

Document 3a

Leiden University Institute of Psychology

Self-Evaluation of its Research Programme (2011-2016)



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Faculty of Social and Behavioural Sciences
Leiden University, The Netherlands
June 2017

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Executive Summary

The Institute of Psychology is one of the five institutes within the Faculty of Social and Behavioural sciences at Leiden University. The Institute's mission is to *perform rigorous and innovative research into the neuro-cognitive and motivational underpinnings of human behaviour with practical implications for health, and economic and environmental decision-making*. We ask whether, when and how humans control their actions, regulate stress and well-being, and cooperate with and trust others to create collective goods and solve conflicts. We wonder how brain and behaviour develop over the lifespan and we seek to understand the root causes of dysfunctional tendencies and psychopathologies, and how we can help children, adults and elderly—vulnerable and resilient—to make the decisions that improve well-being and welfare.

Using novel experimental techniques and innovative technologies we develop neuro-biologically tractable and psychologically plausible explanations with strong translational value and clear societal benefit. To achieve its ambitions, the Institute recruits and develops *high-quality staff* at all levels of seniority, invests in *state-of-the-art laboratory facilities* for experimental research and technological infrastructures for neuroscientific and psychological measurement, and promotes *cross-disciplinary work with the medical, biobehavioural and neurosciences*. To ensure and promote its aims for strong translational science that benefits society, the Institute forged *mutually beneficial public-private collaborations* (PPC) with stakeholders in healthcare, and environmental and economic decision-making through *5 new Special Chairs* and a new *Clinical Facility*.

Our Institute has developed into one of the major players in psychological science within Europe. Compared to the previous period, MSc student numbers increased by 40% to 646, 25% of whom have an international background. Full-time equivalent for research increased by 29%, research productivity increased by 38% to over 300 peer-reviewed publications per year, and annual income from competitive grants increased by more than 200%. Indeed, both our basic and translational science is very successful. The quality of our staff is high and the Institute has a *strong culture of collaboration and scientific integrity*. Our research is published in the best journals and its scientific impact exceeds both national and international means. No less than half of our work is published in cross-disciplinary outlets, with *strong impact in the medical, biobehavioural, and neurosciences*. With over 32M€ in *excellence grants* from NWO and the ERC, we have contributed ground-breaking insights into the ways emotional maltreatment of children translates into affective disorders in adulthood, into the neurobiological trajectories underlying adolescent pro-sociality and risk-taking, into the neural and motivational underpinnings of human cooperation and conflict, and into the biomarkers for the early detection of dementia. Our PPCs accumulated in over 5M€. It created over 50 new jobs-years in research and development around healthcare and environmental and economic decision-making, networked databases of 500,000 patients for new translational research, instruments and tools for diagnosis and patient care, and evidence-based policy advice for governance.

Our future is bright. The Institute has a positive reputation for its science and work climate and is financially healthy. Its basic research seamlessly connects to leading research agendas at the (inter)-national level, and staff members take central positions in (inter)national networks with leading institutes and research universities. Our connections to stakeholders in targeted domains of practice provides for a strong position to make new and exciting discoveries about the workings of the human mind with actionable and transferrable implications for both science and society.

1. Organization

1.1 Local Embedding

The Institute is part of the *Leiden Faculty of Social and Behavioural Sciences*, together with the Institutes of Education and Child Studies, Political Science, Cultural Anthropology and Development Sociology, and the Centre for Science and Technology Studies. At the end of 2016, the Institute employed *100 scientific and 19 technical support staff, 59 PhD students and 27 Postdoctoral fellows*. The overall responsibility for the Institute rests with the Scientific Director (De Dreu [Westenberg from 2011—2017]), who is supported by a Director of Studies and an Institute Manager; They consult with the Institute's Full Professors and with the Scientific Committee (PhD programme and strategy), the Ethics Committee (ethics; research integrity), and the Partial Beta-Fund Committee (laboratory facilities).

1.2 National and international embedding

The Institute coordinates two *cross-disciplinary Research Priority Areas (RPA)* at Leiden University: "Health, prevention and the human life cycle," and "Brain function and dysfunction over the lifespan." Research staff assume key roles in (inter)national graduate training networks (see Doc 1B), in (inter)national academic societies such as the *Royal Netherlands Academy of Sciences and Arts (KNAW)*, the *Association for Psychological Science*, and agenda-setting institutions such as *NWO* and the *ERC*. The Institute participates in the *NWO-Gravity Programme on Individual Development*, has strong and institutionalized affiliations with renowned research institutions such as various *Max Planck Institutes*, and with world-leading research universities and their medical centres (e.g., *Oxford, Cambridge, New York University, Stanford, University College London*). Since 2011 in particular, the Institute has created public-private collaborations (PPC) for translational science with major stakeholders in *healthcare*, and *economic and environmental decision-making*.

1.3 Funding channels

Direct Funding. Leiden University provides a 27% addition to the funding provided for teaching undergraduate students, bonuses for successful grant acquisition and successful PhD defences and a *partial beta-fund (PBF)*—a fixed amount per annum from Leiden University as partial compensation for the lower direct funding to the social and behavioural sciences relative to the biological and medical sciences. The PBF finances cost-intensive facilities and research infrastructures for psychological science. Direct funding comprises between 34% (2011) and 45% (2016) of the total research budget.

Competitive Grants. Funding from competitive grants comprised between 48% (2011) and 47% (2016) of the Institute's research budget and generated an average 3.18M€/year (per Appendix 1: Table 3.D3c).

Other Income. The institute obtained on average 773K€/year from research grants from not-for-profit agencies and charitable organizations (per Appendix 1: Table 3.D3c). This figure does not include the substantial funding (well beyond 1M€/year) for our translational science in healthcare, and environmental and economic decision-making (see Section 5.2, and Appendix 2.4.1 and 2.4.2).

2. Strategy

To achieve its mission, the Institute aims to provide *excellent research infrastructures and experimental laboratories* for research from the molecular to the (inter)group level of analysis; to stimulate *cross-disciplinary work with high translational value*, and to organize research around *six viable units of basic and translational science* that, together, span the breadth of psychological science.

2.1 Technological and Research Infrastructures

Since 2011, and in adherence to policy set forth by the Faculty of Social and Behavioural Sciences, the Institute has invested the PBF in experimental laboratories and advanced measurement technologies. During this evaluation period, the Institute created for its Staff and PhD students *free of charge* access to and usage of (i) 35 fully-equipped cubicles for behavioural experiments; (ii) 5 behavioural labs for interactive studies (e.g., group decision-making; public speaking; driving simulations) equipped with Biopac® wireless units for assessing ECG, GSR, Respiration; (iii) 2 Baby Labs for visual and auditory research, equipped with looking-time systems and Tobii® T120 eyetracker; (iv) 10 Physiological Labs equipped with Biopac® wireless, ECG, GSR, ICG, BMEYE®, EMG facilities for hormonal and VSRRP98 measurement; and 32-, 32-, 64-, and 128-channel Biosemi; (v) 10 Workspaces with Matlab®, Tobii®, and BVA® for data analysis; (vi) computing facilities “Corleone” and “Shark” for big data and high-fidelity processing; and (vii) research-dedicated 3T and 7T MRI scanners (Philips).

2.2 Cross-Disciplinary Research

Cross-disciplinary research is promoted through active participation in two RPAs that receive additional funding from Leiden University. Staff members assumed leadership roles in both RPAs. “*Brain function and dysfunction over the lifespan*” (Hommel, Rombouts) brings together the cognitive and the biomedical neurosciences in a unique multidisciplinary setting, studying brain function and dysfunction in the developing, adult, and ageing brain. “*Health, prevention and the human life cycle*” (Elzinga, Evers, Westenberg) focuses on health from infancy and childhood to old age.

2.3 Science-to-Practice Transfer

To facilitate societally relevant research and application, the Institute has promoted research collaborations with professional stakeholders in healthcare, and economic and environmental decision-making. Specifically, it (i) created 5 *new Special Chairs (Bijzondere Leerstoelen)* that serve as link-pins with non-academic partners and professional stakeholders; (ii) built, in conjunction with the Institute for Education and Child Studies, a *full-scale Clinical Facility* for patient counselling and psychotherapy; and (iii) stimulates *public outreach* through its Annual LIBC-days (co-funded by Leiden Municipality) and *open access science*.

2.4 Thematic Research Programmes

To facilitate the interchange between internationally competitive basic and translational science on the one hand, and targeted translation into actionable insights in various stakeholder domains on the other, the Institute has organized its research into six identifiable programmes with good span of control (see also Section 5.1 and 5.2 for highlights and key scientific discoveries).

Action Control aims to unravel the neurocognitive, neurochemical, and functional mechanisms underlying the control of intentional actions, how they are shaped by goals and internal needs, and adaptively tailored to environmental circumstances and challenges. We investigate how actions are organized and controlled by perceptual and affective processes, working memory, intentional selection processes and mental sets, and how planning and performing actions reflect back on cognition, emotion, and self-representation. Translational value is in the domain of economic and environmental decision-making.

- *Senior Staff*: Hommel; Nieuwenhuis; Band.
- *Research Methods*: Behavioural experiments in healthy subjects, special populations (e.g., drug users, patients, children, elderly), and non-human primates; psychophysiological, psychopharmacological, and brain-imaging measurement (EEG, MEG, fMRI) and stimulation techniques (tDCS, tVNS); behavioural genetics, neuro-computational simulations, and virtual reality.
- *Academic Partners*: Univ. Amsterdam, Univ. Toronto, MPI Evol Anthropology, UC Davis, Caltech.

- *Non-Academic Partners*: Winlove Probiotics Company; LEF future center/Rijkswaterstaat, MARIN, SWOV, KLM, NLR, TNO, Gemeente Leiden, Sophia Revalidatie Den Haag, Onderzoeksraad voor Veiligheid, Philips Research, Hersenstichting, Apenheul Primate Park.

Social Decision-making examines the neurocognitive and motivational mechanisms involved in (i) the decisions that influence other people, and create cooperation and conflict within and between groups of individuals; and (ii) judgment and decision-making during financial hardships (e.g., debts, poverty) and how decision-making under such conditions can be improved. Translational value is in economic and environmental decision-making.

- *Senior Staff*: E van Dijk; Ellemers (until 09/2015); De Dreu (per 01/2016); W van Dijk; van Dillen; Scheepers.
- *Research Methods*: Game-experimental studies of behavioural decision-making; randomized control trials and longitudinal survey studies; video-registered group decision-making; hormonal challenge and measurement; eye-tracking; fMRI, EEG; neurophysiological stress-responses.
- *Academic Partners*: MPI Collective Goods (Bonn); Universities of Amsterdam, Oxford, Stanford, New York, Toronto, Sapienza University (Rome), Vrije Univ. Amsterdam, Tilburg;
- *Non-Academic Partners*: National Institute for Family Finance (NIBUD), Tax and Customs Administration (Belastingdienst); Authority Financial Markets (AFM); TNO Delft.

Pathways through Adolescence contributes to a deeper understanding of this key transitional period in human development through a unique combination of experimental, neurocognitive and psychophysiological analysis of normative transitions as well as developmental deviations in adolescent development. Professional outreach is in education (psychological testing; anxiety and school refusal) and healthcare.

- *Senior Staff*: Crone, Westenberg; Güroglu; Resing; Rieffe; Heyne.
- *Research Methods*: fMRI; EEG; ECG; mobile eye-tracking; automatic speech analysis; measurement of neuro-hormones; behavioural observations; on-line surveys; testing and training with tablets; cognitive training programmes; clinical trials; experimental and cross-sequential longitudinal designs; family and genetic designs; microgenetic designs.
- *Academic Partners*: Gravity-consortium (Universities of Utrecht, Leiden, Amsterdam, Groningen, Rotterdam, Nijmegen, and VU Amsterdam); Harvard; UC Berkeley; UCLA; Duke; Cornell; Yale; Aarhus; Pittsburgh; Max Planck Inst. Berlin; Univ. College London; Cambridge.
- *Non-Academic Partners*: Dutch Foundation of the Deaf and Hard of Hearing; Dutch Educational Services (OnderwijsAdvies & HCO); Stichting Breekjaar; NIBUD; Stichting Rubinstein-Taybi syndroom; Fragiele X syndroom vereniging; Stichting ABBAS; Landelijke Kenniskring Schoolweigeren; Stichting Centrum 1622; Jeugdformaat; TNO-Leiden; Borselen Scholengemeenschap Rotterdam.

Stress and Psychopathology examines (i) the aetiology, psychological and biological mechanisms and treatments of psychopathology, in particular the mood and anxiety disorders, and (ii) how prevention and treatment of affective disorders can be improved. The programme specifically focuses on the neurocognitive and behavioural effects of psychological, pharmacological, nutritional and other lifestyle interventions, and evaluates the effectiveness of novel psychological, pharmacological and neurostimulation interventions. Professional outreach is in the domain of healthcare.

- *Senior Staff*: Spinhoven; Van der Does; Elzinga; Putman; De Bruijn; Garnefski; Schoorl; Blom; De Beurs.
- *Research Methods*: Clinical trials; Cohort studies; case-control studies; experimental (psychological and biological challenge) designs; surveys; eye-tracking; fMRI, EEG; neurophysiology.
- *Academic Partners*: NESDA consortium (VU, Univ. of Groningen; Trimbo Institute); LUMC; LIACS, Cambridge Univ., Oxford Univ.; Universities of Mannheim, Amsterdam, Nijmegen, Hong Kong.
- *Non-Academic Partners*: Parnassia mental health center; PsyQ mental health; Rivierduinen mental health; 113Online (lifeline); RINO groep; SBG; CURIOUS.

Self-regulation and Health examines self-regulation in cognition, stress, and adjustment in relation to health. Key foci are the psychological and neurobiological aspects of health, in order to prevent, assess and treat psychological aspects of somatic conditions, and to unravel their underlying mechanisms. Translational value is the domain of healthcare.

- *Senior Staff*: Evers (per 01.11.2013); Brosschot; Gebhardt; Van Middendorp (per 01.01.2014); Middelkoop; de Gucht; Veldhuizen; Maes (until 01.01.2013).
- *Research Methods*: Experimental exposures to physical and psychological challenges; quantitative sensory testing (QST); survey and user-focused designs in patient populations; eHealth applications (e.g. gaming, e-coaching, virtual reality); neurobiological markers (e.g. cortisol, cytokines) and challenges (e.g. BCG challenge, immune conditioning); fMRI; EEG; navigation tools; genotype assessments.
- *Academic Partners*: LUMC; Medical Delta Network; Gent Univ.; Univ. Groningen; Univ. Amsterdam; Radboud Univ.; Utrecht Univ.; Maastricht Univ.; Ohio State Univ.
- *Non-Academic Partners*: Various national consortia with medical centres and mental health care centers; TNO; GGD and private companies in, e.g., the area of eHealth (Karify).

Multivariate Analysis studies how psychological research is performed and how statistical methods are used, develops new statistical methods and measurement techniques for psychological science, and provides significant support to the Institute's research programmes. The programme focuses on statistical learning for psychological research, fMRI methodology, and applied psychometrics. Translational value is in the domains of healthcare and in the internal methods and statistics support provided to our research staff.

- *Senior Staff*: De Rooij; Rombouts; Heiser (until 31.12.2014); Dusseldorp (per 1.8.2015).
- *Research Methods*: Thinking, Computer Simulation, fMRI and other MRI modalities.
- *Academic Partners*: KU Leuven; Universities of Coventry, Manchester; Naples; Granada; Oxford; McGill Univ.; Medical Univ. of Graz; Sao Paulo; Erasmus Medical Center; Donders Institute; AMC-UvA; VUMC-Alzheimer Center; UMC Utrecht.
- *Non-Academic Partners*: CITO, SPSS, Kenniscentrum UWV, Centre for Human Drug Research (CHDR), TNO Leiden; various University Medical Centres (Radiology; NeuroImaging).

3. Specific targets

3.1. Specific targets for the past six years

The previous evaluation took place in 2010. In this report we presented five targets for the current period. First, we aimed to expand our broad and dynamic programme of research. In 2014, the Institute created a *new programme on self-regulation of health behaviour* (with strong connections with Leiden University Medical Center and the Delft-Erasmus-Leiden Medical Delta). It complements the other programmes, in particular that on stress and pathology, and it is a prime example of our aim to combine basic and translational science. Second, we aimed to maintain and *upgrade our research infrastructures and laboratory facilities*. This goal has been achieved, in part with the aid of the PBF. Third, we aimed to further cross-disciplinary research through active involvement in the two RPAs, and by *promoting cross-cutting collaborative research* both within and outside of our Institute. We achieved this target: 236 publications (8%) were co-authored by staff members from at least two research programmes within the Institute, a percentage that increased from 7% (2011) to 11% (2016). Fourth, we aimed to *increase earning power*. This goal was accomplished. Income from competitive grants doubled compared to the previous period (see Section 6.3). Finally, we aimed to develop and *attract top-scientists at all career-levels*. In addition to senior scientists (Evers in 2013; De Dreu in 2016), the Institute hired 36 new assistant professors. Finally, and next to these self-set targets, the previous research evaluation committee noted the absence of a full-scale Clinical Facility for translational science in clinical and health psychology. With the help of Leiden University, the

Institute was able to fill this gap with a *new and internationally competitive Clinical Facility* (also see Section 5.2).

3.2. Specific targets for the next decade

The institute is on a clear and upward trajectory to become one of the main centres for psychological science in Europe, both in terms of student numbers and in terms of research facilities, research volume, and visibility. Its unique blend of basic and translational science provides for a strong identity and enables further growth. To support these positive developments, the Institute aims to further *intensify cross-disciplinary research*, to solidify its strong interconnection with the medical and neurosciences and to further *expand outreach towards experimental/behavioural economics and (neuro)biology*. Relatedly, it aims to solidify its strong embeddedness in professional networks and institutions, and to continue and further implement our *culture of open science*, including transparent reporting and modern data stewardship. Following from our SWOT-analysis (Section 8), future targets include (i) a *structurally funded PhD programme* that contributes to the Institute's international visibility, outreach, and reputation; and (ii) *new space for offices and laboratories* that can provide a large interconnected computer-laboratory for (neuro)economic decision-making, access to Pet-CT scanner and MEG-facilities, expanded lab facilities for neuroendocrine measurement and challenge studies, an advanced VR Environment, and accessible TMS/TBS/TDCs facilities and technology; and (iii) *upgraded computing facilities for big data*.

4. Performance Criteria

In Section 6 we self-assess our performance. *Quality* is assessed in terms of (i) Productivity and impact relative to the previous period, and to the (inter)national benchmark; (ii) Cross-Disciplinarity, as reflected in number and impact of publications in non-psychology journals; our high impact fields outside of psychology, and our Knowledge User Profile (Appendix 2.9); (iii) Quality of the PhD Programme, as reflected in entrance, turn-around and career prospects of PhD-students; and (iv) Peer Recognition through memberships of editorial boards; plenary keynotes at international congresses, and awards and honours. *Relevance* is assessed in terms of (i) *Public Outreach* through publications for professionals; non-academic audience publications, lectures and seminars, open access science, and increase in MSc students numbers; (ii) Science-Practice Transfer as evidenced by Special Chairs and our strong interconnectedness with training (research) Master students, and (iii) Value-creation through Public-Private Collaborations—the extent to which our scientific insights transmit to and are applied by stakeholder organizations, and the estimated economic revenue our science generates. *Viability* will be assessed in terms of the (i) Funding Channels, including earning power; (ii) Quality of our Staff Members; (iii) Research Facilities; and (iv) Research Potential and Future Outlook.

5. Results achieved

5.1 Scientific highlights

This section highlights six streams of scientific discovery that we consider exemplary for our work and that define the Institute's scientific outlook. References marked (**) are given in Appendix 2.8.

Arousal and Cognitive Control. The waking state is characterized by constant, sometimes large, fluctuations in arousal level—the global state of activation of our central and autonomic nervous system. Prior research suggested that such fluctuations in arousal account for a significant proportion of the variability in task performance and spontaneous patterns of cortical activity. However, until recently, the exact ways in which arousal affects the human brain, mind and behaviour were still poorly understood.

Funded by an ERC-Starting grant, Sander Nieuwenhuis and his group set out to characterize the computational and neural mechanisms by which moment-to-moment fluctuations in arousal affect cognitive functions and cortical state. One line of research focused on the effects of spontaneous and experimenter-induced changes in arousal on information processing and the underlying neural activity patterns. Mathematical modelling allowed Nieuwenhuis and colleagues to isolate the components of information processing that are affected by arousal. Advanced methods for analysing resting-state fMRI and task-based fMRI data allowed them to characterize the effects of arousal on large-scale measures of brain activity. The research programme included a prominent emphasis on discovering the neural basis of trial-to-trial fluctuations in cognitive control, as exemplified by the phenomenon of post-error slowing. A second line of research concerned the role of the noradrenergic system, one of the main brainstem arousal systems. Pharmacological manipulations, behavioural genetics, and pupillometry methods were used to characterize the specific role of this system in learning, attention and decision-making.

Key Findings indicate that arousal affects the precision of neural representations, the functional connectivity between brain areas, the rate of learning about environmental change, and the urgency during perceptual choice. Together, these studies provide a systematic and comprehensive investigation of the role of arousal in cognitive and brain functions.

Key Publications: Jepma et al. (2016). *PLoS Comp Biol*, 12: e1005171 | Murphy et al. (2016). *Nature Comm*, 7: 13526 (**) | Van den Brink et al. (2014). *J Neuroscience*, 34:11096 | Jepma et al. (2012). *Cognition*, 122:426 | Nieuwenhuis et al. (2011). *Nature Neuroscience*, 14:1105.

Enforcing Norms for Group Cooperation. Defying core premises of neoclassical rational choice theory, our research and that of others has revealed that humans not only have strong capacity to cooperate with others, but also create and enforce cooperation norms through reward and punishment. What until recently remained poorly understood was what motivates individuals to punish non-cooperation in others, and to reward their cooperation, what the neural bases of such peer pressures are, and how such peer pressures can create a dark side to cooperation—increased willingness to contribute to the in-group’s capacity to fight out-groups. Supported by four PhD grants from the NWO-Graduate and Talent-programmes, and following-up their publications in *Science* (2010, 2012), Van Dijk, Ellemers, and De Dreu addressed these questions using a range of experimental games and neuroscientific methods.

Key Findings: Four core insights emerged. First, humans punish non-co-operators in their group, but prefer rewarding co-operators. Second, such norm-enforcement is in-group bounded, not extended to (non-)co-operators in rivalling out-groups, and particularly likely when groups compete against and try to subordinate rivalling out-groups. Third, enforcing in-group norms for cooperation was found to be conditioned by the evolutionary ancient neurohormone oxytocine, and to be the subject of peer pressure tracks activation in prefrontal and striatal brain circuitries: Conforming to cooperation norms may rely on the controlled processing of (social) reward. Fourth, we found that such norm enforcement is neither needed nor effective when the group goal is to defend and protect, and raises cooperation and compliance when the group goal is to expand, dominate, and exploit. Combined, these findings set the stage for future work into the evolutionary and cultural pressures that favoured evolved and institutionalized capacities for cooperation and competition within and between groups.

Key Publications: Van Hoorn et al. (2016). *Soc Cogn Affect Neuroscience*, 11, 923 | Mooijman et al. (2015). *J Pers Soc Psych*, 109, 75 | Molenmaker et al. (2014). *Org Behav Hum Dec Process*, 125, 175 | Ellemers (2012). *Science*, 336, 348 | Van den Bos et al. (2011). *Psych Science*, 22, 60 | De Dreu et al. (2016) *Proc Nat Acad Sciences*, 113, 10524 (**).

Neurocognitive Development of Pro-sociality and Risk-taking. One of the main challenges of developmental cognitive neuroscience studies is to track changes in brain and behaviour longitudinally. Supported by 3 VENI-, 1 VIDI, 1 VICI- and a prestigious ERC-Starting grant, Eveline Crone and her research group documented important and largely non-linear developmental changes

in childhood, adolescence and emerging adulthood in three domains: cognitive control and learning, impulse regulation and risk-taking, and social-emotional functions and prosocial behaviour. All functions are examined in relation to functional and structural brain development (gray matter density and white matter tracts) and the role of gonadal hormones as an index of puberty.

Key Findings: Using multi-level models of change, Crone and colleagues have uncovered systematic changes in developmental trajectories over time, and how brain structure and function predict future academic and social outcomes. They discovered protracted development of prefrontal cortex, especially for deliberative cognitive control, heightened emotional sensitivity in the dopamine-rich ventral striatum in the context of reward processing and social valuing, and non-linear changes in the medial prefrontal cortex, a key brain region for thinking about self and others. Together these findings provide deep insight into the neuro-behavioural changes in domains that are most prone to vulnerabilities in adolescence.

Key Publications: Van Duivenvoorde et al. (2016). *Neuroscience Biobehav Rev*, 70: 135 | Braams et al. (2015). *J Neuroscience*, 35: 7226 | Koolschijn, Crone (2013) *Dev Cog Neuroscience*, 5: 106 | Crone, Dahl (2012) *Nature Rev Neuroscience*, 13: 636 (**) | Jolles et al. (2011). *Dev Science*, 14: 713.

Early Life Stress and the Ontogenesis of Affective Disorders. An emerging question across the biomedical and psychological sciences is how chronic stress early in life shapes and programmes emotional, physiological and brain responses far into adulthood. Supported by VENI-VIDI-VICI grants, and several other grants in collaboration with larger consortia, Bernet Elzinga and her research group addressed this issue by focusing on sensitivity to stress-related affective disorders in adulthood, and the modulating role of emotional, physiological and brain responses. Their approach was strongly interdisciplinary, and integrated novel methods from neuroscience, physiology (cortisol, BDNF), (epi-)genetics, and experimental psychopathology with an epidemiological approach (NESDA, n=2981). With this unique approach Elzinga and colleagues set out to disentangle the impact of various forms of maltreatment (i.e., emotional vs. physical abuse and neglect) and their associations with alterations in brain structure (i.e., reductions in dmPFC) and function, for example, of brain networks involved in emotion regulation and cognitive functioning.

Key Findings: This research programme has consistently documented the pervasive and specific impact of parental childhood emotional maltreatment in the context of adult depression. To further elucidate the processes underlying these maladaptive family interactions, she established the 'Leiden Family Lab' with several other PIs of Leiden University. Here, a unique 3-generation study has been conducted on the factors that play a key role in the intergenerational transmission of parental abuse and neglect, involving neurobiological markers of stress, observations of parent-child interactions and neuroimaging. In most recent current work, aided by a VICI grant, Elzinga discovered that the impact of parental (emotional) maltreatment yielded remarkably similar findings on a broad range of neurophysiological and emotional outcomes as is typically found in adults.

Key Publications: Van Harmelen et al. (2014). *Soc Cogn Affect Neuroscience*, 9: 2026 | Molendijk et al. (2014). *Molecular Psychiatry*, 19: 791 (**)| Spinhoven et al. (2014). *Psych Medicine*, 44, 337 | Burger et al. (2016). *Neurobiol Learn Memory*, 132, 49 | Veer et al. (2011). *NeuroImage*, 57, 1534.

Psychological determinants of chronic somatic symptoms. One of the major health care challenges is to establish how psychological factors, such as expectations, play a role in the cause, maintenance and chronification of somatic symptoms, such as chronic itch or pain. Supported by a VIDI, ERC Consolidator and ERC Proof of Concept grants, Andrea Evers set out to study psycho-neurobiological factors (e.g. expectancy learning and placebo effects) in the development, maintenance and treatment of somatoform symptoms. This interdisciplinary work integrates knowledge from biomedical sciences, experimental psychopathology and psychobiology to develop new interventions for somatosensory symptoms.

Key Findings: A new experimental approach was developed to induce various somatosensory stimulation in the laboratory with different Quantitative Sensory Testing (QST). These methods made it possible to directly compare the effects of learning mechanisms, such as expectancies, on the

development, maintenance and recovery of different somatosensory symptoms (e.g. itch, pain, fatigue). Evers and colleagues were the first to show that expectancy learning processes of placebo and nocebo effects play a comparable or even larger role for itch than for pain. This unprecedented insight is used already for novel therapeutic interventions (e.g. online personalized treatments).

Key Publications: Berende et al (2016). *New Engl J Med*, 374: 1209 (**)| van Laarhoven et al. (2015). *J Invest Dermatology*, 135: 1234 | Evers et al (2011). *Nature Rev Rheumat*, 7: 409 | Evers et al (2014). *Psychother Psychosom*, 83: 148|Evers et al. (2014) *Annals Rheumat Disease*, 73: 1683.

Multivariate Analyses: Biomarkers of Dementia. The holy grail in dementia research is the discovery of biomarkers for early diagnosis of dementia. Supported by NWO-VICI and other NWO grants, and as coordinator of the National Initiative Brain and Cognition (NIHC) programme ‘functional markers for cognitive impairment’, Serge Rombouts and his team and collaborators have detected early changes on (f)MRI scans in the brain in dementia.

Key Findings include effects in structural and functional brain networks. Some of these network effects are present even before symptoms occur, showing their potential as early MRI biomarkers. As a next step, and with the aid of a VICI-grant to Rombouts, they are using multivariate techniques on multidimensional (f)MRI data and developing machine learning-based methods to study individual classification accuracy, and, more importantly, prediction accuracy of future cognitive decline. Combining different types of MRI information on functional and structural networks and on regional brain volumes, further improves MRI-pattern based classification of individual patients, and may be helpful for predicting cognitive decline. They also showed how pharmacological agents acting on neurotransmitter systems with relevance for dementia target specific functional brain connections. These studies can provide new leads for drug development for dementia and other neurologic and psychiatric impairments

Key Publications: Hafkemeijer et al. (2015). *Hum Brain Mapp*, 37:978|Cole et al. (2013) *Neuro-Image*, 78:59|Dopper et al. (2013) *Neurology*, 80:814|Möller et al. (2015). *Radiology*, 11:150220|Rohrer et al. (2015). *Lancet Neurology*, 14: 253 (**).

5.2. Societal relevance highlights

This section highlights examples of science co-created in close collaboration with public and private stakeholders and which have had tangible societal relevance and actionable consequences for (i) healthcare, and (ii) economic and environmental decision-making.

Healthcare. Our Institute contributes to evidence-based practice in healthcare. To this end, intensive research collaborations have been initiated with the *Medical Delta Network* (LUMC, TU Delft and Erasmus University), and with regional and (inter-) national partners such as research and clinical institutions (e.g. TNO), GGD and Health foundations for patient care and prevention, and *Parnassia*—a large network organization with 8,000 professionals and 150,000 sub-clinical and psychiatric patients treated each year.

A prime example of such a PPC is the eHealth institute in the Medical Delta network. The programme encompasses a broad variety of projects developing and testing the effectiveness of *digital screening instruments* to select subjects at risk and offer them *tailored interventions* (e.g. online self-management interventions for patients at risk for adjustment problems to a chronic condition) using various applications (e.g. apps, games, e-coaching, virtual reality). In collaboration with the LUMC (Child & Adolescent Psychiatry) we developed a treatment manual for adolescent school refusal that is now used at several locations in the Netherlands and abroad.

In 2016, Evers received grants over 3M€ within these research collaborations (e.g. consortium Grant ZonMW Hartstichting, Nierstichting, Reumafonds). Another example is the *new infrastructure of population data (approx. 500,000 patients) of a general practitioners network* that was set up in the region Leiden and the (more recently started) Campus The Hague. It can be connected to other population datasets our Institute contributes to (e.g. *NESDA*), and provides a critical stepping stone for answering large numbers of practically relevant questions about human health and its treatment.

It provides a rich source for many ongoing and future PhD projects in the context of a recent NWO-VICI grant to Evers.

Our translational successes in healthcare prompted the Faculty Board and the University Board to jointly invest over 1M€ in a brand new out-patient *Clinical Facility—the Leids Universitair Behandel en Expertise Centrum [LUBEC]*. It opens in 2017 and is conveniently housed adjacent to the Institute and has state-of-the-art observation rooms and allows for testing new treatment techniques on specific patient samples and to establish ‘proof of principle’ ahead of its application in actual clinical practice. We can now involve external partners in innovative projects from the start and enable the ultimate application in standard clinical practice. *Front runners in this new facility include treatment of unexplained somatic complaints, stress-related disorders such as PTSD, depression and suicidality, and early detection and intervention of fear of public speaking, social anxiety and school refusal.*

Economic and Environmental Decision-making. The Institute has longstanding research collaborations with various stakeholders in environmental decision-making. A prime example concerns our contributions to a *national consortium of Industry, governmental platforms, NGOs, and leading scientists and researchers on CO₂ Capture, Transport and Storage* (CATO-1 and CATO-2; combined providing for >1M€ industry funding to Leiden University across the evaluation period). CATO-2, to which our Institute contributed expertise on social acceptance (Ter Mors, Daamen) was concluded in 2014. *It resulted in four externally-funded PhD dissertations, several widely distributed reports to professional stakeholders and validated survey instruments to assess social acceptance of environmental policy, and 10 scientific articles in peer-reviewed journals.* Our commitment to contributing to environmental decision-making was continued in 2015 when the Netherlands Enterprise Agency (RVO) awarded a grant to HIER Climate Bureau and Leiden University (150K€) for improving the sustainability of loyalty programmes.

In 2014, we expanded our reach to include economic decision-making more prominently. Indeed, there is growing realization in society that *psychological science can help citizens and professionals make smart(er) financial decisions.* In 2014, Leiden University and the NIBUD installed a Special Chair and a PhD project on “Psychological Determinants of Economic Decision-making” (Chair: prof. W. van Dijk). With this initiative, the Institute quickly became a focal point in an *expanding network of public and private institutions concerned with financial and economic decision-making*, including AFM, Delta Lloyd Foundation (DLF), Dutch Banking Association (NVB), Money Wise, VFN, and NIBUD. Targeted research grants cumulated beyond 250K€ already and senior staff members are now on the advisory boards of leading financial institutions (W. van Dijk: Dutch Tax and Customs Administration; E. van Dijk, NVB). First yields include an *intervention designed to enable people to save more money so as to better cope with financial setbacks, and a new instrument to measure people’s experience of financial hardship; it is currently used by different organizations dealing with debt prevention and counselling.*

6. Self-assessment on the three SEP criteria

6.1 Quality

Productivity and Impact. The Institute has seen a *marked growth in size* over the past evaluation period. Full-time equivalent for research increased by 29% (from 70 in 2011 to 90 in 2016), research productivity increased by 38% to over 300 peer-reviewed publications per year (from a total of 1048 in the previous evaluation period [2005-2010] to 1413 in the current period [Appendix 2.1.1. Table D1.1]). Combined, this shows a strong increase in productivity, with 3.4 publications per research fte/year in the current period being higher than the 2.8 publications per research fte/year in the previous period. In short, *the Institute is strongly growing in size, and staff members are more productive than in the previous period.*

Whereas our past performance on mean citation score (mcs) was below the national average (9.09 versus 9.35, our research potential mcs ranks us third within the Netherlands, and positions us above the national (9.45 versus 9.34) and the international benchmark (see Doc 1B Bibliometric CWTS-Analyses). Of our scientific publications, 15% is in the top-10% most cited papers in its field. Figure 1 (Appendix 2.9) shows particularly strong impact in the neuroscience/neuroimaging, experimental/-multidisciplinary psychology, social psychology and behavioural sciences, and clinical psychology/-psychiatry/clinical neurology. It is these fields of enquiry also where we find our most important knowledge users (see Figure 3; Appendix 2.9). In short, *the Institute's science is impactful and positions us in the upper echelon both nationally and internationally, especially in those areas of basic and translational science that define our Institute's outlook and research strategy.*

Cross-Disciplinarity. No less than 665 (53%) of our publications in the current period appeared in scientific journals that (i) are in the (non-psychology) fields of neuroscience, medicine, psychiatry, and (multidisciplinary) biobehavioural sciences. Across these fields, we publish in journals that have the highest reputation in their fields. Indeed, *medicine and neuroscience are our high impact fields* (see Figure 3; Appendix 2.9). Second, 69% of all citations of our work derive from high-ranking journals outside of psychology, in particular neuroscience, psychiatry, clinical neurology, and the biobehavioural sciences. Outside of the Netherlands, our main knowledge users are colleagues at top-rated Research Universities such as Harvard, Oxford, Cambridge, University of California, Stanford University, and University College London (Appendix 2.9). In short, *our work addresses core questions in psychological sciences that have strong relevance to and interconnections with the medical, biobehavioural, and neurosciences.*

Quality of the PhD Programme. Table D1.5 (Appendix 2.2) shows that 99 PhD theses were granted with our staff as (co-) supervisor; 76 were granted by Leiden University, a number that compares well to the 68 PhDs in the previous evaluation period. Figure 1 (Appendix 2.2) shows that 62% continued a career as University-based researcher; 6.3% pursued a career in Research & Development (also Section 9). In short, *our Institute delivers high quality PhD students with good career prospects.*

Peer Recognition. Our Institute has received significant peer recognition through the *awards and honours* (Appendix 2.3). Crone and De Dreu are members of the KNAW; Evers and Elzinga are members of the KNAW-Young Academy, and Hommel was elected into the German National Academy of Sciences. Crone was elected member of the Academia Europaea, De Dreu was appointed Distinguished Research Fellow at Univ. Oxford, and Spinhoven was elected Fellow of the American Association for Behavioural and Cognitive Therapies. Prestigious awards were given to Crone (Early Career Award SPR) and De Dreu (KNAW/Hendrik Mullerprijs 2016). Senior staff is regularly invited to give *plenary keynotes at major international congresses in psychology* (Appendix 2.5). Examples include keynotes at the Intern Neuroscience Society (Crone, 2014), the Intern Conf Attachment (Elzinga, 2013), the Ass Psych Science (De Dreu, 2016), the World Congress of World Institute of Pain (Evers, 2014), and on Statistical Data Analysis (Rombouts, 2014). Finally, staff members serve as *editor and board member* of major journals in psychology (related) fields, such as *Psych Science, Cogn Emot, Educ Child Psych, Neuroimage, Soc Cogn Affect Neuroscience; Org Behav Hum Dec Process, Pain*, and *Proc Nat Acad Sciences* (Appendix 2.6).

Summary and Conclusion. Our Institute is on a clear and upward trajectory to become one of the larger and internationally competitive centres for psychological science in Europe. Embedded in a strong culture of research integrity and open science, productivity has increased and stabilized across the years. Often working in multidisciplinary teams, staff members publish in the best journals in psychology, psychiatry, neuroscience, and biology. Our research is well-cited and supported by grants from prestigious funding agencies; staff members give keynotes and organize invited symposia and international conferences. Several senior staff attained fellowship status in academic societies such as the Academia Europaea, the Leopold Academy, and the KNAW.

6.2 Relevance

Public Outreach. Staff contributes significantly to public outreach. The Institute is well-represented in the (inter)national media (Appendix 2.7), over 150 publications for professional audiences appeared during this evaluation period (Appendix 2.1.2), and *best-selling books* for the general audience were published on, e.g., the adolescent brain (Crone, 2012), on disorders (van der Does 2013), and on creativity at work (De Dreu, 2016). In addition, staff members regularly give lectures and seminars for targeted professional audiences and, in the context of our well-attended *Annual LIBC-days* for the general public (Appendix 2.7). To further support such outreach, we aim for science that is *accessible and open access*. Of our 2016 publications, 30% was already open access and available to the general public at no cost. The Institute has become a respected and (inter)nationally visible centre of psychological science which people turn to when they want to learn, be inspired, and be informed. As one indicator of success, we note the *substantial increase in student numbers for our (Research) MS. programmes*. Our regular MSc programme saw a 40% increase in entry (461 in 2010/11 to 646 in 2016/17) and our two-year selective Research Masters saw a 48% increase from 31 (2011) to 46 (2016). Fitting our international outreach, in 2016 *25% and 34% of these student cohorts had an international background*.

Science-Practice Transfer through Special Chairs and Research-intense Teaching. The appointments of special chairs (Appendix 2.3) and several PPCs made science-to-practice transfer and public-private co-creation inherent to each of the six research programmes (see non-academic partners listed in Section 2.4). In addition, staff members serve on a large number of *advisory and governing boards of stakeholder organizations* in healthcare, and environmental and economic decision making (Appendix 2.7). Finally, we involve (Research) Master students in on-going research projects, thus *transferring critical academic and scientific skills to the next generations of professional psychologists*.

Value-creation through Public-Private Collaborations. Our questions and methods are informed by the needs and interests of societal partners, and our scientific insights quickly transmit to and can be applied by stakeholder organizations or the general public. *Value-creation is clearly reciprocal*. Our basic research is strongly informed by and facilitated through our connections with key stakeholders.

The economic value created through our PPCs is difficult to overestimate. *PPCs result in tangible and innovative products for stakeholder organizations such as diagnostic tools, protocols for patient care, and policy-reports*. This can have substantial economic yield, for example because we increase the effectiveness in allocating and treating patients, reduce health risks in specific populations, and increase citizens' financial and economic resilience. The other way around, many PPCs resulted in PhD fellowships through which basic science questions could be addressed in a programmatic fashion, and large databases of patients for basic and translations science in the foreseeable future. In the current evaluation period, PPCs have yielded over 5M€ external grant income, which *created approximately 50 job-years in R&D and Development and Industry-based Research*.

Summary and Conclusion. Our psychological science matters. It matters to the general public who buys our books and attend our public outreach events. It matters to stakeholder organizations with whom we co-create translational science and innovative products and services that benefit organizations and the general public. It matters because our PPCs create jobs for high-skilled employees; our science contributes substantially to both local and regional economies.

6.3 Viability

Direct Funding. Table 3.D3c (Appendix 1.3) shows that direct funding from Leiden University increased from 2.21M€ (2011) to 3.26M€ (2016). Most of this increase in income is due to increased student numbers and turn-around, and unrelated to research performance. At the end of 2016,

direct funding constituted 45% of the total budget for research. *Direct funding can finance dedicated research time for staff members and maintain laboratory facilities.*

Competitive Grant Acquisition. Competitive grant acquisition yielded a total of 19.13M€ (Appendix 1.3 Table 3D3c). This *more than doubles* the 9.163M€ earned in the previous period. Earning power is *stable across the evaluation period and well-spread across levels of seniority*: Staff members received 11 NWO-talent/Rubicon grants, 4 VICI, 3 VIDI and 9 VENI grants, 9 ZonMW grants, and from the ERC (1 Marie-Curie Fellow; 2 StG; 2 CoG; 1 AdG; 1 PoC) (Appendix 2.4.1). To these figures we add the more than 13M€ for basic research from other sources (Appendix 2.4.2).

Quality of our Staff Members. Table 3Da2 (Appendix 1.2) shows a good spread across age groups. 65% of our staff members are female. The quality of our staff is high: Across the six research programmes and at all levels of seniority, staff members successfully acquire outside funding for their research programmes, they work collaboratively and in (inter)national networks, and they publish in the best journals. There is good mobility, both within the Institute (e.g., staff members have been promoted into higher ranks) and (inter)nationally. Due to its solid reputation, the Institute continues to attract talented and established scientists into its vacant research positions.

Research Facilities. The Institute's research infrastructures and laboratory facilities are up-to-date and providing for all types of research conducted within the Institute. An outstanding feature is the availability of *fMRI equipment that is free-of-charge*. The PBF suffices to maintain and expand, where needed, research facilities and technical support. There is, however, urgent need for additional space to build new laboratories and such need is now an integral part of the Faculty of Social and Behavioural Science's future policy agenda.

Research Potential and Future Outlook. Fitting the sizable growth our Institute has realized in the past few years, a quantitative analysis of our research potential, in terms of productivity and impact, shows strong improvement compared to past performance (Appendix 2.9). While this applies to our basic science, our efforts at translational science and PPCs are likely to yield increasingly important benefits. We have high expectations of our new Clinical Facility and by the end of 2016/early 2017 several important basic science grants have been acquired (e.g., a VICI to Evers, the KNAW-AMMODO Award to Crone). The same applies to the funding of translational science. Early 2017, large grants from ZonMW (to Evers and to Spinhoven) along with substantial grants from the State Department of Social Affairs (to W. Van Dijk) have been secured that, alone and in combination, support our aim to conduct basic science with strong translational relevance.

Summary and Conclusion. Viability is strong. The Institute is financially healthy and has all-round research laboratories. We host ambitious researchers in all career stages, many of whom have strong international visibility and reputation. These observations apply to the Institute as a whole and to each of its six research programmes, and to our basic science and to our translational efforts alike.

7. Environmental factors and developments

There are several *developments* that affect the viability and quality of our research. First, national budget cuts implemented since 2008 have *decreased the Institute's ability to provide for structurally funded PhD fellowships*. As noted (Section 6.3 and 8), this exerts strong pressure on the Institute's members to acquire outside funding for their research. Because the predictability of such outside funding is low, this development hampers programmatic research that is novel, curiosity-driven and potentially ground-breaking. Second, the *PBF has been fixed and is not conditioned on changes in teaching and/or research performance*. However, with increased performance, both in terms of volume and clear advances in productivity and quality, this policy implies an increasing watering-

down of available research funds. Given that our work increasingly requires high-level technology and precise measurement that is costly in terms of personnel and equipment and technological infrastructures, this needs urgent attention at the highest level. *Current funding policies at local and national level impede the Institute's ability to maintain its forefront position in developing neuro-computationally rigorous psychological science with strong cross-disciplinary and translational value.*

Several more positive developments are noteworthy. First, our Institute continues to be *well-positioned with the two RPAs at Leiden University*, and these provide exciting possibilities to continue our cross-disciplinary work with the medical and biobehavioural (neuro)sciences. Second, a recent initiative is *Leiden Data Science*, a university-broad programme in which our Institute participates. It relates to national (research) agendas on big data and digital science and enables our Institute to *reach out to new partners in, e.g., Archaeology, Conflict and Security, and Computational Biology.*

8. SWOT analysis and benchmark/positioning

8.1 Strengths

The Institute has many strengths, including *high quality scientific staff* at all career-levels and across all research programmes, *excellent team spirit and international reputation*, strong and identifiable research programmes, and state-of-the-art research facilities, both of which are strongly embedded in local RPAs and in *joint research programmes with renowned Research Universities and their Medical Centres*. Finally, we have established a broad range of long-term and mutually beneficial partnerships with non-academic institutions and professional stakeholders. We have developed *an internationally competitive and impactful mixture of basic and translational science with very strong potential for further growth and cross-disciplinary impact.*

8.2 Weaknesses

The Institute's structural weaknesses include, first, the *lack of structural funding for PhD students resulting from national policies*. This hinders high-risk/high-gain research that can break new ground in basic and translational science. Initiatives to address this pressing issue have not yet been responded to. Second, the *PBF is fixed per annum* and without substantial revision in policy impedes our aim for computationally rigorous and (neuro)biologically tractable models of human cognition and behaviour (see also Section 7).

The increase in direct funding (see Section 6 and Appendix 1.3 Table 3D3c) is mostly due to the substantial increase in student numbers. *The balance between teaching and research is under pressure*, especially among junior staff and early-career scientists. In the mid- to long-run, we need to create policy in which research ambitions and creativity are stimulated and a healthy balance is created between well-funded senior staff with good opportunities for research, and well-supported junior staff who can pursue and materialize their scientific and professional ambitions. With Leiden University, we need to *create internationally competitive research positions for talented young scientists*. This would boost the Institute's reputation as a vibrant and creative work environment where novel and ground-breaking research is initiated and pursued.

8.3 Opportunities

We see *continued opportunity to intertwine basic and translational science* through our special chairs and contract research with professional stakeholders. Our new Clinical Facility creates new opportunities to conduct such work of the highest international standards in medical, health, and clinical psychology. Other PPCs in the domain of economic decision-making and eHealth provide similar building blocks for designing programmatic, innovative, and internationally impactful science.

The Institute is visible and well-connected in precisely those areas that are core to both national and international research agendas. Our research programmes connect seamlessly to themes within the NWA (National Science Agenda; i.e., conflict and cooperation; promotion of health through lifestyle; the impact of chronic diseases such as stress; personalized medicine; and big data) as well as to recent national developments of *Digital Society* as a nation-wide research theme coordinated by the VSNU and all universities. This provides new opportunities for competitive research funding. Furthermore, both within and outside Leiden University, the Institute's *research programmes and staff members are increasingly sought after by the medical, biological, and economic sciences*. This creates new opportunities for new discoveries with cross-disciplinary relevance and outreach.

8.4 Threats

Although there is an increasing awareness that *quantitative assessments can provide a biased view with possibly perverse effects*, there is a continuing practice among funding agencies and science-policy institutions to apply such quantitative measures. This threatens our Institute's strategy on conducting cross-disciplinary science—which is arguably more high-risk/high-gain than a monodisciplinary research strategy—and the aim for an intimate mix of basic and translational science. Especially the *quality of translational science is difficult to assess in traditional, quantitative terms* and, therefore, easily framed as second-tier. This would inhibit individual career prospects and discourages translational science.

9. PhD Programme

Local and Networked Embedding. The PhD programme is embedded in the Leiden Graduate School of Social Sciences. The Graduate School oversees the formal requirements and administration of PhD projects, *training and development takes place in the national research networks* (see Document 1AB).

Selection and Supervision. Selection of PhD students is conducted by the project's principal investigators, typically following open recruitment advertising within relevant professional networks, and comparative examination of applications and interviews with potential candidates. *PhD students are admitted into the Graduate School upon formal approval of a dissertation plan by the Scientific Committee*. It details the research problem and its embedding in the relevant literature, an outline of the methodological approach, a training and development plan, and a data management/storage protocol. PhD students are supervised by the *PI and at least one other staff member* ([co]-promotor). Typically, this involves regular meetings to support research design, analyses, and write-up, and career guidance.

Performance and Exits. Between 2008—2012, the programme enrolled 61 students, of which 64% obtained their PhD (31% are not yet finished, and 5% quit) (Appendix 1.4.Table D3d). Not counting 2012, it follows that *47% (65%) finishes within 5 (6) years*. While an average project is 4 years full-time, many of our students work part-time and this explains why many projects take 5 to 6 years to complete. Our PhD students have *good career prospects*. Of the 77 PhD students that received their PhD title between 2011 and 2016, approximately 62% continued as researcher at a University (20% relocated to foreign institutes). Five pursued a career in applied/industry research; 3 identified themselves as self-employed, and 0 as unemployed (Appendix 2.2, Table D1.5b).

10. Research Integrity

Policy. The Institute expects staff members to be familiar with the [Netherlands Code of Conduct for Scientific Practice](#) (VSNU), the amendments added by Leiden University in its Regulations on Academic Integrity, and with the [APA Ethics Code](#). The Institute recognizes that an ethical, reliable and

sound pursuit of science and scholarship requires discussions with colleagues, mutual cooperation and a shared commitment to research integrity. Concerns about research integrity can be brought to the Confidential Adviser and/or the Committee on Academic Integrity at Leiden University. In this evaluation period (nor before) *no concerns or complaints involving (violations of) academic integrity have arisen.*

Culture. The Institute has a *strong culture of mutual learning and critical (self)-reflection.* Its collegial climate ensures constructive collaborations within which individual achievements and successes can be cherished, and failures and mistakes are taken as input for mutual learning and improvement. In (bi)weekly research meetings faculty and PhD students present and discuss their research ideas, designs, and initial findings. Staff members regularly organize *ad hoc meetings around specific themes and topics* (e.g., on social neuroscience; virtual reality; conflict, crime and risk-taking, trust and empathy; and MRI).

Ethics. All empirical research within the Institute requires (medical) ethics approval. The Institute has an [Ethics Committee](#) (chair Elzinga) with an expert member from each of the research programmes.

Data Management/Storage. All raw data collected within the Institute's research laboratories, along with relevant (pre-processing) analysis scripts, experimental materials, and metadata are stored at a password-protected central server. As of 2017, all *published data and additional materials are archived for 10 years at Archiving and Networked Service (DANS).* In adherence with the Research Data Management Regulations at Leiden University, as of June 2016, new PhD students are required to write a *data management plan* that details who owns and can access the data, where data are stored, and how privacy issues and sharing are dealt with. This data management plan is written in the context of a compulsory training for PhD students, and submitted to the Science Committee for approval.

11. Diversity

The Institute applies the [diversity policies](#) at Leiden University. There is a healthy spread across age cohorts at all levels of seniority. The Institute now hosts almost twice as many female as male scientists. Over 30% of its full professors are female, which compares favourably to the 17% female professors at the national level (all sciences), the 23% female professors at Leiden University (all sciences). It also exceeds the 27% target set by Leiden University for 2019. There are no data available on ethnic background of the staff and there is no explicit policy to increase socio-cultural diversity or international composition of the research staff.

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