

**Stellungnahme zum
Leibniz-Institut für Neurobiologie, Magdeburg (LIN)**

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Vorbemerkung

Die Einrichtungen der Forschung und der wissenschaftlichen Infrastruktur, die sich in der Leibniz-Gemeinschaft zusammengeschlossen haben, werden von Bund und Ländern wegen ihrer überregionalen Bedeutung und eines gesamtstaatlichen wissenschaftspolitischen Interesses gemeinsam gefördert. Turnusmäßig, spätestens alle sieben Jahre, überprüfen Bund und Länder, ob die Voraussetzungen für die gemeinsame Förderung einer Leibniz-Einrichtung noch erfüllt sind.¹

Die wesentliche Grundlage für die Überprüfung in der Gemeinsamen Wissenschaftskonferenz ist regelmäßig eine unabhängige Evaluierung durch den Senat der Leibniz-Gemeinschaft. Die Stellungnahmen des Senats bereitet der Senatsausschuss Evaluierung vor.

Für die Bewertung einer Einrichtung setzt der Ausschuss Bewertungsgruppen mit unabhängigen, fachlich einschlägigen Sachverständigen ein. Ihr stand eine vom LIN erstellte Evaluierungsunterlage zur Verfügung. Die wesentlichen Aussagen dieser Unterlage sind in der Darstellung (Anlage A dieser Stellungnahme) zusammengefasst.

Wegen der Corona-Pandemie musste der für den 8. und 9. Oktober 2020 vorgesehene Evaluierungsbesuch am LIN in Magdeburg entfallen. Die Bewertung erfolgte im Rahmen eines Ersatzverfahrens, das der Senatsausschuss Evaluierung (SAE) in Umsetzung eines Grundsatzbeschlusses des Senats vom 31. März 2020 eingerichtet hat. Der Senat hält in diesem Grundsatzbeschluss fest, dass das Ersatzverfahren ein Notbehelf ist und ausschließlich auf Einrichtungen angewendet wird, die im Regelturnus von sieben Jahren evaluiert werden. Die Bewertungen, auf deren Grundlage der Senat Stellung nimmt, sind auf zentrale Kernfragen der Entwicklung und Perspektive einer Leibniz-Einrichtung fokussiert. Ausführliche Einschätzungen und Schlussvoten zu Teilbereichen und Planungen für „kleine strategische Sondertatbestände“ müssen regelmäßig entfallen.

Die Bewertungsgruppe erstellte den Bewertungsbericht (Anlage B). Das LIN nahm dazu Stellung (Anlage C). Der Senat der Leibniz-Gemeinschaft verabschiedete am 1. Juli 2021 auf dieser Grundlage die vorliegende Stellungnahme. Der Senat dankt den Mitgliedern der Bewertungsgruppe und des Senatsausschusses Evaluierung für ihre Arbeit.

1. Beurteilung und Empfehlungen

Der Senat schließt sich den Beurteilungen und Empfehlungen der Bewertungsgruppe an. Das Leibniz-Institut für Neurobiologie (LIN) erforscht sehr erfolgreich die grundlegenden neurologischen Prozesse von Lernen und Gedächtnis. Dabei werden alle Organisationsebenen neurobiologischer Aktivität, von molekularen und zellulären Prozessen bis zu komplexen Verhaltensmustern bei Mensch und Tier, betrachtet. Das Institut verfügt über ein breites methodisches Spektrum, das von bildgebenden Verfahren bis zu experimentellen Interventionen reicht. Dem Institut gelingt eine enge Verknüpfung zwischen Grundlagenforschung und Translation der Ergebnisse in die klinische Anwendung.

¹ Ausführungsvereinbarung zum GWK-Abkommen über die gemeinsame Förderung der Mitgliedseinrichtungen der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.

Das LIN hat seit der letzten Evaluierung im Jahr 2013 sein wissenschaftliches Profil in sehr überzeugender Weise **weiterentwickelt**. Auch durch neue Gruppen, die hervorragende Ergänzungen darstellen, ist das LIN jetzt international eines von wenigen Zentren, das über Expertise auf allen neurobiologischen Analyseebenen verfügt. Im Jahr 2020 wechselte die wissenschaftliche Institutsleitung. Unter dem ruhestandsbedingt ausscheidenden Direktor hat sich das Institut einen außerordentlich guten Ruf auf dem Gebiet der Gedächtnisforschung erarbeitet. Als Nachfolger konnte erneut ein exzellenter Wissenschaftler gewonnen werden.

Die Arbeitseinheiten des LIN erbringen sehr gute, teilweise herausragende **Leistungen**. Die Forschungsergebnisse sollten jedoch noch regelmäßiger in führenden fachübergreifenden *Journals* publiziert werden. Die vom LIN angestrebte strategische Stärkung interner Kooperationen ist ein wichtiges Element, um das Potential in dieser Hinsicht noch besser auszuschöpfen. Im Transfer seiner Forschungsergebnisse in klinische Anwendungen ist das LIN erfolgreich und verfügt über eine beträchtliche Anzahl an Patenten.

Die **strategische Arbeitsplanung** des Instituts schließt an die bestehenden und neu hinzugewonnenen Kompetenzen an. Dabei ist es wichtig, auch die molekularbiologische Perspektive, die durch den früheren Direktor eingebracht wurde, mit Blick auf den ganzheitlichen Ansatz des Instituts wie geplant zu erhalten. Zur Stärkung der multidimensionalen Datenanalyse sieht das LIN die Einrichtung einer neuen *Core Facility für Combinatorial NeuroComputing* vor, für die zusätzliche Mittel der institutionellen Förderung beantragt werden. Zu einer ersten Planung dieser Maßnahme gab die Bewertungsgruppe einige Hinweise. Das Land Sachsen-Anhalt hat den überarbeiteten Antrag zum 1. Januar 2021 in dem für Sondertatbestände vorgesehenen Verfahren vorgelegt.

Die **Ausstattung** des LIN mit Mitteln der institutionellen Förderung ist zur Erfüllung des derzeitigen Aufgabenspektrums auskömmlich. Bei der DFG wirbt das Institut umfangreiche Drittmittel ein, auch im Leibniz-Wettbewerb ist es erfolgreich. Das Institut sollte seine Möglichkeiten zur Einwerbung von Mitteln der europäischen Forschungsförderung, auch in Kooperationen, noch weitergehend ausschöpfen. Die technische Ausstattung des LIN für bildgebende Verfahren wurde wie empfohlen modernisiert und erweitert. Investitionen in die Ausstattung bleiben auch zukünftig wichtig, um die Wettbewerbsfähigkeit des Instituts zu sichern. Über Kooperationsbeziehungen mit lokalen Partnern hat das Institut Zugang zu weiteren Forschungsinfrastrukturen.

Das LIN bietet attraktive Rahmenbedingungen für die **wissenschaftliche Karriereentwicklung**. Das belegt der mittlerweile erfreulich hohe Anteil wissenschaftlich Beschäftigter, die aus dem Ausland an das Institut kommen. Die durchschnittliche Promotionszeit ist mit fünf Jahren jedoch deutlich zu lang, wie das LIN selbst erkennt. Der Senat begrüßt, dass nach einigen personellen Wechslen die Anzahl der Promovierenden wieder zunimmt. Der **Anteil von Frauen** am wissenschaftlichen Personal lag Ende 2019 bei 42 %. Während bei der vergangenen Evaluierung nur eine Frau wissenschaftliche Leitungsaufgaben am LIN wahrnahm, waren Ende 2019 drei der 14 entsprechenden Positionen mit Wissenschaftlerinnen besetzt. Diese Entwicklung muss fortgesetzt werden, um die Gleichstellung auf Leitungsebene weiter zu verbessern.

Das LIN ist sehr gut in die Magdeburger Forschungslandschaft eingebettet. Alle Abteilungsleitungen sind gemeinsam mit der Universität bzw. dem Universitätsklinikum Magdeburg berufen. Es wird begrüßt, dass der neue Direktor und die Gremien des LIN sehr gute Planungen für die weitere inhaltliche und strukturelle Gestaltung dieser strategischen wichtigen **Kooperationen** verfolgen. Auch mit dem Deutschen Zentrum für Neurodegenerative Erkrankungen (DZNE) gibt es eine enge Zusammenarbeit, unter anderem im gemeinsam betriebenen *Centre for Behavioral Brain Sciences* (CBBS) in Magdeburg, das seit 2015 als Leibniz-WissenschaftsCampus gefördert wird. International unterhält das LIN enge Verbindungen zu führenden Gruppen, die durch mehr Gastaufenthalte weiter gestärkt werden könnten.

Der am LIN verfolgte Ansatz, die neurologischen Prozesse für Lernen und Gedächtnis in ihrer gesamten Komplexität zu betrachten und dabei sowohl vielfältige Methoden als auch tier- und humanexperimentelle Forschung zu kombinieren, ist in dieser Form an einer Hochschule nicht möglich. Eine Eingliederung des LIN in eine Hochschule wird daher nicht empfohlen. Das LIN erfüllt die Anforderungen, die an eine Einrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischem Interesse zu stellen sind.

2. Zur Stellungnahme des LIN

Der Senat begrüßt, dass das LIN beabsichtigt, die Empfehlungen und Hinweise aus dem Bewertungsbericht bei seiner weiteren Arbeit zu berücksichtigen.

3. Förderempfehlung

Der Senat der Leibniz-Gemeinschaft empfiehlt Bund und Ländern, das LIN als Einrichtung der Forschung und der wissenschaftlichen Infrastruktur auf der Grundlage der Ausführungsvereinbarung WGL weiter zu fördern.

Annex A: Status report

Leibniz Institute for Neurobiology, Magdeburg (LIN)

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1. Key data, structure and tasks

Key data

Year established:	1992 (precursor institution founded in 1981 as “ <i>Institute for Neurobiology and Brain Research</i> ” in the Academy of Sciences of the GDR)
Admission to joint funding by Federal and <i>Länder</i> Governments:	1992
Admission to the Leibniz Association:	1997
Last statement by the Leibniz Senate:	2014
Legal form:	Foundation under Public Law
Responsible department at <i>Länder</i> level:	Ministry of Economy, Science and Digitalisation, Saxony-Anhalt (MW)
Responsible department at Federal level:	Federal Ministry of Education and Research (BMBF)

Total budget (2019)

- € 14.31M institutional funding
- € 4.67M revenue from project grants
- € 0.12M revenue from services

Number of staff (2019)

- 104 individuals in research and scientific services
- 62 individuals in service sector
- 26 individuals in administration

Mission and tasks

“The foundation’s statutory purpose is to pursue and promote science and basic research in the field of neurobiology. The combination of molecular and cell-biological neuroscience and systems-oriented brain research serves above all to improve our understanding of learning and memory.” (Quoted from §2 of the Statutes of the LIN)

LIN’s activities are conducted in six scientific departments, five research groups, and research support units. The administration and service units cover animal husbandry, research and media technology, mouse genotyping and phenotyping, IT and core administration (see appendix 1).

2. Overall concept, activities and results

The Leibniz Institute for Neurobiology (LIN) conducts fundamental research on learning and memory and their underlying neuronal mechanisms in the brain. The institute’s research combines behavioral and cognitive science with the application of neuroscientific methods at all levels of brain organisation: from molecules via cells and networks to

whole-brain imaging. Based on its fundamental research, LIN aims to translate its scientific knowledge towards applications e.g. in education and life-long learning. Therefore, a research focus on cognitive development in early childhood and its neuropsychiatric complications has been added to the established research on cognitive faculties in healthy ageing and in age-related memory decline.

The institute's concept includes the interaction of different scientific disciplines, the integration across levels of analysis, and cross-species comparisons to uncover principles of learning and memory and their implications for humans. LIN future research is coordinated through three research programs:

- RP1 “Molecular and cellular mechanisms of neural circuit function” investigates how the mechanisms of molecular and cellular plasticity shape circuit function in the context of learning and memory.
- RP2 “Learning and memory at the systems level” focusses on the general principles underlying the mechanisms of learning, memory and adaptive behavior in animals and humans at the level of interacting brain regions, and behavior.
- RP3 “Cognitive (dys)function and intervention“ investigates learning and memory in the context of clinical disorders, with a focus on neurodegeneration, neuropsychiatric disorders, and non-pharmacological interventions for improved learning in rehabilitation and psychotherapy.

Results

Research

In the previous funding period, the institute contributed to the understanding of many aspects of learning and memory, ranging from molecular mechanisms to human cognition and cognitive disorders.

The LIN highlights the following activities and core results:

- At the molecular and cellular level, amongst others, the institute points to its uncovering of novel mechanisms of activity- and motor-dependent transport of synaptic proteins along microtubules to the nucleus. Further achievements have addressed the nanoscale structure and function of spines and molecular dynamics at pre- and postsynaptic specializations.
- At the systems level, the institute discovered e.g. principles of brain functional architecture for learning and memory, such as a circuit mediating a dopamine-driven corticothalamocortical positive feedback loop. Also, LIN researchers identified neural correlates of auditory working memory within the auditory cortex of humans and non-human primates in a cross-species approach.
- At the clinical level, the institute contributed to the understanding of neurodegeneration by identifying structural and functional connectivity changes as result of ALS or molecular pathways following autoimmune-mediated damage. In the development of treatments for neurological and psychiatric disorders, the institute has investigated the deep brain stimulation effects on learning and memory networks across several

clinical populations (e.g. alcohol addiction, epilepsy, dementia, and movement disorders).

Between 2017 and 2019 scientists from LIN published research results in 384 publications, of which 367 (96 %) were articles in peer-reviewed journals (see appendix 2). As a result of the wide range of disciplines at the institute, the LIN's peer-reviewed articles were published in more than 100 different journals.

Research infrastructure

The *Combinatorial NeuroImaging core facility* (CNI, see chapter 7) hosts, develops and provides access to a wide range of imaging techniques for non-invasive human imaging, translational animal imaging, and microscopy. The aim is to support research that bridges the gaps between molecular, cellular and systems neurosciences in learning and memory research. 15 % of scan time at each device is open for external use. The vast majority of external users are local scientists from the University of Magdeburg and *the German Center for Neurodegenerative Diseases Magdeburg* (DZNE Magdeburg) or collaborators of LIN scientists, e.g. in SFBs, BMBF- or EU-funded cooperative projects. The open source software *eGroupware* was developed into CNI's booking system to manage scan time and to follow the billing status.

Between 2015 and 2019, the use of CNI's infrastructure resulted in 157 publications from 150 registered projects. Currently, CNI's infrastructure is actively used in 111 research projects (19 human imaging, 16 small animal imaging, and 76 microscopic imaging).

Transfer

The institute points to three channels how its basic research is transferred into society: applications based on LIN patents, advice for policy makers, and communication of research findings.

As of March 2020, the institute held 7 national and 21 international patents, and had 13 pending patent applications. The institute points to two spin-off companies founded by leading scientists that develop applications based on LIN patents. The institute highlights the organisation of parliamentary events and a salon evening for local companies as examples for exchange with local policy-makers and industry representatives. LIN's communication of research findings to the public is conducted through outreach events, media formats, and social media. The institute openly communicates about animal experiments on a dedicated website.

3. Changes and planning

Development since the previous evaluation

Since the last evaluation, LIN has strengthened its fundamental research on learning and memory. The institute has pursued its approach of interaction across different disciplines,

integration across levels of analysis, and comparisons across species. This approach has benefitted from the following changes in departments and research groups:

- 2016: new Department of Functional Architecture of Memory in joint appointment with the University of Magdeburg. This department strengthened LIN's research on the network, cellular, and molecular mechanisms underlying medial temporal lobe memory function and their functional changes in aging, amnesia and Alzheimer's disease.
- January 2020: new Department of Cellular Neuroscience, headed by the new scientific director in joint appointment with the University of Magdeburg. The department brought a new approach of combining molecular, cellular and systemic approaches with neural data science tools to the institute.
- 2017: new junior research group Neurocognitive Development in joint appointment with the University of Applied Sciences Magdeburg-Stendal (2018). This group introduced a developmental perspective to LIN's research.
- 2018: new junior research group Neuromodulatory Networks. This group contributes optogenetic approaches to LIN's research profile.
- 2019: new guest group Sensory Physiology, primarily affiliated with the Institute of Biology at the University of Magdeburg. The group contributes to LIN's methodological spectrum with 7T high field scanning of the primate brain and optogenetics.
- March 2020: new junior research group Cognition & Emotion. The group recently joined the institute and will extend LIN's research on the cognitive and emotional functions of subcortical and hippocampal neurons.

As result of a change in the institute's leadership, a new Scientific Managing Director took office on 1 January 2020. The former scientific director, who had led the institute since 2010, stepped down as scientific director on 31 December 2019, and will retire as head of the *Department of Neurochemistry and Molecular Biology* at the end of 2020.

The leaders of the former junior research groups *Presynaptic Plasticity* and *Molecular Physiology* left the institute to take up professorial positions at the University hospital Erlangen in 2016 and the University of Mainz in 2018, respectively. The leader of the former work group *Neuropsychiatric Dysfunctions* left the institute to take up a professorial position at Tübingen University in 2016.

LIN points to the restructuring of scientific support facilities as another significant change since the last evaluation. In 2013, the institute had five special labs. Since then, all imaging facilities were combined in the *Combinatorial NeuroImaging (CNI)* core facility. Also, they were extended following recommendations from the previous evaluation (see chapter 4). The former special labs *Primate Neurobiology* and *Non-invasive Imaging* were combined in the newly formed research group *Comparative Neuroscience*. The special lab *Molecular Biological Techniques* (until June 2020 in the *Department of Neurochemistry and Molecular Biology*) and the special lab *Neurogenetics* were closed (the latter as recommended in the last evaluation).

To support researchers in their career development, the **LIN-Career Office** (*Office for career development and equal opportunities*) was established in 2018. The office provides qualification courses, aids incoming researchers' integration into the institute, and offers support to develop individual career paths and opportunities. The measures are adapted to the different career stages. The office also provides measures to support equal opportunities at LIN. Initially financed through third-party funding, the institute aims to establish the office as a permanent structure.

Strategic work planning for the coming years

The institute plans to further develop its scientific profile, advance research support structures, and increase international visibility and competitiveness. In particular, the institute plans to focus on comprehensive investigation of neural correlates of memory on the neural circuit and systems levels via implementation of computational methods and data science.

Among the planned changes and strategic goals, the institute points to the following:

- Put a focus on the translation of fundamental to clinical research by strengthening cross-species comparative research at LIN. As first step, the institute mentions the new guest group and the new *research group Comparative Neuroscience*, which combines previous LIN units focusing on primate research and brain imaging in humans.
- Strengthen neural data science and computational modelling within the institute. The institute will build on the recent establishment of the new *Department of Cellular Neuroscience*, the *research group Comparative Neuroscience*, and the new Behavioral Imaging section of the *Combinatorial NeuroImaging core facility* (see above, also *Sondertatbestand* below).
- Restructure the research support services with the goal to make state-of-the-art technology accessible to all current and future research projects by bundling the services in three units: (1) Specific support/Central services (including Animal Care & Genotyping, a new viral production unit, the scientific workshop, and the technology transfer unit); (2) The CNI core facility (including human imaging, small animal imaging, microscopy, and a new behavioral imaging unit); and (3) the CNC core facility (including neural data science, computational modeling and research data management, *Sondertatbestand*, see below).
- The leader of the Department of Behavioral Neurology is expected to retire in the coming years. The institute aims to continue its close relationship to the university hospital at the University of Magdeburg to ensure collaboration with clinical scientists.

Planning for additional funds deriving from institutional funding

Neurobiology is increasingly seeing the availability of high-dimensional data. This data reaches levels of complexity that can only be unraveled by the use of modern information technology and computational approaches. To efficiently analyze such data, LIN has identified neural data science and computational modeling as key areas for expansion in the coming years. For this purpose, the institute intends to apply for additional institutional

funding (Extraordinary item of expenditure, *Sondertatbestand*) to establish a Combinatorial NeuroComputing (CNC) core facility. The Scientific Advisory Board and the Supervisory Board approve of presenting the proposal to the evaluation board.

LIN states that such expansion will allow the institute to employ artificial intelligence (AI) and machine learning methods for data analysis. Experimental science will benefit from the generation of new testable hypothesis by computational modeling and neural simulations. The institute plans to promote synergy between neuro-computing and research teams in the *CNC*. *CNC* data scientists will carry out computational research of their own and pursue collaborative projects with LIN groups on the basis of this work.

With the *CNC* core facility the institute aims at the development of scientific software, for example by making machine learning or other AI-based approaches accessible or by supporting automated quality assurance of scientific data. State-of-the-art scientific computing infrastructure is to be established and maintained in the core facility. Data management will be supported through registries and repositories. Also, the *CNC* will support open science by fostering data and code sharing to ensure data reproducibility.

In detail, the planning includes the following items:

- Additional staff (9.5 FTE): The CNC Coordinator (E15), 4 data analysts (E14), 1 research data manager (E13), 1 open science specialist (E13), 2 specialists for IT security (E13) and IT integration (E10), 1 assistant for administrative project handling (E7, 50%)
- Means for licenses and software, running costs, and hardware maintenance
- Five additional computing nodes, two new data storage nodes, and upgrades to the LIN network and firewall

„Extraordinary item of expenditure“: summary of funds planning

	2023	2024	From 2025
Own funds + additional funds = „extraordinary item of expenditure“	3,369.2 k€	1,956.7 k€	1,283.7 k€
Own funds from existing funding by institution (at least 3 % of core budget)	445 k€	474.4 k€	479.6 k€
Additional funds of institutional funding	2,924.2 k€	1,482.3 k€	804.1 k€

4. Controlling and quality management

Facilities, equipment and funding

Funding (see appendix 3)

In 2019, LIN's revenue was € 19.10 M. Institutional funding amounted to € 14.31 M. Additional funding from third-party sources included € 4.67 M from third-party funded project grants (corresponding to 24 % of revenues) and € 0.12 M from services (1 %).

The most important **third-party funding sources** are the German Science Foundation (DFG; share of third-party funding: 35 % in 2019), the EU (22 %) and the Leibniz Association (22 %). The LIN aims at annual revenues from third party funding amounting to one third of the institutional budget. LIN states that the institute has only partially reached its

self-set goals over the past three years. In order to reach these quotas in the future, the institute has taken a number of measures. These measures include revised programs for young scientists that support the preparation of external funding applications (through basic funding and assistance) and the establishment of the EU and Research Officer to support applications for and administration of external funding.

LIN states that the fixed annual increases in funding based on the “Pakt für Forschung und Innovation” have been used to strengthen and adapt the institute's profile. These funds have allowed the institute to e.g. establish a new small animal imaging laboratory, establish two new junior research groups (see chapter 3), and address the succession of the former scientific director by establishing the new director's *Department of Cellular Neuroscience* while the former director's department is still phasing out.

To ensure financial flexibility, the institute plans to introduce additional instruments, including one-line budgeting for all scientific units and internal invoicing for all essential central scientific services. Additionally, the institute plans to increase the reimbursements of operating costs by external users and increase funding from infrastructure programs e.g. through the European Union.

Facilities

LIN's main building houses the laboratories, offices, and special areas, e.g. for animal holding or workshops. The institute moved into this then newly constructed building in 2011. The 7T-human-MRI scanner facilities are located in separate buildings.

LIN's imaging facilities are grouped in the *Combinatorial NeuroImaging Core Facility* (CNI, see chapter 7). The institute aims to extend its facilities with the establishment of a new core facility on *Combinatorial NeuroComputing* (CNC, see chapter 3).

At the last evaluation, a modernization and deliberation of necessary updates and investments in imaging equipment was recommended in order to ensure the institute's competitiveness in the long term. In response to this recommendation, the institute established a new laboratory for small animal imaging, which includes a 9.4-T small animal MRI scanner (financed mainly by the *European Regional Development Fund*, EFRE). The institute invested in microscopic imaging equipment, including new technologies for light-sheet microscopy. Plans for further investments in imaging facilities include a new module specialized on behavioral imaging to be added to the CNI with EFRE funding and an upgrade of the 7T-MRI scanner.

The institute also advanced its experimental facilities. In 2017, a new laboratory for the neuropsychological investigation of children was established for the junior research group *Neurocognitive Development*. In spring 2020, LIN extended its animal care facility (for details see below) with new infrastructure for husbandry of and research with rhesus macaques, mostly financed through EFRE funding.

LIN overhauled its IT infrastructure and concept in 2017 and 2018. The IT regulations of 2018 specify the rules for IT services and priorities for long-term IT development. In order to ensure IT safety and meet the future requirements placed on scientific institutions, LIN scientific and administrative staff annually review the institute's IT concept and make the

necessary adjustments. The institute strives for certification of its IT security and data protection concept.

Organisational and operational structure

The institute is a foundation under public law. The foundation bodies governing operations are the Management Board and the Board of Directors. These are appointed and supervised by the Board of Trustees and the Scientific Advisory Board. The statutes of the foundation were updated in 2019 and are due to be approved by the Board of Trustees by the end of September 2020.

The **Management Board** (*Geschäftsführung*) consists of the Scientific Director and the Administrative Director (see chapter 5). The Scientific Managing Director, who is head of a scientific department as defined by the statutes, represents the institute to the outside and manages scientific life at LIN. The Administrative Director is responsible for economic, legal and administrative matters. The Board of Trustees appoints both Managing Directors for five years (reappointment is possible). The **Board of Directors** (*Direktorium*) consists of the heads of all LIN research departments. The Board of Directors advises the Management Board on scientific and strategic matters. Additional advice is provided in bi-monthly meetings by the *Extended Board of Directors*, which includes the heads of all structural units and employee representatives.

LIN's organisational units as of September 2020 are six scientific departments, five research groups, the *CNI core facility*, and the *Service, Administrative & Infrastructure* unit (see appendix 1). The departments form LIN's scientific backbone and ensure continuity of the institute's research. Five of the six departments contain partially autonomous scientific work groups, which structure the scientific work thematically. The institute aims to further define and develop the role of these working groups within the departments. Research groups at LIN operate independently of the departments and include permanent senior research groups and junior research groups. The CNI core facility includes the scientific support services and can also conduct independent research projects.

Across the organisational units, activities are coordinated by the **research programs** (see chapter 2). Strategic decisions about the research programs and about the fourth program, which also includes the *LIN-SpecialProject* and *LINseeds* competitions (see chapter 5), are made by the Management Board during the meetings of the Board of Directors.

Quality Management

In recent years, LIN has implemented a structured quality management system (following a recommendation of the last evaluation). A new guideline on good scientific practice was issued in January 2020. The institute has one internal and one external ombudsman for good scientific practice. The institute outlines its focus on establishing a sustainable and secure research data management strategy following the *FAIR* (*Findability, Accessibility, Interoperability, Reproducibility*) principles. The research rules for the secure storage of research data were updated in 2018 to ensure data security, data documentation, and data reuse. To improve data documentation, the introduction of an Electronic Lab Notebook

(ELN) is planned. The institute plans to further pursue its efforts in Open Science and encourage its scientists to publish research data in publicly available repositories.

LIN aims for high-quality publications in peer-reviewed internationally renowned scientific journals. In particular, the institute mentions the 25 most important journals in the field of neuroscience (according to scientific journal rankings) as main publication outlet targets. For research projects that deserve distribution to a wide readership, the institute aims for prestigious multi-disciplinary journals (eLife, Nature Communications, PNAS, Nature, etc.) preferably with open access option. As part of the institute's Open Access policy, allowances for Open Access publication fees are provided and counselling on questions of Creative Commons licensing is available. LIN's transfer concept involves the recording, securing, and exploitation of intellectual property rights.

Additional measures for quality management include the Commission for Ethics in Security-related research (KEF). The KEF provides consultation and support on matters of scientific ethics in security-related research projects at the institute.

For animal work at the institute, the animal core facility provides support and supervision. The facility staff includes animal care attendants and three veterinarians. Two veterinarians act as Animal Welfare Officers. LIN established an in-house veterinary pharmacy in 2018. Scientists are constantly trained on proper conduct when working with animals. The animal work includes a wide range of species such as drosophila, rodents and non-human primates. The institute highlights its commitment to the 3R principle. Thus, the institute strives for continuous refinement of experimental approaches, reduction of animal numbers, and replacement by *in vitro* technology, wherever possible.

Target- and result-oriented budget control is implemented by the program budget and the corresponding statement of expenditure.

In 2020, the institute set up a new system of performance-based allocation of funding (LOM) with the aim to increase transparency and to set incentives for acquisition of third-party funding. The system includes fixed premiums for newly acquired third-party funding (depending on the size of the new grant) and a proportional premium based on third-party funding in the previous year. The institute plans to introduce an additional criterion based on Third Mission and Transfer (to be introduced in 2021 and planned to include criteria such as intellectual property rights, scientific events, media coverage, and societal outreach).

Quality management by advisory boards and supervisory board

The Scientific Advisory Board (SAB) consists of nine scientists. Members are elected for four years, reappointment is possible once. The SAB advises the Board of Trustees and the Management Board on scientific matters and on operational questions. The SAB is responsible for assessing the results of the institute's scientific work and the scientific directions. The SAB meets annually. Biannually, the scientific progress of all LIN groups is assessed in depth by the SAB. Between external evaluations, the SAB performs an audit. SAB members participate in recruitment committees.

The Board of Trustees consists of up to seven members. Up to two members each are delegated by the State and the federal government. Up to three persons are appointed from the academic world, including the rector of a neighboring university. The board of trustees supervises the Management Board, approves the institute's financial plans and appoints the directors, department heads, and the members of the SAB.

5. Human Resources

As of 31 December 2019, the institute has 192 employees, thereof 104 in research and scientific services, 62 in services, and 26 in administration. These persons are supported by 23 student assistants and 5 trainees (see appendix 4).

Leadership level

The current Scientific Managing Director took up office in January 2020 and succeeds the head of the Department of Neurochemistry and Molecular Biology, who has led the institute since 2010 and will retire in December 2020 (see chapter 3). The Scientific Managing Director is appointed by the Board of Trustees from among the department heads after consultation with the Scientific Advisory Board and LIN's Board of Directors. The Administrative Director has filled the post since 2009 and was last reappointed in 2018.

Department heads are appointed based on international public advertisements and the proactive identification of candidates. Selection criteria include scientific excellence and leadership skills. Department heads are university professors jointly appointed with University of Magdeburg. The Management Board decides on new appointments to leadership positions in research groups or core facilities after consulting with the Board of Directors.

LIN aims at developing leadership culture by workshops for leadership personnel. The Management Board has initiated an institutional strategy to develop the institute's culture and started with the definition of core values, followed by corresponding procedures and standards for leadership. Annual assessments of group leaders' leadership and mentorship performance by their own groups will be introduced for additional feedback.

Postdoctoral staff

On 31 December 2019, LIN hosted 15 Postdocs (7 male, 8 female), who completed their doctoral degree in the last six years. In accordance with the "Career Guidelines of the Leibniz Association" LIN divides the postdoctoral phase into three segments (orientation, consolidation, tenure track phase). The institute set up a structured program for the different postdoc phases. The program includes a development plan, a mentoring team, and consistent support by the *Career Office* (see chapter 3). Applications to external mentoring programs are supported.

Within the institute, junior Postdocs and doctoral students can apply for internal research funding as part of the LINseeds program. The program provides one-off funding of € 5k on very brief proposals. Projects are selected based on a combination of initial peer-ranking followed by a lottery. Furthermore, LIN's experienced Postdocs can apply for funding in

the annual *LIN-SpecialProject* competition. This competition encourages cooperative projects that ideally have the potential to lead to a DFG application. Funding covers one PhD position and bench money for a period of three years. As a step towards establishing independence, advanced Postdocs may head their own small work group in a department. LIN points to three former young group leaders who gained full professorial positions as examples for the success in promoting junior researchers.

LIN developed a **Tenure Track program** that involves the leadership of a junior research group and is to be implemented from September 2020. The typical timeframe of the program is 5+4 years, where the additional four years can be granted in special cases. The tenure evaluation committee includes the SAB and external reviewers. In case of positive evaluation, the group can be included as a permanent structure at LIN. Candidates for the program will be identified outside of LIN and invited to scientific symposia held at the institute.

Doctoral Candidates

The institute has a structured doctoral program. The program includes a doctoral agreement defining rights and responsibilities, a draft and approval of the research proposal within the first six months, and a three-person thesis committee. The thesis committee meets yearly and provides critical feedback on the research progress, supports the development of scientific independence, discusses potential conflicts, and mentors the student on future career steps. The LIN doctoral program interacts with other doctoral programs on the Magdeburg Neuro-campus to provide additional courses on academic and soft skills. The institute plans to establish annual retreats for young scientists. Doctoral students can apply for project funding in the *LINseeds* program (see above).

As of 31 December 2019, 48 doctoral candidates worked at LIN, of which 40 were employed on a contract while 8 held a scholarship. 30 doctoral candidates came from abroad. On average, 11.6 doctoral degrees were completed annually over the period 2017 – 2019. The average doctoral period was 5 years. As the institute points out, targeted measures to ensure that a doctoral period does not exceed 4 years are now being implemented. In general, doctoral students are hired on an initial 3-year contract (65 %, E13) with a one-year extension possible upon recommendation by the thesis committee.

Science-supporting staff

LIN established a vocational training program in 2013. As of 2020, it includes four different professions: office administrator, laboratory technician, animal technician, and IT specialist. Workshop engineering is planned as a fifth profession to be added in 2021. As of 31 December 2019, five trainees worked at LIN. Over the period 2017 – 2019, four persons completed their training.

LIN offers an in-house lecture series for science supporting staff with content suggested by the staff. The offers of external training providers are used for continuous education of science-supporting employees.

Equal opportunities and work-life balance

As of 31 December 2019, the proportion of women in “Research and Scientific Services” was 43 %. In terms of individual scientific status groups, 50 % of doctoral students and 25 % of leadership personnel were women.

In the program budget, LIN has itself set binding target quotas for the proportion of women at all levels based on the cascade model. Female candidates are actively encouraged to apply for leadership positions at the department or research group levels, for example through recruitment symposia organised at LIN. The institute has an equal opportunity officer since 1997 (closely interacting with the LIN-Career office, see chapter 3). The institute points to a series of measures to support female staff, including career days and meeting platforms. The institute was certified for a family-friendly environment by the audit *berufundfamilie* in 2013 and recertified in 2016 and 2019.

6. Cooperation and environment

The institute cooperates with local universities on joint professorial appointments. The six department heads are appointed jointly with the University of Magdeburg (W3-professorship), while one junior research group leader is appointed with Magdeburg-Stendal University of Applied Sciences (W2 Leibniz-professorship for female professors). Two professors of University of Magdeburg are appointed as External Scientific Members at LIN.

Approximately 30 LIN scientists contribute to undergraduate and graduate teaching in six different study courses. They conduct 35 - 50 semester weekly hours at the University and the University of Applied Sciences. The institute manages the MSc. program *Integrative Neuroscience* jointly with the Medical Faculty at University of Magdeburg.

The Magdeburg site of the German Center for Neurodegenerative Diseases (DZNE Magdeburg) is an important local partner for LIN. Currently, the institute has two joint work groups with DZNE. LIN is a partner in the Centre for Behavioral Brain Sciences (CBBS) Magdeburg. CBBS serves as a coordination structure and involves LIN, the University of Magdeburg and DZNE. In 2015, CBBS was awarded the status of Leibniz ScienceCampus. Cooperation in the CBBS includes collaborative equipment use, public relations work, lab animal courses, conference organisation, and lobbying activities. The CBBS also provides collaborative graduate and postgraduate teaching in the common CBBS Graduate Program.

LIN is a founder, lead, or active partner in several DFG-funded *Sonderforschungsbereiche* (SFB), SFB/Transregios (TRR), or Graduate Schools (GRK), mostly at Magdeburg University:

- “Molecular organization of cellular communication within the immune system” (SFB 854, 2010-2021) with University of Magdeburg
- “Neurobiology of Motivated Behaviour” (SFB 779, 2012-2019) with DNZE and University of Magdeburg
- “The ageing synapse - molecular, cellular and behavioral underpinnings of cognitive decline” (GRK 2413, since 2019) with University of Magdeburg

- “The active auditory system” (TRR 31, 2013-2017) with Oldenburg University
- “A Companion-Technology for Cognitive Technical Systems” (TRR 62, 2013-2017) with Ulm University

Other cooperative projects funded by the State of Saxony-Anhalt/EU include the research initiative “Intentional, anticipatory, interactive systems” (2018-2020) with Magdeburg University, the Research Network “Autonomy in old age” (since 2016) together with partners from Magdeburg and Halle, and the Graduate School “Analysis, Imaging, and Modeling of Neuronal and Inflammatory Processes” with, among others, University of Magdeburg, DZNE, and the Helmholtz Centre of Infection Research in Braunschweig (HZI).

In the *Initial Training Network NPlast* (2012-2015, coordinated by LIN and supported by the European Marie Curie Funding Initiative), LIN cooperated with partners in Edinburgh, Geneva, Zurich, Utrecht, and Paris. Within the Leibniz Association, the institute contributes i.a. to the Leibniz Research Alliances “Healthy Ageing” and “Bioactive Compounds and Biotechnology”, and the Leibniz Network “Mathematical Modeling and Simulation (MMS)”.

Institution’s status in the specialist environment

LIN investigates the mechanisms of learning and memory at all levels of brain organisations. In doing so, the institute pursues animal and human experimental research in parallel and in a comparative manner. At LIN fundamental research and clinical research are combined under the same roof. By LIN’s assessment, this closely integrated concept is unique among national and international institutes of comparable size.

Internationally, LIN mentions a number of institutes with learning and memory research as dedicated focus. These include i.a. the *Picower Center & McGovern Institute* at the Massachusetts Institute of Technology, the *Center for Neurobiology and Behavior* and *Zuckerman Institute* at Columbia University New York, and the Neuroscience Domain at University College London with the *Sainsbury Wellcome Centre for Neural Circuits*.

According to the institute, other research institutions in Germany pursue partially overlapping research portfolios. These include, among others, the University of Göttingen which focusses on non-human primate research on higher cognitive functions, the *Center for Molecular Neurobiology Hamburg* which studies neuroplasticity in memory processes, the *Central Institute of Mental Health* in Mannheim and the *Hertie Institute for Clinical Brain Research* in Tübingen which focus on neurological diseases. The *NeuroCure excellence cluster* Berlin covers individual topic areas of LIN research. On the topics neuroplasticity and circuit neuroscience, the institute points to thematic similarities with the neurobiologically oriented *Max Planck Institutes* in Munich, Frankfurt, Heidelberg, Bonn, and Göttingen.

7. Subdivisions of LIN

Department of Neurochemistry and Molecular Biology

(5 work groups and special labs; 16.2 FTE, thereof 6.6 FTE Research and scientific services, 3.9 FTE Doctoral candidates, and 5.8 FTE Service staff)

The department's central aim is to elucidate molecular mechanisms of learning and memory. The department focuses on chemical synapses, specialized cell contacts crucial for inter-neuronal communication in the brain.

In its five lines of research, the department studies (i) the role of the presynaptic scaffolding protein Bassoon in organising the neurotransmitter release sites; (ii) Neuroplastins as cell adhesion molecules involved in the regulation of synaptic plasticity; (iii) neuromodulatory mechanisms how dopamine regulates the perisynaptic extracellular matrix; (iv) auditory learning involving cortical release of the plasticity modulators dopamine and noradrenaline; and (v) the dynamics of the synaptic proteomes during physiological and pathological plasticity. The department participated in the SynGO consortium in synapse research to establish a comprehensive open knowledge base covering more than 1,100 curated synaptic protein entries.

Over the period 2017-2019, the department published on average 11 articles in peer-reviewed journals per year. Average yearly project grants amounted to € 465k over the same period and were obtained mostly from the DFG (€ 235k), the Leibniz Association (€ 90k), and Federal and *Länder* governments (€ 75k). On average, 2 doctoral degrees were completed in the department per year.

The department contributed mainly to research programs 1 and 3; it will be closed by the end of 2020 due to the department head's retirement.

Department of Genetics of Learning and Memory

(12.3 FTE, thereof 5 FTE Research and scientific services, 2 FTE Doctoral candidates, and 5.4 FTE Service staff)

The department focusses on the contribution of learning and memory systems to the problem of what to do next. To understand this process, *Drosophila melanogaster* is used as model organism.

The department contributed to the discovery of complex circuit motifs in the synaptic connectome of the mushroom body, the highest brain center in insects. The aim now is to understand the functional implications and computational capacities of these circuit motifs and the possible generality of these circuit motifs across species. Having so far focused on how memories are formed and stored ('memory-afferent' processes), the department plans a shift to studying the principles of how memories are retrieved and behaviorally implemented ('memory-efferent' processes). The department's work largely falls into LIN's Research Program 2.

Over the period 2017-2019, the department published on average 8 articles in peer-reviewed journals per year. Average yearly project grants amounted to € 250k over the same

period and were obtained mostly from the DFG (€ 230k). On average, 0.3 doctoral degrees were completed in the department per year.

Department of Systems Physiology of Learning

(4 work groups; 20.0 FTE, thereof 8.7 FTE Research and scientific services, 5.1 FTE Doctoral candidates, and 6.3 FTE Service staff)

The department investigates the functional anatomy and physiology of neuronal circuits that underlie the learning-induced plasticity of the brain. A particular focus of its work is the auditory cortex, the part of the brain's cortex that mediates processing of auditory information. The department combines two traditionally separated disciplines, auditory neurophysiology and neuroscience of learning and memory. To investigate the neuronal mechanisms underlying learning, behavioral experiments are combined with electrophysiological recording and optical recording as well as with optogenetic and pharmacological intervention strategies.

The department has investigated in particular the neuronal basis of motivational control during learning, of learning-induced changes in the processing of auditory information, and of the optogenetic control of learning behavior. Translational aspects of the research include research on human-machine interaction as well as improved methods of machine learning.

The department contributed to LIN's collaborations with external partners in the DFG-funded SFBs and TRRs (see chapter 6), the department head served as spokesman of the SFB 779 and local spokesman of the SFB TRR 31. Over the period 2017-2019, the department published on average 10 articles per year in peer-reviewed journals and one contribution in edited volumes. Average yearly project grants amounted to € 560k over the same period and were obtained mostly from the DFG (€ 285k), the Leibniz Association (€ 160k), and the EU (€ 115k). On average, 15 patents were granted for the department's work and two doctoral degrees were completed per year.

Department of Cellular Neuroscience (Since January 2020)

This new department will be investigating the role of the hippocampal formation in learning and memory with a focus on understanding neuronal input to output conversion. It will cover research topics spanning from fundamental mechanism to disease contexts.

The overarching strategic research goal will be the identification of neural correlates of memory-guided behavior on the level of individual neurons (synaptic integration and plasticity) and neuronal networks. The key questions motivating future research are: a) How is synaptic input transformed into a stable neuronal representation of intrinsic and environmental variables by synaptic plasticity, b) How does hippocampal learning change over lifetime from juvenile to adult states, and in the presence of progressing pathological challenges, and c) What are the roles of cell-type specific subcortical modulation (during reward-seeking, arousal and specific behavior-al motifs) in memory acquisition and recall.

The department plans to bridge several scales of investigation ranging from the molecular dissection of cell types using RNAseq with bioinformatics over the investigation of synaptic integration/plasticity on the cellular level in mice and humans up to the network/systems level analysis of activity patterns during behavior. Thus, the new department aims at cross-linking between all three research programs.

Department of Functional Architecture of Memory

(2 work groups; 11 FTE, thereof 4 FTE Research and scientific services, 3 FTE Doctoral candidates, and 4 FTE Service staff)

The department, founded in 2016, is dedicated to leveraging the fundamental principles of memory by investigating its behavioral, network and cellular mechanisms.

The department focuses on characterizing the role of the Medial Temporal Lobe (MTL) areas of the brain, a region that suffers damage in aging and in patients suffering from amnesia or Alzheimer Disease (AD). The department applies the conditions typically used in human experiments to rodents with the aim of bridging further research on human and animal memory. The department's approach allowed LIN to recently formulate new concepts describing an unexpected segregation of spatial and non-spatial information within the MTL region and a switch between MTL subnetworks for retrieving memories over half a lifetime. The department's activities focus on research program 2.

Beginning in 2012, the department head organised the biennial international and inter-species Functional Architecture of Memory conference, which has been held at LIN since 2016. Since 2017, the department runs a monthly outreach program for preschool children. Over the period 2017-2019, the department published on average 5 articles in peer-reviewed journals per year. Average yearly project grants amounted to € 170k over the same period and were obtained almost exclusively from the DFG. On average, 0.3 doctoral degrees were completed per year.

Department of Behavioral Neurology

(8 work groups; 9.3 FTE, thereof 4.5 FTE Research and scientific services, 1.3 FTE Doctoral candidates, and 3.5 FTE Service staff. Additionally, 15 persons employed by the university hospital contribute as external members.)

The department studies different learning processes, including implicit learning mechanisms and mechanisms that profit from conscious deliberation. Over the last years, the department has examined network function for both implicit and explicit learning in humans, with an emphasis on the systems physiology and psychology of attention and expectation, sensorimotor learning, and motivated learning. In addition, the department has investigated dysfunction of networks for learning and memory in neurodegenerative and mood disorders. Finally, the department has a strong interest in brain-computer-interfaces (BCI) and in learning and memory network modulation via deep brain stimulation (DBS).

Research combines human non-invasive and invasive electrophysiology with 3T and 7T magnetic resonance imaging, genetics, psychophysics, and machine learning. The department functions as an interface with the university hospital at OVGU Magdeburg: Many of the department's principal investigators are physicians, allowing LIN to pursue basic research with clinical relevance, including studies in clinical populations.

Over the period 2017-2019, the department published on average 43 articles per year in peer-reviewed journals. Average yearly project grants amounted to € 310k and were obtained mostly from the state government (*Landesregierung Sachsen-Anhalt*, € 130k), the EU (€ 65k), and the DFG (€ 60k). On average, two patents were granted for the department's work and 2.3 doctoral degrees (including 1 medical doctor) were completed in the department on average per year.

Research Group Neuroplasticity

(19.1 FTE, thereof 9 FTE Research and scientific services, 5.2 FTE Doctoral candidates, and 4.9 FTE Service staff)

Research in the group is concerned with fundamental questions on the communication and functioning of synapses and how these determine functional properties in the context of learning and memory. The group tries to understand how local organelles serve synaptic function and investigates synaptic processes in ageing and neurodegenerative diseases. A multi-disciplinary approach is used, with studies ranging from single molecules to in vivo animal experimentation.

The group, for example, (1) deciphered principles of synapse-to-nucleus communication based on macromolecular protein transport from spine synapses to nuclear target sites; (2) discovered novel organelles in dendrites and axons that serve synaptic function and plasticity; and (3) analyzed molecular mechanisms that allow synaptic calcium signals to be translated into long-lasting changes of synaptic strength. The group cooperates closely with the group leader's Leibniz Group *Dendritic Organelles and Synaptic Function* at the ZMNH in Hamburg (established in 2016). Together, they contributed in the past mainly to RP 1 and to a lesser degree to RP 2 and 3.

Over the period 2017-2019, the group published on average 8 articles per year in peer-reviewed journals. Average yearly project grants amounted to € 760k over the same period and were obtained mostly from the Leibniz Association (€ 385k) and the DFG (€ 205k). On average, 2.3 doctoral degrees were completed in the department per year.

Junior Research Group Neuromodulatory Networks

(3.3 FTE, thereof 1 FTE Research and scientific services, 1.3 FTE Doctoral candidates, and 1 FTE Service staff)

The junior research group was initiated through funding by the Leibniz Competition in July 2018. Its research program focusses on (1) the functional dissection of noradrenergic circuitry and its role in learning using in vitro and in vivo preparation rodents and (2) the development of molecular tools and stimulation technology to drive innovation towards non-invasive therapeutical and brain enhancing applications. The research bridges the

gap between synaptic and subcellular neurophysiology and circuits on the mesoscale levels representing various behaviors. The group therefore contributes predominantly to RP1 and RP2.

In 2018 and 2019, the group's average yearly project grants amounted to € 200k and were obtained exclusively from the Leibniz Association.

Junior Research Group Cognition and Emotion (From March 2020)

This newly founded research group will apply a unified perspective regarding the molecular signatures, oscillatory activity, and cognitive and emotional mnemonic functions of input-output clusters of subcortical and hippocampal neurons.

The group will rely on the molecular identification of the imaged cell types and will employ machine learning tools in order to relate specific molecular signatures of the identified cell types to oscillatory activity and behavior. The group also aims to enhance ecological validity in memory research by establishing more naturalistic environments. For this goal, animals will be housed in larger groups and monitored over prolonged periods of time. Using a combination of electrophysiological and imaging techniques, the group will study ventral hippocampal and subcortical memory-related circuits in relation to social behavior. With this focus on systems and circuit physiology, the group's research is part of RP2.

Research Group Comparative Neuroscience

(8.1 FTE, thereof 4 FTE Research and scientific services and 4.1 FTE Doctoral candidates)

The research group investigates neuronal mechanisms underlying short-term memory drawing on the combination of expertise in monkey single cell physiology, human magnetoencephalography, and computational modelling. The group discovered correlates of sensory and working memory on the highest level of the auditory system, the auditory cortex. The group also established a computational model of auditory cortex dynamics that integrates their findings on different spatial scales in non-human primates and humans. The activities are related to LIN's research programs 2 and 3.

Over the period 2017-2019, the group published on average 4.3 articles per year in peer-reviewed journals. Average yearly project grants amounted to € 88k over the same period and were obtained almost exclusively from the EU (€ 52k) and the DFG (€ 34k). On average, 0.3 doctoral degrees were completed per year.

CBBS Junior Research Group Neurocognitive Development

(4.4 FTE, thereof 2.1 FTE Research and scientific services, 1.3 FTE Doctoral candidates, and 1 FTE Service staff)

The group was established at the LIN in 2017 and studies the development of auditory attention and related learning and memory processes on the behavioral and brain level. The group increasingly includes digital media use and real life scenarios to investigate effects on distraction of attention during childhood. Furthermore, it investigates attention in children suffering from attention disorders. The research focuses on the relations between

behavior and neuronal network activity using behavioral measures, EEG, and pupillometry. The group developed a new pupillometry approach and linked pupil responses to attention-related markers in the EEG. In collaboration with other groups at the LIN, it integrates imaging methods and prospective animal studies to explore the functional link between pupil dynamics and locus coeruleus activity in the framework of attention and memory development. The group contributes a developmental perspective to RP 2 and RP 3.

Over the period of 2017-2019, the group published on average two articles per year in peer-reviewed journals. Average yearly project grants amounted to € 250k over the same period and were obtained mostly from the EU (€ 150k), the Leibniz Association (€ 70k), and the DFG (€ 30k).

Combinatorial NeuroImaging Core Facility

(21 FTE, thereof 12 FTE Research and research support, 3 FTE Doctoral candidates, and 6 FTE Service staff)

The *CNI* Core Facility hosts and provides access to a wide range of imaging techniques for microscopy, animal and human imaging. *CNI* staff members perform research projects at the molecular, cellular and systems level that integrate with all four research programs of the LIN. The aim of *CNI*'s dual working principle is to ensure cost-efficient, sustainable operation of advanced technology and to facilitate synergy in collaborating research projects.

The *CNI* investigated the subcellular organisation and signaling pathways of memory forming synapses by high resolution microscopy and invented a new technology for ultra-sensitive Förster Resonance Energy Transfer measurements and label-free imaging based on Fluorescence Lifetime. Spatial patterns of cerebral blood flow was mapped in behaving animals and in rodent models for dementia and autism. Options for systemic imaging of awake animals were improved by new light-sheet microscopy and 9.4T MR imaging technology. *CNI*'s human imaging research has a strong focus on the mechanisms of hemispheric specialization and interaction in auditory cognition and developed a multimodal acquisition scheme for studying the dynamics of learning and efficient feedback interventions.

Over the period 2017-2019, the CNI published on average 23 articles per year in peer-reviewed journals. Average yearly project grants amounted to € 660k over the same period and were obtained predominantly from the DFG (€ 375k), Federal and Länder governments (€ 210k), and the EU (€ 70k). Additionally, the CNI received € 115k in revenue for services provided to external users. On average, 3 patents were granted for the CNI's work.

8. Handling of recommendations from the previous evaluation

LIN responded as follows to the 9 recommendations of the last external evaluation (highlighted in italics, see also statement of the Senate of the Leibniz Association issued on 20 March 2014, pages B-3/B-4):

- 1) *“It is welcomed that the special labs not only see themselves as service providers, but also independently perform predominantly very convincing research work. In the future, however, care should [...] be taken to ensure that [...] their range of services [...] are oriented towards the overarching scientific priorities of LIN. If possible, decisions should be taken within the framework of transparent procedures.”*

LIN points to the restructuring of the former special labs in the CNI core facility and the research group *Comparative Neuroscience* (see chapter 3). Within the new research support concept, the CNI core facility will provide services to the institute’s research units. The research group *Comparative Neuroscience* will focus on comparative research across species including primates with an emphasis on working memory.

- 2) *“Third party funding for research projects has reached a very good level. Third party funds raised from the EU for 2012 have increased significantly compared to previous years. It is recommended that this gratifyingly high proportion of EU funds within the third-party funding portfolio be kept as constant as possible. Furthermore, LIN should strive to attract junior researchers to the institute financed by third party funds.”*

The institute established the position of an EU and research coordinator to support third-party funding applications, in particular for EU funding (see chapter 4). The new scientific director holds an ERC consolidator grant, while the junior research groups *Neuromodulatory Networks* (initially funded by the Leibniz Competition) and *Neurocognitive Development* (funded by EU-ESIF) were established with third-party funding.

- 3) *“The equipment is sufficient for the current tasks. However, some devices are no longer state of the art. In order for LIN to continue to conduct research at the highest international level and to be able to publish competitively, the equipment needs to be modernized in the medium term. LIN must prioritize the funding requirements in consultation with the Scientific Advisory Board. In close coordination with the Board of Trustees, the institute must examine if additional investment resources are required and [...] if they are to be applied for on the basis of extraordinary items of expenditure (“Sondertatbestände”).”*

See chapter 4, facilities.

- 4) *“Greater efforts should be made to attract highly qualified scientific personnel from abroad. This will also contribute to a further intensification of the already very good international networking.”*

44 of the 104 employees in Research and scientific services at LIN are foreigners. LIN points to the international recruitments of the Head of the Department *Functional Architecture of Memory* and the leader of the junior research groups *Neuromodulatory*

Networks and Cognition and Emotion to illustrate successful international recruitments.

- 5) *“The Institute must continue to work hard to achieve its goals in the area of gender equality, especially at the management level.”*

The institute has recruited one female department head and two female junior research group leaders since the last evaluation. Additional measures to support women in science and recruit women were implemented (see chapter 5).

- 6) *“Postdocs should – potentially in cooperation with the University of Magdeburg – receive mentoring to support them in their career planning.”*

See chapter 5.

- 7) *“It is recommended to make systematic use of postdoctoral funding schemes, like the DFG Emmy Noether Program or the Marie Curie Program of the EU, for both internal and externally recruited young researchers and to include corresponding objectives in the strategic planning of LIN.”*

The institute points to the recruitment of young scientists with funding provided by the Leibniz competition, the Swedish Research Council, the Volkswagen foundation, Erxleben professorships, and international fellowship programs.

- 8) *“The performance of the institute suggests a de facto very good scientific quality assurance. However, the informal mechanisms should be more strongly structured and thus made more transparent. It should be examined which further quality assurance measures can be introduced. In doing so, the definition of central performance indicators that are important for the overall development of the institute should be considered in coordination with the Scientific Advisory Board.”*

The institute implemented the research information management system PURE to support data collection and analysis. A revision of LIN’s system of performance-oriented budgeting has been put in motion by the new Management Board in 2020.

- 9) *“As is customary for Leibniz institutions, the chairpersons of the Scientific Advisory Board should in future take part in the meetings of the Board of Trustees only as guests in an advisory capacity.”*

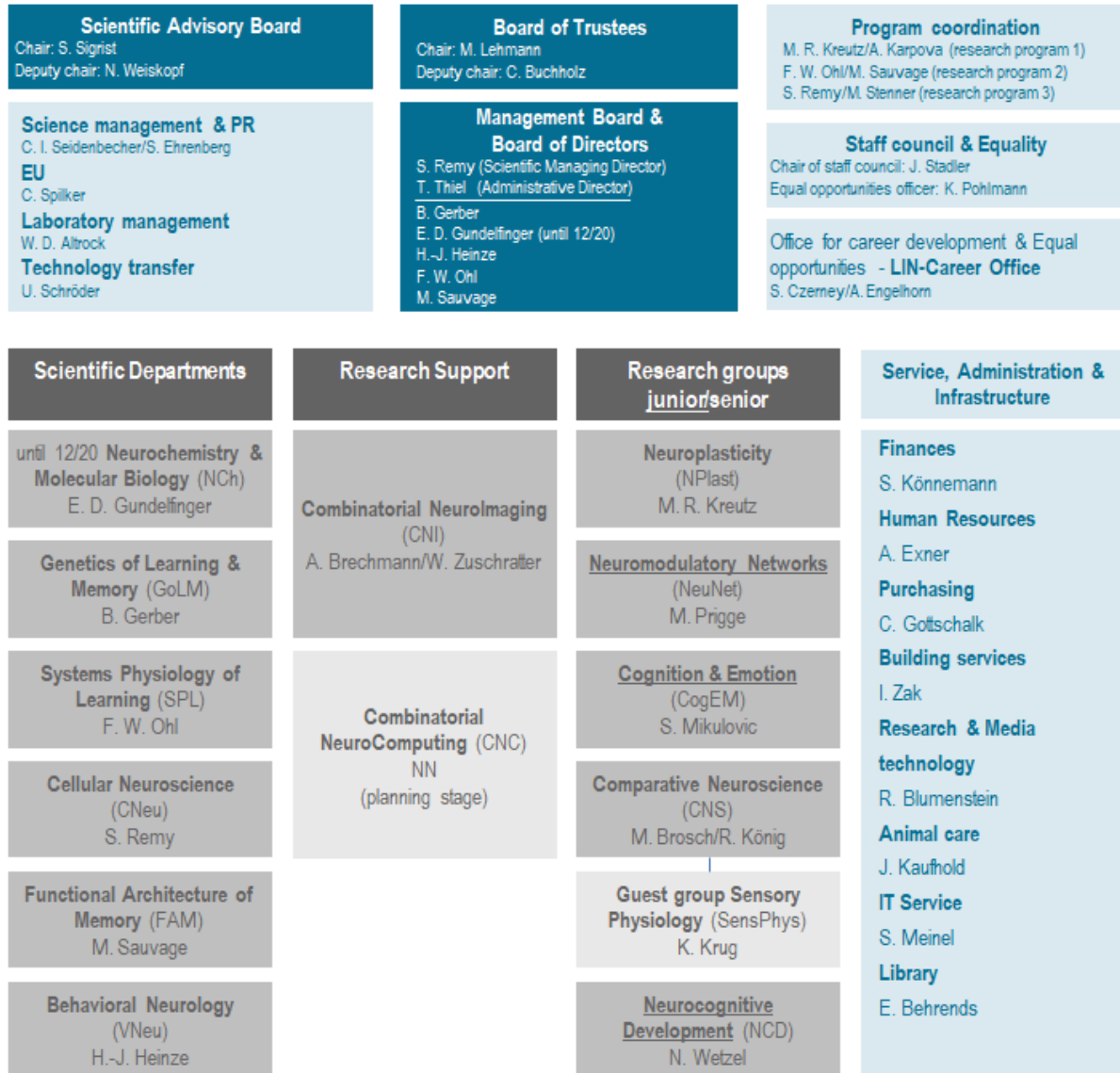
The Board of Trustees decided in 2013 to adapt LIN’s statutes accordingly and to invite the SAB chairperson and deputy chair as guests to the Board of Trustees meetings from 2014 onwards.

Appendix 1

Organisational Chart

Leibniz Institute for Neurobiology (LIN)

September 2020



Appendix 2

Publications and patents

	Period		
	2017	2018	2019
Total number of publications	137	110	141
Individual contributions to edited volumes	10	4	3
Articles in peer-reviewed journals	127	105	135
Articles in other journals	0	1	3

Industrial property rights ¹⁾	2017	2018	2019
Patents (granted/applied)	13/13	16/12	24/10
Other industrial property rights (granted/applied)	4/0	4/0	4/0
Exploitation rights/licenses (number)	1	0	0

¹ Concerning financial expenditures for revenues from patents, other industrial property rights and licences see Appendix 3.

Appendix 3

Revenue and Expenditure

Revenue		2017			2018			2019 ¹⁾		
		k€	%	%	k€	%	%	k€	%	%
Total revenue (sum of I., II. and III.; excluding DFG fees)		23,910.2			22,319.4			22,307.5		
I.	Revenue (sum of I.1., I.2. and I.3)	20,074.1	100 %		20,320.0	100 %		19,095.3	100 %	
1.	<u>INSTITUTIONAL FUNDING (EXCLUDING CONSTRUCTION PROJECTS AND ACQUISITION OF PROPERTY)</u>	14,629.5	73 %		14,164.7	70 %		14,307.1	75 %	
1.1	Institutional funding (excluding construction projects and acquisition of property) by Federal and <i>Länder</i> governments according to AV-WGL	14,629.5			14,164.7			14,307.1		
2.	<u>REVENUE FROM PROJECT GRANTS</u>	5,349.5	20 %	100 %	6,018.9	29 %	100 %	4,671.4	24 %	100 %
2.1	DFG	2,431.5		45 %	1,974.9		33 %	1,966.19		42 %
2.2	Leibniz Association (competitive procedure)	1,012.7		19 %	1,053.0		17 %	1,203.8		26 %
2.3	Federal, <i>Länder</i> governments	808.0		15 %	491.4		8 %	580.3		12 %
2.4	EU (incl. ESIF)	945.6		18 %	2,309.7		39 %	1,040.9		22 %
	<i>thereof: ESIF</i>	831.8			2,185.9			1,017.6		
2.5	Foundations	140.0		3 %	92.9		2 %	1.0		0 %
2.6	others	10.0		0 %	14.9		0 %	8.2		0 %
2.7	misc. program allowances	1.7		0 %	82.2		10 %	-128.9		-3 %
3.	<u>REVENUE FROM SERVICES</u>	95.0	0 %		136.3	1 %		115.8	1 %	
3.1	Revenue from commissioned work	95.0			126.3			114.4		
3.2	Revenue from publications	0.0			10.0			0.0		
3.3	Revenue from exploitation of intellectual property for which the institution holds industrial property rights (patents, utility models etc.)	0.0			0.0			1.5		
II.	Miscellaneous revenue (e.g. membership fees, donations, rental income, funds drawn from reserves)	3,836.2			1,999.5			3,213.2		
	<i>Thereof: Funds drawn from reserves (institutional funding)</i>	1,887.3			2,167.7			1,890.2		
	<i>Thereof: Funds drawn from reserves (project grants, donations)</i>	1,902.9			-213.9			1,137.5		
III.	Revenue for construction projects (institutional funding by Federal and <i>Länder</i> governments, EU structural funds, etc.)	0.0			0.0			0.0		
Expenditures		k€			k€			k€		
Expenditures (excluding DFG fees)		23,901.8			22,309.9			22,157.8		
1.	Personnel	11,725.6			11,324.6			11,655.4		
2.	Material expenses	5,252.2			5,030.2			5,262.2		
2.1	<i>Proportion of these expenditures used for registering industrial property rights (patents, utility models etc.)</i>	24.2			32.5			24.2		
3.	Equipment investments	4,276.7			1,516.4			1,259.6		
4.	Construction projects, acquisition of property	30.9			720.5			37.7		
5.	Other operating expenses	2,616.4			3,718.2			3,942.8		
	<i>thereof: Selbstbewirtschaftungsmittel</i>	1,057.1			1,195.5			1,560.1		
DFG fees (if paid for the institution – 2.5% of revenue from institutional funding)		632.5			352.3			355.9		

¹ Preliminary data: no.

Appendix 4

Staff

(Basic financing and third-party funding / proportion of women (as of 31 December 2019))

	Full time equivalents		Employees		Female employees		foreigners
	Total	on third-party funding	Total	on temporary contracts	Total	on temporary contracts	Total
	Number	Percent	Number	Percent	Number	Percent	Number
Research and scientific services	83.7	46.3	104	76.9	43	90.7	44
1 st level (scientific directors)	1.0	0.0	1	0.0	0	0.0	0
2 nd level (department leaders or equi.)	4.0	0.0	4	0.0	1	0.0	1
3 rd level (group leaders or equi.)	6.2	0.0	7	14.3	1	100.0	1
Junior research group leaders	2.0	70.0	2	100.0	1	100.0	0
Further academic staff in executive positions	10.7	4.7	12	41.7	3	33.3	3
Scientists in non-executive positions (A13, A14, E13, E14 or equivalent)	28.4	65.6	32	93.8	15	100.0	15
Scientific services (from E13, senior service)	6.0	0.0	6	33.3	2	50.0	1
Doctoral candidates (A13, E13, E13/2 or equi.)	25.5	71.7	40	100.0	20	100.0	23
Service positions	58.6	3.4	62				
Laboratory (E9 to E12, upper-mid-level service)	16.6	6.0	18				
Laboratory (E5 to E8, mid-level service)	17.4	5.6	18				
Laboratory service (E1 to E4)	1.8	0.0	2				
Animal care (E5 to E8, mid-level service)	4.9	0.0	5				
Animal service (E1 to E4)	3.8	0.0	4				
Workshops (E5 to E8, mid-level service)	4.0	0.0	4				
Secretaries (E5 to E8, mid-level service)	6.3	0.0	7				
Library (E9 to E12, upper-mid-level service)	1.0	0.0	1				
Information technology - IT (E9 to E12, upper-mid-level service)	3.0	0.0	3				
Administration	25.1	3.0	26				
Head of the administration	1.0	0.0	1				
Staff positions (from E13, senior service)	5.9	12.8	6				
Staff positions (E9 to E12, upper-mid-level service)	2.0	0.0	2				
Internal administration (financial administration, personnel etc.) (from E13, senior service)	4.9	0.0	5				
Internal administration (financial administration, personnel etc.) (E9 to E12, upper-mid-level service)	6.6	0.0	7				
House technicians (E5 to E8, mid-level service)	2.8	0.0	3				
Building service (E1 to E4)	2.0	0.0	2				
Student assistants	4.4	59.9	23				
Trainees	5.0	0.0	5				
Scholarship recipients at the institution	5.2	100.0	8		4		6
Doctoral candidates	5.2	100.0	8		4		6
Post-doctoral researchers	0.0	0.0	0		0		0

Annex B: Evaluation Report

Leibniz Institute for Neurobiology, Magdeburg (LIN)

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Appendix:

Members of review board

1. Summary and main recommendations

The Leibniz Institute for Neurobiology (LIN) is very successful in studying fundamental neurological processes of learning and memory. In doing so, the institute investigates all levels of neurobiological activity, from the molecular level to the human mind. Research is conducted across species using imaging techniques and interventions.

Within Germany, and to some extent within Europe, the institute's approach to bridging the scales of neurobiological activity, from the synaptic level to human behaviour, is unique. By combining these levels of analysis and a cross-species approach in one institution, LIN has established an excellent reputation in the field of memory research. The institute has a coherent research concept that combines research departments, research groups, and core facilities. These units generate truly remarkable scientific results, which form the basis not only of publications but frequently also of patents. The plan is for these to be increasingly translated into clinical and pathological applications.

Since the last evaluation, LIN has developed very positively. The institute has established new departments and research groups that have added highly relevant and innovative research angles to its research portfolio. In line with a recommendation in the last evaluation, the way the research support units are organised has been restructured. The institute has developed its imaging facilities, extending the excellent research opportunities further. The institute's future plans build coherently on its strengths and the newly added expertise.

In January 2020, due to an upcoming retirement, a new scientific director took up leadership at LIN. He took over from the head of the Department of Neurochemistry & Molecular Biology, who had served very capably as LIN's scientific director since 2010. Under his leadership, the institute has flourished and has become a well-known centre for molecular learning memory. The institute and the committees involved have managed the transition very well and have succeeded once again in recruiting an excellent scientist for the role of scientific director. Quality management measures at LIN are already well-organised and are being developed further. The institute has increased its efforts to pursue open access. It collaborates successfully with important partners in the region, especially with the University of Magdeburg and the University Hospital.

LIN is an internationally attractive environment for scientists at all career stages. A significant share of its employees (42%) come from abroad, and three department and junior research group leaders were recruited internationally.

Special consideration should be given to the following main recommendations in the evaluation report (highlighted in **bold face** in the text):

Overall concept, activities and results (chapter 2)

1. In the coming years, the institute's research units should continue their efforts to pool their expertise, for example by combining different datasets to investigate an overarching research question from a number of different perspectives. LIN should strategically promote internal collaboration in multi-scalar projects. This could create a further basis for innovative joint research projects.

2. LIN generates very good, in some cases even excellent, research results. At the moment, the institute's publication record does not reflect this entirely. Moreover, the number of high-level publications is expected to increase as LIN strategically enhances collaborative research.

Changes and planning (chapter 3)

3. Providing LIN's core facilities with opportunities to engage in their own research projects is a good strategy. In this way, the institute ensures that the core facilities maintain the skills to provide state-of-the-art support services and develop new methods. However, the institute needs to clarify further how the resources bundled in the core facilities are allocated to services for other LIN units and to own research projects.
4. After the department head's retirement, the Department of Neurochemistry & Molecular Biology ended its activities in December 2020. It is important that the molecular neurobiological perspective is not lost afterwards. The institute's strategic efforts in this direction are most welcome and should be carried through.
5. The head of the Department of Behavioral Neurology was director of the Clinic for Neurology at Magdeburg University Hospital. In this position, he was an important factor in LIN's close collaboration with the clinic. In 2019, he was appointed CEO of Magdeburg University Hospital, while maintaining his position at LIN.

In September 2020, a new director of the Clinic for Neurology was appointed. Close collaboration with the clinic is a major asset for LIN's research activities. Therefore, it is important for LIN to put in place the necessary structures to ensure that the close partnership with the clinic continues. In the long term, LIN needs to sustain the relationship after the current department head's retirement.

6. LIN aims to strengthen multidimensional data analyses through computational techniques in order to further analyse the complex data generated in its experiments. These plans are meaningful and should be pursued further. For this purpose, LIN intends to apply for additional institutional funding from the Federal and *Länder* governments (minor extraordinary item of expenditure, *Sondertatbestand*) to establish a new Combinatorial NeuroComputing (CNC) core facility. As LIN acknowledges, computational modelling and neural simulations are necessary to generate testable hypotheses to guide the analyses. The institute's application for additional institutional funding should therefore spell out how the availability of sufficient modelling expertise is to be ensured. Additionally, the division of resources between own research activities and services in this core facility needs to be clarified.

Controlling and quality management (chapter 4)

7. Funding from the DFG is at a high level. LIN is also successful in the Leibniz Competition programme. LIN's potential to receive European-level funding for research projects, and particularly for collaborative work with partner institutions, should be exploited more intensively, following recent developments and plans.

Human resources (chapter 5)

8. The average doctoral period of five years is too long. It is welcomed that LIN acknowledges this and is taking action, with the aim of reducing the doctoral period to four years.
9. The institute has increased the proportion of female researchers in leadership positions since the previous evaluation. Given the situation that five scientific positions had to be filled, it is appropriate that three women and two men were hired. LIN should continue to attract women to leadership positions in the coming years.

2. Overall concept, activities and results

LIN successfully studies fundamental neurological processes in learning and memory, in particular the underlying neuronal mechanisms in the brain. Research activities range from the molecular and cellular level to the human mind. To investigate these systems, the institute applies and combines different techniques, from imaging technology to intervention experiments. Research is conducted following a cross-species approach that includes *Drosophila*, rodents, non-human primates, and human clinical patients.

The overall concept is coherent. LIN's research impressively bridges different scales of neurological analysis, from the synaptic to the behavioural level. At all levels, LIN makes important contributions to the understanding of neurological processes. The combination of the different scales with the cross-species approach in one institution provides LIN with unique research opportunities to advance the field of memory research. Thanks to this combination of features, and as a result of its research activities, the institute has established an excellent reputation in the field. **In the coming years, the institute's research units should continue their efforts to pool their expertise, for example by combining different datasets to investigate an overarching research question from a number of different perspectives. LIN should strategically promote internal collaboration in multi-scalar projects. This could create a further basis for innovative joint research projects.**

The organisational structure provides an appropriate framework for this. LIN's research activities are organised into 5 research departments,¹ 5 research groups, and one core facility. Cooperation between the units is visible in a number of joint publications. The core facility provides services for other research units, but can also pursue its own research work (see chapter 3).

Results

Research

LIN generates very good, in some cases even excellent, research results (see chapter 7). **At the moment, the institute's publication record does not reflect this entirely. Moreover, the number of high-level publications is expected to increase as**

¹ As the result of an overlap in recruiting a new department head, who also became LIN's new scientific director, the institute had 6 departments throughout the year 2020 (see chapter 3).

LIN strategically enhances collaborative research (see above). In its publication strategy, the institute should set clear publication targets and also define the necessary steps to reach these targets.

Transfer

LIN's research results have extensive translational potential. A successful example is the development and commercialisation of a mobile, wireless, dry EEG system that makes it possible to test patients at home, and which led to a spin-off company (see Department of Behavioral Neurology, chapter 7). The transfer of results to clinical and other environments should continuously be an important priority in LIN's activities. The institute holds a considerable number of patents for technology that has been developed based on its basic research results. The institute should pursue its plans for further valorisation and application development.

Moreover, LIN staff are active in outreach e.g. through public lectures, media presence, and policy advice. These activities should be intensified. In particular, LIN is encouraged to develop innovative formats for engaging its target groups, e.g. in pathology or life-long learning. Activities for these groups may provide valuable opportunities to receive feedback and perspectives on the institute's basic research.

3. Changes and planning

Development since the previous evaluation

LIN has developed very positively since the last evaluation. Excellent hires have added highly relevant and innovative angles to the institute's research portfolio.

The decision to establish the new Department of Functional Architecture of Memory in 2016 was very reasonable and in line with recent scientific developments. This department extends LIN's research on ageing, amnesia and Alzheimer's disease after the closing of a previous department.

In the years 2017 and 2018 and in March 2020, the institute set up three new junior research groups. These groups have advanced LIN's research at the systems level, but have also extended it to include the development of learning processes in children.

In January 2020, the establishment of the Department of Cellular Neuroscience was an important step, introducing additional methodological expertise to LIN. It brings high-resolution, subcellular imaging at network level to the study of behaviour and memory. This expertise had previously been missing at the institute and will open up extensive opportunities for collaboration within LIN. The institute, and in particular the newly established junior research groups, will benefit from this new angle and from the new ideas and techniques (for example in optogenetics).

The establishment of this new department is embedded in the context of a change in LIN's scientific management. With his move to LIN, the new head of department also became the institute's scientific director. He took over from the head of the Department of Neurochemistry & Molecular Biology, who had served as LIN's scientific director very capably from 2010 until December 2019. Under his leadership, the institute has flourished and

has become a well-known centre for molecular learning memory. When he retired in December 2020, his department was closed (see below).

The institute and the committees involved have managed this transition very well. It is especially noteworthy that they started the process as early as 2016 and thus succeeded in creating a transition period during which the previous and the new director both had departments at the institute. The new director is an excellent scientist, with a strong background in neural network activity.

At the time of the last evaluation, the institute had five special labs, which primarily supported the other LIN units but also conducted their own research projects. It was recommended that they develop transparent mechanisms in order to ensure that the special labs' service provision was guided by the institute's scientific priorities. In response, the institute restructured its research support units in a meaningful way: all imaging service units are combined in the Combinatorial NeuroImaging Core Facility (CNI) and two former special labs form the Research Group "Comparative Neuroscience", which aims to strengthen comparative research.

Providing LIN's core facilities with opportunities to engage in their own research projects is a good strategy. In this way, the institute ensures that the core facilities maintain the skills to provide state-of-the-art support services and develop new methods. However, the institute needs to clarify further how the resources bundled in the core facilities are allocated to services for other LIN units and to own research projects.

Strategic work planning for the coming years

LIN's plans for further development build coherently on the institute's strengths and the expertise introduced by the new departments.

After the department head's retirement, the Department of Neurochemistry & Molecular Biology ended its activities in December 2020. It is important that the molecular neurobiological perspective is not lost afterwards. The institute's strategic efforts in this direction are most welcome and should be carried through. The former department head will maintain an emeritus group at LIN, while some of the topics are included in other departments and the Research Group "Neuroplasticity". The institute is also considering the establishment of an additional junior research group with expertise in the molecular and cellular mechanisms of neural plasticity. The institute should maintain strong expertise in molecular mechanisms in order to investigate the fundamental interactions at synapse level and to support the translation of research findings.

The head of the Department of Behavioral Neurology was director of the Clinic for Neurology at Magdeburg University Hospital. In this position, he was an important factor in LIN's close collaboration with the clinic. In 2019, he was appointed CEO of Magdeburg University Hospital, while maintaining his position at LIN.

In September 2020, a new director of the Clinic for Neurology was appointed. Close collaboration with the clinic is a major asset for LIN's research activities. Therefore, it is important for LIN to put in place the necessary structures to ensure the close

partnership with the clinic continues. In the long term, LIN needs to sustain the relationship after the current department head's retirement.

LIN aims to strengthen multidimensional data analyses through computational techniques in order to further analyse the complex data generated in its experiments. These plans are meaningful and should be pursued further. For this purpose, LIN intends to apply for additional institutional funding from the Federal and *Länder* governments (minor extraordinary item of expenditure, *Sondertatbestand*) to establish a new Combinatorial NeuroComputing (CNC) core facility. As LIN acknowledges, computational modelling and neural simulations are necessary to generate testable hypotheses to guide the analyses. The institute's application for additional institutional funding should therefore spell out how the availability of sufficient modelling expertise is to be ensured. Additionally, the division of resources between own research activities and services in this core facility needs to be clarified.

4. Controlling and quality management

Facilities, equipment and funding

The provision of institutional funding is sufficient to cover LIN's current portfolio of activities. Over the period 2017-2019, the institute had a core budget of on average approx. €14.4m per year at its disposal. Over the period 2017-2019, on average €5.3m per year derived from project grants (corresponding to 27% of revenues).

Funding from the DFG is at a high level, including €2.1m per year in the institute's budget, and substantial further resources being administrated at the University of Magdeburg in Collaborative Research Centres (*Sonderforschungsbereiche*). **LIN is also successful in the Leibniz Competition programme. LIN's potential to receive European-level funding for research projects, and particularly for collaborative work with partner institutions, should be exploited more intensively, following recent developments and plans.** It is appreciated that some newly recruited scientists have obtained international grants, including the new scientific director, who holds an ERC Consolidator Grant. The institute's goal to recruit internationally funded research groups in the next years should be pursued consistently. The establishment of an EU Office to support scientists with applications for European Union funding is appreciated.

Based on a recommendation in the previous evaluation, the institute has expanded and updated its imaging facilities. The small animal imaging laboratory was extended with the addition of a 9.4T MRI scanner (in operation since September 2018). Upgrading the institute's equipment consistently is important for LIN's competitiveness. It is expected that the new facility will significantly boost the institute's research output as more LIN groups utilise the technologies and staff become more familiar with the scanner system. Given the high set-up and maintenance costs of the facilities, the institute should ensure that they are used effectively and operate at a high capacity.

It is welcomed that the institute plans to introduce an internal financial compensation system to ensure that a sufficient budget is available for the maintenance of and additional investments in the core facilities.

The institute's access to research facilities operated by local partners, e.g. via the collaboration as part of CBBS (see chapter 6) is appreciated. In particular, the institute is advised to secure ready access to the MEG system, an infrastructure that is critical to its research activities and is located at the university hospital.

Organisational and operational structure

The Management Board, consisting of the scientific director and the administrative director, has led the institute very capably since the last evaluation. The scientific director is appointed from among the department heads. The department heads form the Board of Directors, which provides valuable advice to the Management Board.

The organisational structure of the institute's research activities, with research departments, independent (junior) working groups, and core facilities, is conducive to achieving its goals. The different tasks and roles of these units are adequately defined; only the balance between the support functions and own research in the core facilities should be further clarified (see chapter 3).

Quality management

The institute's quality management is comprehensively and consistently aligned with the established standards. Rules are in place to ensure good scientific practice and they were recently updated based on the current DFG guidelines and the guidelines of the Leibniz Association. It is welcomed that the institute has reacted to a recommendation in the last evaluation by defining performance indicators and installing a research data management system.

LIN provides internal seed funding for research projects. The institute should adjust this internal competitive funding mechanism to systematically advance internal collaborations between the units and promote integration between the core facilities and the departments or research groups.

LIN has reworked its performance-based allocation system (LOM). It is particularly welcomed that the institute plans to encourage transfer activities by including a 'Third Mission & Transfer' criterion in the LOM.

LIN's dedication to open access is notable. The institute provides funding to cover open access publication fees. It should continue on this trajectory and encourage open access publications further. The frequent availability of LIN's publications as preprints and the increasing accessibility of its software code for download are laudable. In line with its commitment to open science, the institute should require experiments at LIN to be pre-registered. The institute's involvement in the efforts to establish a National Research Data Infrastructure (NFDI) is appreciated.

Quality management by advisory board and supervisory board

The scientific advisory board now meets yearly at LIN (instead of bi-annually), as is customary for Leibniz institutes. In between evaluation periods, the advisory board conducts an audit of the institute as a whole and of its individual units. In addition, as recommended

at the time of the last evaluation, the chair and the co-chair of the scientific advisory board now participate in the meetings of the supervisory board as guests only.

As of October 2020, only three of the nine members of the scientific advisory board are women. The institute should ensure that this proportion does not decrease. The institute should ensure that the increasing importance of computational expertise to its activities is reflected on the advisory board.

5. Human resources

As of 31 December 2019, LIN employed 104 people in research and scientific services. This number has dropped from 122 at the time of the last evaluation. It is welcomed that the institute has increased the share of employees from abroad to 42%, as recommended in the previous evaluation. It is a good achievement that scientists from abroad were recruited for three of the five new department and research group leadership positions. These recruitments indicate that LIN and Magdeburg form an internationally attractive research location.

Management

Two of the six department heads will retire in the coming years (see chapter 3). The institute has wisely initiated the succession planning process very early and has found excellent solutions to manage the transfer of leadership. Since January 2020, the institute has a new scientific director (see chapter 3).

Postdoctoral staff

As recommended in the last evaluation, the institute has recruited several third-party funded junior research group leaders. The office for career development provides targeted support. Junior researchers can receive internal mentoring from other established researchers at LIN. The institute's participation in the mentoring programmes offered by the Leibniz Association and in conjunction with local partners in Magdeburg is welcomed and should be continued. The institute plans to further advance its mentoring activities by strengthening the emphasis on leadership skills of group leaders. It is good that the institute has recently developed a structured tenure track programme.

Doctoral candidates

LIN provides graduate training for doctoral candidates in collaboration with local partners. The number of doctoral candidates employed at LIN has fallen (from 56 in 2012 to 40 in 2019). This is partly a result of the welcome development that the institute now offers doctoral candidates 65% positions (as compared to 50% at the last evaluation). The number of doctoral candidates is expected to increase as the new departments and junior research groups are established further. On average, 11.6 doctoral degrees are completed per year. **The average doctoral period of five years is too long. It is welcomed that LIN acknowledges this and is taking action, with the aim of reducing the doctoral period to four years.**

Equal opportunities and work-life balance

As of 31 December 2019, the proportion of women among staff in research and scientific services was 41% (43 out of 104 employees). This share is similar to the share at the last evaluation. At that time, an increase in the number of women was recommended, especially in leadership positions in research and scientific services (1 out of 18 in 2012).

As expected by the Federal and *Länder* governments, the institute introduced the cascade model and has set goals to increase the proportion of women. Where possible (i.e. at the group leader and non-executive levels), these goals are to be reached by 2024. The institute has taken appropriate measures conducive to this goal, including programmes in the LIN Career Office and recruitment symposia to identify potential female group leaders.

As of 31 December 2019, one of the five department heads and two of the nine (junior) research group or core facility leaders were female. This means that out of the 14 people in leadership positions, three were women. Another female junior research group leader took up work at LIN in March 2020. **The institute has increased the proportion of female researchers in leadership positions since the previous evaluation. Given the situation that five scientific positions had to be filled, it is appropriate that three women and two men were hired. LIN should continue to attract women to leadership positions in the coming years.**

6. Cooperation and environment

LIN collaborates closely with the University of Magdeburg. All six department heads are jointly appointed with the university. Additionally, one junior research group leader is appointed jointly with Magdeburg-Stendal University of Applied Sciences. Scientists employed at LIN make valuable contributions to teaching at the universities.

The institute's cooperation with the university and with other local partners, such as the German Centre for Neurodegenerative Diseases (DZNE), is welcomed. Of particular relevance is the collaboration between LIN, the DZNE and the University of Magdeburg in the Centre for Behavioral Brain Sciences (CBBS) in Magdeburg which, in 2015, was awarded the status of a Leibniz Science Campus.

The institute has benefitted from the close interaction with the Clinic for Neurology at the university hospital. This good partnership must be maintained past the retirement of the head of the Department of Behavioural Neurology in the coming years (see chapter 3).

The collaboration with local and national partners in DFG-funded collaborative research centres (CRCs, *Sonderforschungsbereiche*) and graduate programmes (Research Training Groups) are noteworthy.

LIN is an active partner in the Leibniz Association and contributes inter alia to three Leibniz Research Alliances. Of particular relevance is LIN's contribution to the Research Alliance "Healthy Ageing". The former scientific director has for many years served as an ombudsman within the Association.

The institute has very good international partnerships, including close connections to some of the leading international experts at HHMI Janelia Research Campus (in Ashburn,

VA) and MIT. To strategically develop its international research profile, LIN should increase the number of visiting scientists. For this purpose, the institute should secure third-party funding from programmes such as the Mercator Fellowship programme, or provide additional financing for a guest programme.

The institution's status in its specialist field

LIN has established an extraordinary national and international reputation in the field of memory research. Within Germany, and to some extent within Europe, the institute's approach to bridging the scales of investigation, from synaptic functions to neurological diseases in humans, is unique. At the institute, experts on the different levels of analysis are interested in the interaction between the various levels of neurological organisation. LIN is one of only a few international centres to have experts on all levels of neurobiological analysis.

7. Subdivisions of LIN

Department of Neurochemistry and Molecular Biology

(5 work groups and special labs; 16.2 FTE, of whom 6.6 FTE research and scientific services staff, 3.9 FTE doctoral candidates, and 5.8 FTE service staff)

The Department of Neurochemistry and Molecular Biology researches the molecular mechanisms of synapses, with a special emphasis on the organisation of the presynaptic release mechanism. In recent years, the department has increasingly moved beyond the level of the synapse to the level of behaviour and pathophysiology, including chronic toxoplasmosis, epilepsy and multiple sclerosis. Of particular importance was the department's discovery of bassoon, a presynaptic protein, and its role in learning, autophagy, and neurodegeneration.

Although the number of people in the department has been reduced over the last two years, it is still very productive. The publication record is very good, with most papers being published in collaboration with other groups at LIN. With its contributions to the SynProt database and the SynGO initiative, the department provides a valuable service to the community. In addition, the department was instrumental in establishing some of LIN's international collaborations, e.g. with universities in Chile.

The department is currently closing after the head of department retired in December 2020. LIN's plans to continue the department's important research topics and activities are most welcome (see recommendation chapter 3).

Department of Genetics of Learning and Memory

(12.3 FTE, of whom 5 FTE research and scientific services staff, 2 FTE doctoral candidates, and 5.4 FTE service staff)

The Department of Genetics of Learning and Memory studies the neural circuit mechanisms for memory acquisition and retrieval, making use of the *Drosophila* larvae, which has been established by the department as a robust model organism. The department has conducted highly relevant research on the roles of the *Drosophila* mushroom body e.g. in

memory formation. Further highlights are a cross-species comparison approach to investigate memory-enhancing compounds found in the medicinal plant *Rhodiola rosea*. This line of research led to the filing of a patent. Further developments to expand the research to a human model would be interesting, e.g. in collaboration with other LIN departments and the DZNE.

The plans to focus on investigating how memories are retrieved and behaviourally implemented build on the department's recent successes and are well thought through. However, the department should reflect on its name, as genetics do not seem central to the department's work.

The department has a very good publication output, with several articles in high-impact journals standing out. It has established strong national and international collaborations (e.g. with HHMI Janelia) which have led to third-party funding successes in collaborative funding schemes (SFB, FOR). Transfer activities are meaningful, such as the development of a manual for the implementation of *Drosophila* learning experiments in secondary school and university teaching.

Department of Systems Physiology of Learning

(4 work groups; 20.0 FTE, of whom 8.7 FTE research and scientific services staff, 5.1 FTE doctoral candidates, and 6.3 FTE service staff)

The Department of Systems Physiology of Learning investigates the circuit-level physiology of the auditory cortex, in particular during learning. It applies optogenetic manipulation methods in innovative ways. The department has established an internationally visible research profile and has produced important results for understanding the neuronal mechanisms of behavioural strategy change across species.

The department's plans to study the dissociation of bottom-up and top-down mechanisms in stimulus adaptation are very promising. The same holds for the projects on bio-inspired modification of machine-learning paradigms, which are an excellent fit with LIN's focus on advancing computational techniques. The department could consider using small animal imaging even more intensively in its work. Its envisioned technology developments of nanoscopes and next-generation resonant-cavity LEDs for optogenetics are highly commendable.

The department holds 21 patents, which is an impressive number. These patents should be exploited further. Although strong, the publication output is below the achievable level, as already mentioned in the last evaluation. Revenues from third parties are high and include substantial collaborative research funding from the DFG. In addition, the department was pivotal in the initiation of a Postdoctoral Network, an important activity funded by the Leibniz Competition programme.

Department of Cellular Neuroscience (Since January 2020)

The Department of Cellular Neuroscience was established in January 2020 (see chapter 3) and will build on the department head's successful previous research at the DZNE in Bonn. The department investigates the role of the hippocampal formation in learning and

memory, a subject that is central to LIN's mission. Impressively, research will extend from the subcellular dendritic level up to network and behavioural levels.

The department is highly advanced technologically, bringing new methods and expertise to the institute, including in-vivo electrophysiology and artificial intelligence modelling tools. These are expected to bridge research among LIN subdivisions, across species and levels of analysis. It is very promising that the department aims for close links between theory and experiments in its research. Its impact on LIN is already becoming visible.

Department of Functional Architecture of Memory

(2 work groups; 11 FTE, of whom 4 FTE research and scientific services staff, 3 FTE doctoral candidates, and 4 FTE service staff)

Established in 2016, the Department of Functional Architecture of Memory has developed well. Its research addresses information processing and modulation of cell properties in the hippocampus concerning the segregation of spatial and non-spatial information in memory.

The department's future plans will provide a logical extension to the current, well-structured research programme. It plans to investigate to what degree the spatial and non-spatial hippocampal subnetworks are embedded in the medial temporal lobe, as well as the cellular mechanisms underlying memory and spatial navigation. Particularly promising is the department's timely cross-species MRI scanner work in the field of cognition.

The department produces a good number of high-quality publications, which is expected to increase as this young department establishes itself further. The department has substantial DFG funding.

Department of Behavioral Neurology

(8 work groups; 9.3 FTE, of whom 4.5 FTE research and scientific services staff, 1.3 FTE doctoral candidates, and 3.5 FTE service staff. Additionally, 15 individuals employed by the university hospital contribute as external members.)

The Department of Behavioral Neurology focusses on the (patho-)physiological mechanisms of human behaviour, with a particular emphasis on human learning and memory, as well as the cognitive states impacting strategies for learning (e.g. attention), by means of network modulation and electrophysiology. Since the last evaluation, the department has very successfully continued its innovative translational activities. Among them, the development of a wireless dry-electrode system stands out for its high potential as a tool for a large number of clinical and research applications.

The plans to expand the department's work to cognitive states and to refine invasive recordings in humans are promising. The department is in a good position to implement its clear vision thanks to successful new recruits, including its new deputy head. It would benefit from more extensive collaborative efforts involving the 9.4T MRI scanner (see chapter 4).

The department has been very successful in securing third-party funds in recent years, in particular from the DFG. The publication output is high, in terms of both quantity and

quality. The department's transfer activities, including public lectures, media presence and policy advice, are welcomed.

Research Group Neuroplasticity

(19.1 FTE, of whom 9 FTE research and scientific services staff, 5.2 FTE doctoral candidates, and 4.9 FTE service staff)

The Research Group "Neuroplasticity" investigates the molecular and cellular mechanisms of synapse function and plasticity. Its recent findings have made important contributions, including to the understanding of synapse-nucleus communication in memory formation, actin dynamics during postsynaptic LTP, and hybrid amphisomes for combining degradation with signalling functions. In 2018, the group leader established a Leibniz group called "Dendritic Organelles and Synaptic Function" at the Center for Molecular Neurobiology in Hamburg (ZMNH).

In the coming years, the group aims to analyse synapse-nucleus communication in memory consolidation, label and visualise active and potentiated synapses, and study local and global protein turnover in the context of plasticity. The group should further increase its collaboration with other LIN groups to support its ambitious research programme and realize the translational potential of its work, for example on amyloid beta.

The group's research results are published well, however the number of publications should be increased further. Third-party income is very high; the group's participation in collaborative DFG-funded projects contributes to its strong links to national and international partners.

Junior Research Group Neuromodulatory Networks

(3.3 FTE, of whom 1 FTE research and scientific services staff, 1.3 FTE doctoral candidates, and 1 FTE service staff)

The Junior Research Group "Neuromodulatory Networks" was established at LIN in July 2018. Since then, it has successfully developed its personnel and the necessary infrastructure for its research activities. The group's research aims to understand the prefrontal and amygdalar inputs to the locus coeruleus (LC). It has a strong background in the development of new molecular tools for manipulating brain activity and has worked on the identification of new biomarkers.

Building coherently on its previous research, the group plans to focus on understanding the noradrenergic modulation of brain states on a global level in correlation with ongoing activity in the LC. These plans offer many important translational aspects in the long run. The group's scientific output based on its work at the previous institution is of high quality. In light of the group's excellent fit with LIN's research profile, it has great potential to continue along this path.

Junior Research Group Cognition and Emotion (Since March 2020)

The Junior Research "Group Cognition and Emotion" joined LIN recently and is currently establishing its personnel and laboratory. The group leader previously held a prestigious

grant from the Swedish Research Council at the Karolinska Institute and the DZNE in Bonn. At LIN, the group's research will focus on identifying the cellular substrates of oscillatory activity in cognitive and emotional learning and memory.

The topic and the timely methods the group intends to employ promise to extend LIN's research portfolio in a very coherent manner. They offer extensive opportunities for collaborations within LIN. Based on the group's previous research, an increase in publication activity is to be expected soon.

Research Group Comparative Neuroscience

(8.1 FTE, of whom 4 FTE research and scientific services staff and 4.1 FTE doctoral candidates)

The Research Group "Comparative Neuroscience" was established in 2020 by combining previous special labs in one research group (see chapter 3). Its work focusses on the auditory cortex, both in sensory and working memory. The group employs a comparative approach, ranging from rodents to humans. Equally important for LIN is the group's expertise in computational techniques. It is not entirely clear how the basic comparative and modelling efforts have applied or will apply to interventions.

In the coming years, the group plans to investigate inter alia how short-term memory emerges from synaptic depression and the network topology of the auditory cortex. The planned CNC core facility (see chapter 3) offers opportunities for synergies on signal processing.

The newly established group consists of research staff and a laudably high proportion of doctoral candidates. In order to utilise its full potential, the hiring of designated service staff should be considered. The publication output and revenue from third-party funding are expected to increase as the group establishes itself further.

CBBS Junior Research Group Neurocognitive Development

(4.4 FTE, of whom 2.1 FTE research and scientific services staff, 1.3 FTE doctoral candidates, and 1 FTE service staff)

The Junior Research Group "Neurocognitive Development" was established in 2017, mainly based on third-party funding. It brings to LIN a highly relevant angle on the development of attention, learning and memory. The group's main research interest lies in understanding the impact of unexpected neutral or emotional sounds on brain activity and learning. It uses novel and interesting combinations of EEG recording and eye-tracking/pupillometry methods. The group has established an impressive developmental database in collaboration with local day care facilities and schools.

The group's future plans to investigate the impact of digital media use on auditory attention in children are timely and build coherently on its expertise. This new research direction seems well suited to making an impact in the field, especially by testing fundamental neuroscience research results and translating them to human development. The group's publication output is respectable, although there is potential to publish in higher-ranking journals, in particular in relation to the impact of digital media on attention. The group

has been very successful in securing third-party funding in recent years, in particular from the DFG, and should continue on this path by targeting EU funding.

Combinatorial Neuroimaging Core Facility

(21 FTE, of whom 12 FTE research and scientific services staff, 3 FTE doctoral candidates, and 6 FTE service staff)

The Combinatorial NeuroImaging Core Facility provides microscopy and imaging support to LIN's research units over a wide range of levels, from subcellular protein localisation to functional imaging in animals and human patients. It also conducts its own research activities, e.g. on the subcellular organisation and signalling pathway of memory-forming synapses. The facility performs its tasks, both in research and scientific services, very capably (see chapter 3).

Its instrumental equipment (see chapter 4) and its personnel are adequate. The 9.4T Small Animal MRI lab (established in 2018) is a good addition that will add significantly to LIN's research activities. The proposed introduction of a steering committee to approve applications for measuring times and investments is welcomed. To guarantee that the high quality of instruments will be sustained, the rules for financing the maintenance and running costs should be clarified (see chapter 4).

The CNI has a good own publication record and has contributed to a high number of publications by other LIN units. The group has received substantial third-party funding. Three patents were granted and the group is encouraged to pursue valorisation further. The founding of a spin-off company to market its 3D spectrograph is welcomed. The group's contributions to national efforts to improve microscopy standards, particularly on the DIN microscopy committee, are notable.

8. Handling of recommendations of the last external evaluation

LIN has successfully addressed the recommendations made by the Leibniz Association Senate in 2014 (see status report, p. A-21f). The recommendations to increase third-party funding from the EU (recommendation 2) and to increase the number of female scientists at leadership level (recommendation 5) still apply.

Appendix

1. Review board

Chair (Member of the Leibniz Senate Evaluation Committee)

Annette Beck-Sickinger Institute of Biochemistry, University of Leipzig

Deputy Chair (Member of the Leibniz Senate Evaluation Committee)

Birgit Spinath Department of Psychology, Heidelberg University

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Dagmar Timmann-Braun Department of Neurology, University Clinic Essen

Annemie Van Der Linden Department of Biomedical Sciences, University of Antwerp

Florentin Wörgötter Department of Computational Neuroscience, University of Göttingen

Representative of the Federal Government (Member of the Leibniz Senate Evaluation Committee)

Frank Reifers Federal Ministry of Education and Research, Bonn

Representative of the Länder Governments (Member of the Leibniz Senate Evaluation Committee)

Anja Steinhof-Adam Hessen State Ministry of Higher Education, Research and the Arts

8 March 2021

Annex C: Statement of the Institution on the Evaluation Report

Leibniz Institute for Neurobiology, Magdeburg (LIN)

The Board of Directors together with all members of the LIN would like to express their gratitude to the members of the evaluation committee and to the members of the Evaluation division of the Leibniz Association. Notwithstanding the necessary procedural adjustments to the pandemic-related replacement procedure, we experienced the entire process to be transparent, fair and appreciative in a very constructive atmosphere. We are honored to receive such an uplifting, positive and encouraging review from the distinguished international evaluation commission.

The evaluation commission acknowledges the achievements of the LIN in all areas of work over the last seven years. Their recommendations will guide us in the next phase of our strategic development. The report recognizes our coherent research concept combining research departments, research groups, and core facilities, and pursuing both a comparative and translational approach towards understanding learning and memory. They acknowledge that LIN is generating important and remarkable scientific results, which form the basis not only for our publications but also of our outreach and translation strategy. It is with particular gratitude that we receive the evaluation commission's endorsement of the measures we have taken and are planning to take in the future. Some of these measures and our strategies to implement specific recommendations by the evaluation commission will be briefly addressed here:

- i) Indeed, it is a major vision of the LIN, to further combine the existing areas of expertise and data sets to develop and pursue an overarching research question in a coherent fashion from a number of different perspectives.
- ii) We will develop our research work further towards more multi-scalar collaborative projects and in close partnership with the clinics as a major asset of our portfolio.
- iii) To further strengthen our collaborative efforts within the LIN and with European partners we have re-arranged our research support concept and introduced performance-based allocation of internal funding. The latter also aims at a continued development of our publication and dissemination strategy.
- iv) One of the keys to scientific excellence is promoting the careers of young, talented researchers. We are committed to be an active driver for further improving the conditions for our young researchers, including doctoral students, postdocs and tenure track scientists, at LIN, but also within the Magdeburg Neuroscience community in general. All measures that have been put in place are in agreement with the Leibniz Guidelines.
- v) The members of the evaluation committee recognize that it will be of high importance for the future to strengthen research support in all aspects of multidimensional data analyses and data science through computational techniques. They endorse our application for additional institutional funding from the Federal and Länder governments to establish a new Combinatorial NeuroComputing (CNC) core facility.

We would like to thank the Land Saxony-Anhalt, the Federal Government, and the Federation of Länder for their trust and support and for their substantial financial commitment to our future.

Finally, we would like to thank everybody who works at and for the LIN, including all members of our Scientific Advisory Board and the Board of Trustees. Without their teamwork, commitment, knowledge, expertise, and enthusiasm none of our achievements would have been possible.