdoctoral council, facilitating a bottom-up initiative proposed by post-doctoral researchers (#6). The council will expedite networking and knowledge exchange, organize social events and workshops, host external speakers invited by the council, and will provide a support structure for all postdoctoral researchers at Donders (#6). In addition, they will have regular meetings with the portfolio holder responsible for Talent Development who will be a member of the DI executive board.

Next to our existing initiatives, like the peer-coaching programme, or the confidant system for the PhD candidates, the board appreciates the recommendation that mental health training and support should be provided for all staff, including PhD candidates and postdoctoral researchers, and will act accordingly. Donders PhD Candidates and postdoctoral researchers already benefit from university-wide offers, e.g. Mindfulness-Based Stress Reduction courses. We will continue informing institute members about the current and upcoming opportunities in our Donders Weekly Newsletter and an increase awareness among our staff in PI and Theme meetings.

All Donders Institute employees are also eligible to meet with occupational social workers of the AMD (Occupational Health & Safety and Environmental Service) to receive support and preventative help regarding their mental health. As an international institute that is home to researchers from 35+ countries, we recognize the fact that current support provided by AMD has its limitations as most AMD personnel do not speak English. In our new organizational structure, we aim to create a new position to facilitate staff training and development, to promote healthy living, organize workshops and consultation hours to increase awareness for mental health (#7).

(8) Increase the amount of structural funding for the DI

We appreciate the external evaluation committee's suggestion. We have created a lean institute which aspires to compete with established institutions with significant financial means. For the Donders Institute to remain competitive additional resources are needed to improve our governance, to support for cross-centre initiatives, to embark upon high-risk/high-gain team-science projects, and for development of novel, disruptive technologies.

(9) Harmonize procedures for tenured positions across the Donders centres

The Donders Institute cannot appoint any faculty members. Therefore Donders (a)PIs need to fulfil the promotion requirements of their own respective faculties which might differ across branches of science even in a given faculty. To establish more comparable conditions in the recruitment and promotion of Donders (a)PIs, the institute advocates cross-centre representation in all evaluation and appointment committees.

- *Facilities*

(10) Build a broader programme in human MRI

Being at the cutting edge of whole-brain imaging in humans and other animal models is critical for the continuation of a leading position of the Institute in brain, cognition, and behaviour. Since 2016 the MR group has obtained funding for: advanced motion correction techniques (3 postdocs, PI Marques); applications of high-frequency gradient coils (3 postdocs, PI Norris); quantitative MRI (1 postdoc, 1 PhD, PI Marques); diffusion-weighted imaging techniques (2 postdocs, PI Norris); applications of laminar fMRI in language (1 postdoc, PIs Hagoort/Norris). In the evaluation period, i.e. 2013-18, David Norris was the package leader for a German-financed project based at the Erwin L Hahn Institute on GABA spectroscopy (3 PhDs, co-PI Tendolkar). The MR Techniques group intends to continue its broad-based research programme, and running grant applications are also not confined to laminar fMRI. Should the 14 Tesla system be awarded this would of course vastly increase the range of MR-based research.

(11) Be more open about animal experiments

We agree that openness about animal research is very important. Therefore we actively promote preclinical-clinical collaborations, for instance through annual "Junior Researcher Rounds", and communicate our research in animal models, including in Donders Sessions.

Translational Neuroscience Unit (TNU), established by the institute in 2015, offers a unique opportunity for us to openly communicate our work with animal models. We have produced a movie (<https://www.ru.nl/donders/research/research-facilities/tnu/>) that provides a visual guide to our work and working environment. The website also provides an overview of the equipment available and the experts working with the equipment.

The animal facility and Radboud University have a "be open" policy regarding animal experiments, meaning that we do not hide our animal work. Public can and have visited the animal laboratory.

Despite these efforts, research on animal models is often not visible in society. To increase exposure and inform the public in a correct way about animal research we have become a member

of the European Animal Research Association (EARA). This organization has extensive experience with communication about animal experiments. In the coming term, with the help of EARA, TNU website will be updated to explain the extensive rules associated with animal experiments and show how we work with animals and the actions researchers undertake to increase animal welfare.

- *PhD Programme*

- (12) Develop a more formalized procedure for admission to the DGS

- (13) Clearly communicate what is expected for graduation

- (14) Inspect the figures on PhD duration and drop-out in more detail

We will take up the suggestion to formalize admission to the DSG (#12). We will keep on emphasizing quality above quantity in a PhD thesis (#13). So, while there are no formal quantitative rules on the minimum number of publications in a thesis, in consultation with the DGS, student and post-doc representatives we will investigate if some informal guidelines can be established (#13). Regarding the PhD duration, our figures suggest that we are comparable to the university and national average (i.e. 65 months at DI, 64 at RU, see [link](#) for field-specific national averages, #14). That is certainly not to say that improvements cannot be made, which is exactly the reason why we have implemented several assessment procedures over the last several years. For example, each PhD candidate and promoter/supervisors is required to provide a detailed research plan and a training and supervision plan at the start of PhD studies. Annual checkpoint meetings (with or without an external advisor) to discuss the feasibility of the research plans and the progression of the project are in place to check if the candidate progresses steadily towards the goal. After each of these meetings, the expected content of the thesis can be adjusted accordingly. We expect all these measures will help PhD candidates to know (better) what is expected from them which will reduce the PhD duration and increase completion dates.

- *Research integrity*

- (15) Maintain and extend the current emphasis on research integrity.

We appreciate the committee's positive evaluation of our efforts on this front as well. We will continue emphasizing research integrity as one of the pillars of success and disseminate the knowledge to everyone, from internship students to senior researchers, to promote responsible conduct.

- *Diversity*

- (16) Continue the efforts to improve the gender balance

- (17) Develop a policy to increase other aspects of diversity

- (18) Consider diversity in research

The Institute is committed to improving gender imbalance at all career levels (#16). In the next term, the Institute will broaden its focus on promoting all forms of diversity, including but not limited to gender, sexual identity, age, ethnicity, background, and disability (#16, #17). Because inclusivity is

a key aspect of the Institute's strategy, diversity is already an integral part of the Institute's policy, but its broader focus will be further developed. The institute will strive to have at least 30% of the executive board members and 30% of Theme speakers meet these criteria until the next evaluation.

Regarding diversity in research, recent findings on the sex-dependent differences in disease progression, drug response, roles of hormones, neural processing of stimulus, emotions and behaviour necessitate studying sex, and plausibly other diversity dimensions, as independent variables. We will also extend our research to underrepresented populations such as deaf and blind, immigrants and to populations outside of the Netherlands (#18). There will be an emphasis on the inclusion of gender within research questions and design in the Horizon Europe funding calls. This will be highly relevant for Donders research, the Institute will organize discussions, scientific workshops and meetings to increase awareness to diversity (in topic as well as researchers) at the Donders Institute.

We would like to thank the members of the evaluation committee, once more, for their careful analysis, critical insight and constructive criticisms. We believe their recommendations will help us to bring the Donders Institute to its next frontiers.

On behalf of the Directors of the Donders Board, the Speakers, the researchers and staff,

Prof. Harold Bekkering

5. Appendices

Appendix 1

Short biographies of the evaluation committee members

Menno Witter (chairman)

Menno Witter is a professor in neuroscience at the Norwegian University of Science and Technology (NTNU) in Trondheim and Director of the Norwegian Research School in Neuroscience. Witter received his PhD at the VU University in Amsterdam (the Netherlands) in 1985, where he subsequently started independent research on the anatomical organization of the hippocampal region. After many years of productive collaborations with May-Britt and Edvard Moser, leading to the discovery of grid cells in 2004/2005, Witter joined the Kavli Institute for Systems Neuroscience NTNU in 2007, where he started his own research group. The current work of his group focusses on the functional architecture of the lateral and medial entorhinal cortex, with the aim to contribute to the explanation of their functional differences. Together with colleagues at various universities in Norway, Witter initiated the Norwegian Research School in Neuroscience in 2013 and now acts as its director. He holds visiting researcher positions at the University of Amsterdam (the Netherlands), Johns Hopkins University in Baltimore (USA), and Tohoku University in Sendai (Japan) and he has been the inaugural chair of the Committee for Higher Education and Training of the Federation of European Neuroscience Societies FENS. Witter is an elected member of the Royal Norwegian Society of Sciences & Letters and the Norwegian Academy of Science, and recipient of the 2016 Olav Thon Foundation International Research Award.

Jeffrey Binder

Jeffrey Binder, MD, is Professor of Neurology and Biophysics, and Director of the Cognitive Neuroscience Research Center at the Medical College of Wisconsin, Milwaukee (USA). His research over several decades focuses on neuroimaging studies of language and conceptual knowledge systems in the human brain. He is a founding member and past chair of the Society for the Neurobiology of Language, the long-time Associate Editor for language studies at Journal of Cognitive Neuroscience, and a senior editor for Neurobiology of Language. As a clinical neurologist specializing in stroke and aphasia, Binder also conducts research on aphasia diagnosis and rehabilitation. His extensive work on presurgical brain mapping in epilepsy includes basic methodological studies, validation of fMRI language lateralization methods, and development of multivariate models for predicting language and memory outcomes in epilepsy surgery.

Bernadette Jansma-Schmitt

Bernadette Jansma-Schmitt is a professor at Maastricht University (the Netherlands). She received her PHD in 1997 at the Max Planck Institute (graduation RU) in Nijmegen on language production. In 1997-1998, she was awarded a McDonnell Pew and a German Academic Exchange (DAAD) Postdoc fellowship to work at UCSD San Diego on the time course of information selection in language production using the EEG. In 1998, she was invited to support the building up of Cognitive Neuroscience at Maastricht University within the Faculty of Psychology and Neuroscience (FPN). In 2002, she received a Dutch Science Foundation (NWO) Aspasia grant to study anaphoric references and the interaction of perception and language using EEG and fMRI. She was co-investigator in two German Science Foundation (DFG Schwerpunkt) programmes on language production, and collaborated in applied fields, such as health communication, reading development, and cognition in

metabolic diseases. She has been a full professor since December 2008. As department head (2004-2008), she contributed to the initiation of the Maastricht Brain Imaging center (M-Bic) and related training programmes, among them the international research master 'Cognitive and Clinical Neuroscience', the graduate school 'EU Marie Curie Initial Training Network NeuroPhysics', and the NWO graduate programme 'Methods in Neuroimaging'. She was Dean of the Faculty Psychology and Neuroscience from 2009 to 2016. In this period, she facilitated the implementation of high field fMRI (7T/9.4 T) in M-Bic and as BV (BrainUnlimited/Scannexus). She co-initiated the interfaculty Center for Integrative Neuroscience (CIN), and the Maastricht Center for Systems Biology (MacBio). In 2016-2018, as dean of the Faculty of Humanities and Sciences (FHS), Bernadette and her team prepared a transition to the Faculty of Science and Engineering (FSE). Currently, next to being a scientific member in the Brain and Language Group, M-Bic, and lecturer, Bernadette is reviewer for international peer reviewed journals, EU and VS national science foundations, and panel member in EU quality assessments for education and research.

Matthew Rushworth

Professor Matthew Rushworth is a Research Fellow in the Department of Experimental Psychology and Wellcome Centre for Integrative Neuroimaging (WIN), University of Oxford (UK). He has previously worked in London and in Montreal. His recent work has been concerned with the operation of neural circuits in prefrontal and cingulate cortex during decision making and social interaction. He is also interested in understanding functional interactions between brain areas during decision making and the anatomical connections that mediate those functional interactions. Over the years, the laboratory has been quick to develop and employ techniques for investigating brain-behaviour relationships that can be used with human subjects and/or which are non-invasive, such as transcranial magnetic stimulation (TMS), functional magnetic resonance imaging (fMRI), and diffusion weighted imaging (DWI). In some cases, however, it is also necessary to use animal models and the laboratory's work has been conducted not just with human subjects but also with rats and macaques.

Nicole Wenderoth

Professor Nici Wenderoth is full professor for Neural Control of Movement in the Department for Health Sciences and Technology at ETH Zürich (Switzerland). Her main research focuses on human systems neuroscience. She leads a multi-disciplinary team which combines brain imaging and non-invasive brain stimulation methods to investigate and modulate brain activity of the sensorimotor system. In addition, she actively pursues translation to research in animal models via a novel 'chemo-connectomics' approach which combines fMRI of network dynamics with chemogenetic manipulations at the cell level. Recently, her group began translating selected technologies for testing or training motor functions from the lab to clinical applications. She is currently the Director of the Institute of Human Movement Sciences and Sport, Director of the interdisciplinary research programme Future Health Technologies at the Singapore-ETH Campus, and President of the Betty and David Koetser Foundation for Brain Research. She is an active teacher and mentors several early career scientists, particularly young women in academia.

Henrik Walter

Henrik Walter, MD, PhD, is a German psychiatrist, neurologist and philosopher. Formerly serving as Professor of Biological Psychiatry in Frankfurt (2004-2006) and Professor of Medical Psychology in

Bonn (2006-2009), he was appointed in 2010 as the Chair for Psychiatry, Psychiatric Neuroscience and Neurophilosophy at the Universitätsmedizin Charité Berlin (Germany). He is Director of the Research Division of Mind and Brain, located within the Department of Psychiatry, where he also serves as its Medical Deputy Director. He worked on neurocognitive mechanisms of higher mental functions and emotions, contributed to the development of imaging genetics, and is now using Big Data to inform clinically oriented imaging science. Besides publishing more than 400 papers and chapters, he wrote a monograph on 'Neurophilosophy of Free Will' (MIT 2001) and edited seven books, amongst them the first German text book on 'Functional Neuroimaging in Psychiatry' (2004) and the text book 'Psychoneurosciences' (in press). His current research topics are in cognitive neuroscience (emotion anticipation and regulation, stress and resilience, mentalizing, and anhedonia), methods (connectomics, big data), imaging science in psychiatry (schizophrenia, depression, addiction, psychotherapy) and neurophilosophy (philosophy of psychiatry). He is PI or WP leader in many National and International Research consortia, including IntegraMent, ESPRIT, SysMedSU, TRR 265: Losing and Gaining control on drug intake, RTG 265: Extrospection: External Access to higher mental states, Clinical Connectomics, DynaMoRe (Dynamic Modelling of Resilience), Imagen, Stratify, PGC and ENIGMA. From 2014-2018, he served as Head of the Ethical Advisory Board of the European Human Brain Project. His three major future goals are to contribute to make translation in psychiatry happen, to investigate the neurobiology of positive mental states and to develop an integrative view on the nature of mental disorders.

Louise Gallagher

Professor Louise Gallagher, MB BCH BAO MRCPsych PhD FTCD, is Chair of Child and Adolescent Psychiatry, TCD, Director of Research in the Trinity College Dublin School of Medicine (Ireland). Her special interest is in neurodevelopmental disorders and rare neurogenetic disorders. She leads an autism and rare neurodevelopmental disorder research group in Trinity College Dublin focused on clinical translational research. The research is focused on understanding the relationships between genetic risks, endophenotypes and symptoms ultimately to provide insights into key molecular processes associated with autism and other rare neurogenetic syndromes. The group is strongly multidisciplinary and collaborative and engages widely with the broader community. In her role as Director of Research in the TCD School of Medicine she is responsible for the development and implementation of strategy for the School within the context of the University's Research Charter and Strategy. As a clinician scientist, she also has a clinical psychiatry commitment to the Irish health service.

Karla Miller

Professor Miller is Professor of Biomedical Engineering at the University of Oxford. She develops novel techniques for MRI acquisition, reconstruction, and analysis. She studies brain microstructure using multi-modal imaging, including MRI and microscopy. Currently, she is the Associate Director of the Wellcome Centre for Integrative Neuroimaging (WIN) and co-leads the UK Biobank neuroimaging study. She is a member of the NeuroSpin Scientific Advisory Board. She has been very active in the International Society for Magnetic Resonance in Medicine (ISMRM), including as an elected member of the Board of Trustees and as Programme Chair for the ISMRM Annual Meeting in 2018. She is a deputy editor of Magnetic Resonance in Medicine, and has served in the editorial boards of Neuroimage and NMR in Biomedicine. She has taken on leadership roles in promoting equality, diversity and inclusion within WIN and the ISMRM.

Maneesh Sahani

Maneesh Sahani is Professor of Theoretical Neuroscience and Machine Learning, and the Director of the Gatsby Computational Neuroscience Unit at University College London (UCL). Graduating with a B.S. in physics from Caltech, he stayed to earn his Ph.D. in the Computation and Neural Systems programme, supervised by Richard Andersen and John Hopfield. After periods of postdoctoral work at the Gatsby Unit and the University of California, San Francisco, he returned to the faculty at Gatsby in 2004, becoming Director of the Unit in 2017. His work spans the interface of the fields of machine learning and neuroscience, with particular emphasis on the types of computation achieved within the sensory and motor cortical systems. He has helped to pioneer analytic methods which seek to characterize and visualize the dynamical computational processes that underlie the measured joint activity of populations of neurons. He has also worked on the link between the statistics of the environment and neural computation, machine-learning based signal processing, and neural implementations of Bayesian and approximate inference.

Linda van den Berg

Dr Linda van den Berg is an independent science writer and scientific secretary with a background in the life sciences. She obtained a MSc in fundamental biomedical sciences in 2000 (*cum laude*) and a PhD in behavioural genetics in 2006, both from Utrecht University (the Netherlands). In the period 2006-2012, she was a Postdoctoral Researcher at VU University Medical Center (the Netherlands), the Broad Institute of Harvard and MIT (USA), and Leiden University Medical Center (the Netherlands). Since 2012, she has worked as a professional science writer and scientific secretary, with a special interest in research quality and science & society. Her company Washoe Life Science Communications offers a variety of communication services to academic institutes, governmental organizations, and companies. Since 2015, she has served as an independent secretary to a variety of research assessment committees.

Appendix 2

Programme of the site visit

Day 1: Monday, October 28, 2019

Location: *Heyendael Mansion* (on University campus)

- 15.30 Taxi from hotel *Blue* to campus.
- 16.00 - 18.00 **Room Schrijnen (plenary committee only)**
Closed session (discussion on individual impressions, programme, procedures, and content of interviews).
- 18.00 - 19.00 **Room Cals**
Welcome by the Rector Magnificus (Prof. Han van Krieken): Reception and introduction with Chair of the Board of Governors (Prof. Lutgarde Buydens) and the DI Board Members (DI Chair, Scientific Directors, Theme Speakers and Management Directors)
- 19.00 Taxi from campus to restaurant
- 19.15 Committee dinner (**Committee only**)
- 21.00 Short walk to Hotel Blue.

Day 2: Tuesday October 29, 2019; location Heyendael Mansion on campus

- 08.15 Taxi from hotel to campus
- 08.45 - 09.30 **Room Marijnen (plenary committee)**
Overview and discussion on the Donders Institute by Donders Chair, Prof. dr. Harold Bekkering; 15 min. interactive presentation followed by 30 min. interview
- 09.30 - 09.45 Intermediate meeting/writing committee
- 09.45 - 10.30 **Room Titus Brandsma (plenary committee)**
Presentation **Theme 1: Language and Communication** Prof. dr. Asli Ozyurek and 2 PIs - 15 min. interactive presentation followed by 30 min. interview
- 10.30 - 10.40 Intermediate meeting/writing committee
- 10.40 - 11.25 **Room Titus Brandsma (plenary committee)**
Presentation **Theme 2: Perception, Action and Control** Prof. dr. Alan Sanfey and 2 PIs - 15 min. interactive presentation followed by 30 min. interview
- 11.25 - 11.40 Intermediate meeting/writing committee
- 11.40 - 12.25 **Room Titus Brandsma (plenary committee)**
Presentation **Theme 3: Plasticity and Memory** Prof. dr. Indira Tendolkar and 2 PIs - 15 min. interactive presentation followed by 30 min. interview

- 12.25 - 12.35 Intermediate meeting/writing committee
- 12.35 - 13.15 **Room van Agt** Lunch (**plenary committee only**)
- 13.15 – 14.00 **Room Titus Brandsma (plenary committee)**
Presentation **Theme 4: Neural Computation and Neurotechnology** Prof. dr. Tansu Celikel and 2 PIs - 15 min. interactive presentation followed by 30 min. interview
- 14.00 - 14.55 **Room Titus Brandsma (plenary committee)**
Intermediate meeting/writing
- 14.55 - 15.10 Walk to Donders Laboratories (**plenary committee**)
- 15.10 - 16.30 Donders Laboratory tour (**committee members can choose which part**)
- 16.30 - 17.00 **Room Titus Brandsma (plenary committee)**
Coffee/beverages break (including snack or fruit) and writing committee (**plenary committee**)
- 17.00 - 17.45 **Room Titus Brandsma (plenary committee)**
Graduate School Donders Institute by Coordinator Graduate School Dr. Femke Maij and Prof. dr. Rob van Lier, Programme Director Research Master Cognitive Neuroscience (CNS).
- 10 min. interactive presentation followed by 35 min. interview.
- 17.45 – 18.00 Intermediate meeting/writing committee
- 18.00 - 18.40 **Two parallel sessions:** Interview PhD candidates (**Room Titus Brandsma**) and Postdocs (**Room Cals**) (**committee divides in two sub-groups**)
- 18.40 - 19.00 **Room Titus Brandsma** Writing on report (**plenary committee**)
- 19.00 Taxi from campus to hotel
- 19.40 Walk to restaurant
- 20.00 Dinner **Plenary Committee** together with Chair Board of Governors, Chair Donders Institute, 4 Speakers, 5 Directors Donders Centres and Staff Member University Board.

Day 3: Wednesday October 30, 2019
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- 08.00 Taxi from hotel to campus

- 08.30 – 09.00 **Room Titus Brandsma Plenary Committee only:** Wrap-up, planning and determination of eventual extra interview
- 09.00 - 11.35 **4 Parallel sessions** of the Themes; per Theme 10 min. interactive presentation followed by 20 mins. interview for each of four groups (i.e. a mixture of approx. 6 junior and senior persons) followed by 10 min. resp. 15 min. break and change of group).
Room Titus Brandsma: Theme 1 (Committee members: **Binder and Jansma-Schmitt**)
Room Cals: Theme 2 (Committee members: **Rushworth and Wenderoth**)
Room Schrijnen: Theme 3 (Committee members: **Walter and Gallagher**)
Room Hermesdorf: Theme 4 (Committee members: **Miller and Sahani**)
- 11.35 - 12.00 **Room Titus Brandsma** Intermediate meeting/writing committee (**plenary committee**)
- 12.00 - 12.40 **Room van Agt** Lunch (**plenary committee only**)
- 12.40 – 13.00 **Room Titus Brandsma (plenary committee)** Interview Board of Governors DI. Prof. dr. Lutgarde Buydens, Prof. dr. Michiel Kompier and (by phone or Face-time) Prof. dr. Jan Smit
- 13.00 - 13.45 **Two parallel sessions:** Interview Societal Impact partners. **Committee in two sub-groups (Room Titus Brandsma)** Health domain: Jan Lantink (Chair Parkinson Society) and his wife Corine. van Esch.
(Room Cals) Food domain: Dr. Ric van Tol (Senior Consultant, TNO Healthy Living)
- 13.45 - 14.00 Writing on report
- 14.00 - 15.00 **Room Marijnen (plenary committee)**
Interview DI Board Members + optional some others if indicated by Committee
- 15.00 - 17.15 **Room Titus Brandsma (plenary committee only)**
Meeting to discuss results, prepare presentation and plan further procedures to finish assessment report. About 16.00 hrs snack/fruit beverages in the room.
- 17.15 - 17.30 Short break and walk to **Trigon Building (plenary committee)**
- 17.30 - 17.50 Presentation of preliminary conclusions by Chair Committee in a DI broad session and in presence of the Rector and a representation of the Deans (**plenary committee**)
- 17.50 Closure, informal meeting and drinks
- 18.45/19.00 Dinner (optional for those members who do not leave immediately)

Appendix 3

Quantitative data on the institute's composition and funding

Table A1: Composition of the institute

Research staff	2013 #pers	2013 FTE	2014 #pers	2014 FTE	2015 #pers	2015 FTE	2016 #pers	2016 FTE	2017 #pers	2017 FTE	2018 #pers	2018 FTE
Professors ¹	145	62	157	67	153	69	170	74	172	72	169	73
Other scientific staff ²	208	136	249	160	248	161	270	161	233	140	229	137
PhD candidates ³	238	177	283	211	305	226	286	230	316	240	315	235
Total	590	375	688	438	706	456	727	465	720	452	713	444

Note 1: Comparable with WOPI categories full professor (HGL), associate professor (UHD) and assistant professor (UD); tenured and non-tenured staff,

Note 2: Comparable with WOPI category Onderzoeker,

Note 3: Standard PhD (employed), excl. contract PhD candidates (externally or internally funded but not employed)

Note 4: The sum may deviate because of the rounding of decimals.

Table A2: Support staff at the institute

	2013	2014	2015	2016	2017	2018
Support staff [FTE]	55	59	66	80	85	75
Support staff [% of total]*	11	12	12	13	14	13

* Percentage of the total amount of FTE financed by the institute (see Table A3 below).

Table A2 presents the FTE and percentage of technical and ICT support staff (i.e., technical and ICT support staff) at the Donders Institute. Data is based on the financial administration databases of the four Donders Centres. Therefore, the table only includes personnel with a paid contract at one of the four Donders Centres.

Table A3: Funding of the institute

	2013		2014		2015		2016		2017		2018	
Funding:	# FTE	% FTE	# FTE	% FTE	# FTE	% FTE	# FTE	% FTE	# FTE	% FTE	# FTE	% FTE
Direct funding ¹	168	39%	179	39%	195	38%	212	40%	211	40%	207	39%
Research grants ²	107	25%	122	26%	126	25%	126	24%	119	22%	133	25%
Contract research ³	160	37%	163	35%	186	37%	196	37%	201	38%	187	35%
Total funding	435	100%	464	100%	507	100%	534	100%	530	100%	527	100%
Expenditure:	k€	% €	k€	% €	k€	% €	k€	% €	k€	% €	k€	% €
Personnel costs	28.401	68%	29.776	68%	32.614	70%	36.191	69%	36.191	69%	35.348	68%
Other costs	13.391	32%	14.314	32%	14.306	30%	15.920	31%	16.586	31%	16.823	32%
Total expenditure	41.793	100%	44.090	100%	46.920	100%	52.112	100%	52.777	100%	52.171	100%

Note 1: Direct funding (basis financiering / lump-sum budget),

Note 2: Research grants obtained in national scientific competition (e.g. grants from NWO and related),

Note 3: Research contracts for specific projects obtained from external organisations such as European Commission and ERC, charities, government and industry.

The data in Table A3 is based on the financial administration databases of the four Donders Centres. Therefore, the table only includes personnel with a paid contract at one of the four Donders Centres, so not from MPI and CLS. FTEs in this table are representative of pure research time (i.e., excluding teaching, management, and clinic).

Appendix 4

Explanation of the categories utilized (scores 1-4)

Category	Meaning	Research quality	Relevance to society	Viability
1	World leading/ excellent	The research unit has been shown to be one of the few most influential research groups in the world in its particular field.	The research unit makes an outstanding contribution to society.	The research unit is excellently equipped for the future.
2	Very good	The research unit conducts very good, internationally recognised research.	The research unit makes a very good contribution to society.	The research unit is very well equipped for the future.
3	Good	The research unit conducts good research.	The research unit makes a good contribution to society.	The research unit makes responsible strategic decisions and is therefore well equipped for the future.
4	Unsatisfactory	The research unit does not achieve satisfactory results in its field.	The research unit does not make a satisfactory contribution to society.	The research unit is not adequately equipped for the future.

Source: Standard Evaluation Protocol 2015 – 2021 Amended version, 2016