



URPP Adaptive Brain Circuits in Development and Learning (AdaBD)

Progress Report University Re- search Priority Program (URPP)

Adaptive Brain Circuits in Development and Learning (AdaBD)

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Scientific Report of the URPP AdaBD

1. Management Summary

The URPP AdaBD wants to understand the fundamental neurobiological processes underlying formation and adaptation of brain circuits during development, multisensory processing and learning. Besides revealing physiological processes, we aim to establish causal links between impaired mechanisms of multisensory processing and brain circuit adaptation and learning deficits or developmental disorders. Finally, we aim to translate new insights from our research to the clinic and to develop new diagnostic tools as well as innovative treatment strategies.

In 2024, our collaborative research projects and platforms made major progress and published many manuscripts (24 publications). The presentation of results in our regular seminar series and at the site visits in April 2024 led to interesting discussions between members of the participating labs. This interdisciplinary exchange is highly appreciated and one of the main goals of the URPP. During 2024, we held very inspiring brainstorming sessions, which culminated in a one-day retreat at Kartause-Ittingen, where concrete plans for Phase 2 (2025-2028) took shape in various workshops. These discussions resulted in several interdisciplinary research projects focusing on brain circuit development and multisensory processing in both neurotypical conditions and developmental disorders. A particular focus hereby will be on autism spectrum disorders. These projects will start in spring 2025. Our PLATFORMS and PLATFORM SEEDS kept supporting URPP researchers. The mesoSPIM PLATFORM published a manuscript describing our new (Benchtop) mesoSPIM system in *Nature Communications* and integrated the first Benchtop mesoSPIM at the Center for Microscopy and Image Analysis as a regular facility instrument. Further, it built up a tissue clearing service. The HDDA PLATFORM SEED further improved the software *dspace* based on knowledge gained in our research projects. The iPSC PLATFORM SEED has been mostly active in collaborating with the laboratory of *Ruxandra Bachmann-Gagescu* for analysis of primary cilia in neural progenitors and different neurons. The Developmental Delay Database has been used as a resource to recruit children with language disorders for our ChildBrainCircuits project. Furthermore, it started a preliminary descriptive study on sensory perceptual abnormalities in cohorts of children with developmental delay. During the last year, we launched a new [PLATFORM focusing on learning disorders](#), including both dyslexia and dyscalculia. This platform provides a space for collaboration in research, education, public outreach, and development of diagnostic and therapy tools. The overarching goal is to help improve educational outcomes and well-being for individuals with learning disorders.

In 2024, we held events promoting networking within our community and beyond. We organized the Site Visits in April 2024 within the evaluation of our program, with participation of nearly all members of our network, including PhD students and young researchers. As a preparation to the site visits, we organized a one-day rehearsal event on effective poster presentation in an interdisciplinary context. Our students had the chance to discuss content and layout of their posters and to practice presenting their poster. Our young researchers also had the possibility to participate in the strategic one-day retreat in October 2024, engaging in workshops on topics such as planning of educational and networking programs for students, or public outreach and science communication. Further, we carried on with our well-attended online research seminars, including talks from international guests.

The URPP AdaBD continued its efforts to promote dialogue within and outside the scientific community. In 2024, we created a new section of our website dedicated to laypersons, called "[AdaBD made easy](#)". In this section, we explain our work in simple terms and with the help of illustrations. We also applied for an exhibition in the Science Pavilion of the Faculty of Science. Our application was accepted and we will prepare the exhibition on the topic of 'Learning with all senses' next year. Furthermore, we published two issues of our AdaBD Newsletter. Several AdaBD members participated in outreach events, which are listed in Chapter 4.2.

2. Objectives

2.1 Scientific, structural and organizational objectives

2.1.1 Scientific objectives

The scientific objectives for 2024 have not changed compared to our original research plan. In this context, we planned to:

- Continue our research projects and publish some manuscripts
- Start planning new and follow-up research projects for phase 2
- Further develop the imaging technologies and the data analysis tools
- Submit to SNSF a pre-proposal for the *NCCR Resilience*, with official UZH support
- Foster synergies and collaborate wherever possible with the new BioVisionCenter ([BVC](#)), dedicated to computational image analysis, which started its activity at UZH this fall. *Fritjof Helmchen* is member of the BVC's steering committee. In the long term, we envision the extension of our mesoSPIM Platform to a Center for Innovative Microscopy, which together with the BVC and the Center for Microscopy and Image Analysis (ZMB) would form a strong Imaging Technology hub at UZH.
- Launch a new platform of the URPP AdaBD focusing on learning disorders. Our goal is to build up structures for efficient research, teaching and support regarding learning disorders.

2.1.2 Structural and organizational objectives

– At the level of professorships, we aimed to complete the recruiting procedure for the advertised assistant professorship “Modeling Neural Diseases using Stem Cell Technology” and to continue supporting the establishment of laboratories for Prof. Dr. Ruxandra Bachmann.

– We planned to hire a staff member for coordination and formation of the new platform on learning disorders.

Further, we planned to:

- Organize the site visit of the URPP evaluation panel on April 16-17, 2024.
- Continue the organization of workshops, seminars, and informal events.
- Organize a retreat for URPP researchers in autumn 2024.
- Organize a scientific conference planned in 2025.
- Organize educational workshops for PhD Students and other researchers of the network on topics to be defined according to the students' needs.

2.1.3 Communication and outreach

– We planned to continue our regular *AdaBD Newsletter*.

– Further, we planned to expand our website with more information for laypersons and schools.

– We also planned to establish our collaboration with *DSN-ZH* by supporting public outreach events.

– We wanted to continue the collaboration with the *communication office* of the University and to expand our activities on *LinkedIn*

– At the scientific level, we planned to maintain partnerships with other universities in collaboration with the ZNZ.

2.2 Which objectives and milestones were achieved? Which not?

In 2024, we achieved almost all objectives listed in the annual report 2023:

2.2.1 Scientific objectives

– Ongoing projects have been continued successfully, giving rise to several publications (see [Chapter 3](#) and [Chapter 6](#)).

– We successfully started planning new research projects, which are starting at the beginning of 2025. Launch a new platform of the URPP AdaBD focusing on learning disorders. Our goal is to build up structures for efficient research, teaching and support regarding learning disorders.

- The imaging technologies and the data analysis tools have been further developed (see [Chapter 3](#))
- For the *NCCR Resilience: Adapting to a challenging world*, a pre-proposal with support of the UZH as leading house (decision taken by the UZH leadership on 24.1.2024) has been submitted in April 2024. We actively participated in the submission process in collaboration with members of the Hochschulmedizin Flagship project [STRESS](#). The full proposal is due 2025.
- We had several exchanges with the BioVision Center (BVC) to identify overlapping interests in computational image analysis. The AdaBD platform leaders Nikita Vladimirov and Sepp Kollmorgen were both involved in these discussions. No concrete specific project has been launched so far, partly because the BVC is still in its early phase of establishment. As a member of the BVC Steering Committee Fritjof Helmchen followed closely the further development of the BVC.
- The new platform for Learning and Learning Disorders (LLD) has been successfully launched in Spring 2024. In the first months of existence, the work of the platform focused on public outreach, raising awareness and providing information and material on dyslexia and dyscalculia.

2.2.2 Structural and organizational objectives

- In agreement with the Faculty of Science, the URPP AdaBD created an assistant professorship tenure-track for “Modeling Neural Diseases using Stem Cell Technology” at the Faculty of Science (double professorship with the Faculty of Medicine). The URPP AdaBD has committed financial support for this assistant professorship, supplementing a generous donation from the private bank Rahn & Bodmer. The recruiting procedure extended throughout 2024, with the AdaBD co-directors and Ruxandra Bachmann as members of the committee.
- Prof. Dr. *Ruxandra Bachmann* built up her laboratories with financial support from the URPP AdaBD.
- For the new platform on learning and learning disorders, the URPP hired *Leonie Holste*, who started as coordinator of the platform in May 2024. She successfully launched the platform and created several initiatives (see [Chapter 3](#) and [Chapter 4](#)).
- We organized very successful and inspiring site visits of the URPP evaluation panel on April 16-17, 2024, with participation of almost the entire staff, including our students.
- We continued our bi-weekly online seminar series and organized a one-day Retreat in October 2024. Further, PhD Students and Postdocs had the opportunity to meet at informal events (see [Chapter 4](#))
- Our application for a meeting within the “[Congressi Stefano Franscini](#)” event series on Monte Verità has been approved in March 2024. Soon after, we started organizing this international conference (*AdaBD 2025 – The Adaptive Brain: Development, Learning, and Learning Disorders*), which will take place from May 25 to May 28, 2025.
- We organized a workshop on poster presentation for an interdisciplinary audience. This workshop for our young researchers (PhD Students and Postdoc) served as Rehearsal for the Site Visits within the Evaluation of our URPP.

2.2.3 Communication and outreach

- We continued our regular *AdaBD Newsletter* with two issues (February 2024 and October 2024)
- We expanded our website with more information on our research projects. In particular, we created a new sub-page called [AdaBD made easy](#), which explains our research in simple words. This website has been created by *Laura Zanetti* and *Sabina Huber* (members of the Coordinating Office) in collaboration with *Marco Garbelli* (Science Illustrator).
- The Platform for Learning and Learning Disorders created additional materials and information for different stakeholders such as schools, pediatricians, persons with learning disorders and their families (see www.lld.uzh.ch)
- We financially supported several events of the DSN-ZH (see [Chapter 6](#))
- We continued regularly using the LinkedIn account and constantly increased the followers number (342 on March 24, 2025). In 2024, we did not publish own articles on the *UZH News* portal because of time constraints.

- The URPP continued its engagement in neuroscience partnerships with McGill University, the University of Queensland, and University College London. The AdaBD directors attended a meeting with colleagues from Queensland at the FENS Forum 2024 in Vienna.

2.3 Updated project planning

2.3.1 Scientific objectives

- Many research projects will be continued in Phase 2. We expect to publish additional results within the next year, as some manuscripts are in revision or are currently in preparation and close to being submitted.
- In Winter/Spring 2025 we will start several new and follow-up research projects focusing on multisensory integration in neurotypical conditions and developmental disorders such as Autism-Spectrum-Disorder (ASD), Developmental Language Disorder and Developmental Dyscalculia.
- The imaging technologies and the data analysis tools will be further developed and expanded. The “mesoSPIM Platform” will be expanded towards a microscopy innovation center including additional technologies such as multiphoton microscopy.
- The “Learning and Learning Disorders (LLD)” Platform will be enlarged including positions promoting a diverse spectrum of basic and applied research initiatives.
- For the *NCCR Resilience*, submission of the full proposal to the SNSF was due in February 2025.
- We plan to continue fostering synergies and collaborating wherever possible with the new BioVisionCenter ([BVC](#)), dedicated to computational image analysis, which started its activity at UZH in fall 2023. *Fritjof Helmchen* is member of the BVC’s steering committee. In the long term, we envision the extension of our mesoSPIM Platform to a Center for Innovative Microscopy, which together with the BVC and the Center for Microscopy and Image Analysis (ZMB) would form a strong Imaging Technology hub at UZH.

2.3.2 Structural and organizational objectives

- Hiring additional staff for the coordinating office, the mesoSPIM platform, and the LLD platform.
- Replacement of the PhD Students and Platforms representatives in the Steering Committee.
- Supporting the establishment of a research group for the new APTT.
- Inclusion of four additional PIs in the URPP AdaBD
- Organizing a new round of internal lab visits between Summer 2025 and Summer 2026.
- Continuing organization of workshops, seminars, and informal events.
- Organizing an international conference on Monte Verità, May 25-28, 2025
- Organizing an international symposium and workshop on occasion of the 10-year anniversary of the mesoSPIM microscope (planned for October 2025). Participation of users from all over the world is expected.
- Organizing educational workshops for PhD Students and other researchers of the network on topics to be defined according to the students’ needs.
- Planning of an interdisciplinary seminar / lecture for BSc and MSc students on learning and learning disorders (Start foreseen in Spring 2026).
- Development of an acquisition strategy for third-party funds to ensure continuation of parts of our activities beyond 2028.

2.3.3 Communication and outreach

- Continuing our regular *AdaBD Newsletter*.
- Continuing partnerships with other universities in collaboration with the ZNZ.
- Establishing our collaboration with *DSN-ZH* by co-organizing public outreach events.
- Expanding our activities on *LinkedIn*.
- Resuming collaboration with the *communication office* of the University.

- Updating and expanding our *webpage* with information on new projects as well as more content for laypersons, schools, patient organizations, etc.
- Organizing events for children, teachers, and other interested groups.
- Planning of an exhibition in the Science Pavilion of the Faculty of Science on the topic “Lernen mit allen Sinnen”. The exhibition is foreseen for 2026-2028.
- Working on teaching material on multisensory learning for primary school teachers.

3. Research



<https://www.ad-abd.uzh.ch/en/research.html>

During the fourth year, we further developed tools within our PLATFORMS and PLATFORM SEEDS (for simplicity called platforms in the following). We also launched a new platform on learning and learning disorders, with the goal to bundle human research on learning disorders and to build up public outreach and support of families, schools and pediatricians. We continued our research projects, had a successful evaluation, and extensively planned the second phase of the URPP. Major achievements are described below, more information on all research projects can be found on our [website](#) (see also QR Code).

3.1 URPP platforms

3.1.1 Light-sheet microscopy PLATFORM (mesoSPIM PLATFORM)

The light-sheet microscopy platform offers custom-built light-sheet microscopes that allow biologists at UZH, USZ and external collaborators to image cleared samples that are too large for traditional microscopes, such as entire mouse brains or post-mortem human tissues. We offer user training, consulting, customization of software and hardware, and carry out our own R&D in light-sheet microscopy to meet the rapidly evolving demands of biologists and medical doctors who want to image deeper into tissues. We develop our microscopes as an open-source project (mesospim.org) and encourage the global biomedical community to build their own systems inspired by our design. Seven URPP groups are currently actively using the platform for their research (*Helmchen, Karayannis, Stoeckli, Jakob, Bachmann, Jessberger, Földy*), giving rise to several publications (see [Chapter 6](#)). The platform also actively collaborates with the HDDA platform for multi-dimensional image analysis. In 2024, we published the paper describing our new (Benchtop) mesoSPIM system in Nature Communications (Vladimirov et al, Nat. Comm., 2024) and added online documentation (<https://github.com/mesoSPIM/benchtop-hardware/wiki/>). This milestone has already resulted in 15 Benchtop microscope systems (either completed or under construction) around the world (<https://mesospim.org/setups/>). In July 2024 we integrated the first Benchtop mesoSPIM at the Center for Microscopy and Image Analysis (ZMB) as a regular facility instrument (<https://www.zmb.uzh.ch/en/News/Benchtop-mesoSPIM.html>), which users can book, with training and support. Marco Garbelli, who started in September 2023 as staff scientist, introduced new tissue clearing methods and strengthened the user training and support. In 2024, it became apparent that some advanced users need to image even larger specimens than currently possible with mesoSPIMs, such as expanded tissues and cleared human organs. Therefore, we are working on a next-generation mesoSPIM that will enable the imaging of such challenging specimen. The large amount of imaging data from mesoSPIM microscopes remains a challenge, but some common workflows are being addressed via collaboration with the HDDA platform or via the use of commercial software.

3.1.2 Developmental Delay Database PLATFORM (DD DB)

In the canton of Zurich, the two units of special needs education (USNE) determine remedial therapy and speech therapy needs in all referred pre-school children in a centralised and standardised procedure. For this purpose, the USNE collect and store detailed information about personal data, including children’s development and the therapy measures recommended in each case, in a joint database (Developmental Delay Database - DD DB).

Until end of 2024, the URPP AdaBD financed a position for a database manager, who used the DD DB to specifically target potential study participants for recruitment, to provide broad data on enrolled participants, and to analyse anonymized data for scientific purposes in the framework of the URPP AdaBD. During 2024, we continued using the DD DB for selection and recruitment of families with children with a developmental language disorder (see [PATH3](#)). Without the DD DB, it would not have been realistic to find such an extensive pool of potential participants. Further, we obtained a positive ethics vote for a preliminary descriptive study (recruitment already started) to characterize the prevalence, variability, and manifestation of sensory perceptual abnormalities in their various modalities in cohorts of children with defined developmental delays (ASD, developmental language disorder, and global developmental delay) aged 6-10 years. The target group size per group is 100 participants per group. The position of the Database manager will be discontinued 2025 and the DD DB will not be supported as a platform of the URPP AdaBD anymore. However, it will remain an important pillar within some of our research projects.

3.1.3 The iPSC platform Seed

The iPSC **PLATFORM SEED** is a resource that provides iPSC-derived material, expertise and support, with a focus on neuronal differentiations. In 2024, the platform has been mostly active in collaborating with the laboratory of *Ruxandra Bachmann-Gagescu* for analysis of primary cilia in neural progenitors and different neurons, publishing one manuscript ([Haenseler et al., 2025](#)) and supporting starting projects.

The aim of this platform seed was to support URPP researchers in establishing or expanding iPSC-based projects for neuroscience in the context of studying neural circuits. The Müller lab has now established this technology independently. The Bachmann lab has expanded their iPSC-derived neuronal models thanks to this platform. The platform developed live imaging of a new reporter cell line, where cilia are fluorescently tagged, which serves as the starting point for a new collaborative project involving the Bachmann, Stoeckli and Müller labs. Further, the platform seed collaborated with the laboratory of Paola Picotti, leading to one publication ([Holfeld et al., 2024](#)). Another manuscript is under preparation by the Picotti lab.

In Phase 2 of the URPP, the platform seed will be discontinued but work with iPSC-derived material will be carried on, with a postdoctoral position shared by several labs.

3.1.4 The High-Dimensional Data Analysis (HDDA) PLATFORM SEED

The HDDA Platform develops the software Dataspace (dspace), which is based on the assumption that a substantial part of data tasks can be broken down to a few primitives. These primitives are made available to combine in a Lego like setting within a GUI. All actions performed are automatically logged and expressed as programming code. Code based workflows and GUI based workflows can merge seamlessly, enabling analyses without coding. At the same time, dspace can easily be integrated with users' existing code and the dspace GUI can be easily controlled through code and expanded by adding new actions. Data and expansions of dspace can be easily shared. In 2024, we continued to improve the software based on knowledge gained in collaborations within research projects of the URPP AdaBD. A manuscript is in preparation for submission soon, and we are approaching an open-source release in 2025.

3.1.5 The Learning and Learning Disorders (LLD) PLATFORM

The LLD Platform was founded in 2024 (see www.lld.uzh.ch, average user rate of 70 users each day from October until December 2024). The platform aims to improve the educational success and overall well-being of individuals with learning disorders and expands research on dyslexia and dyscalculia through new and interdisciplinary research projects, combining the expertise and resources of different groups within and beyond UZH. This synergy allows for the integration of research findings, fostering a deeper understanding of shared and distinct

underlying mechanisms. As a result, new and unique research projects can be developed, paving the way for innovative diagnostic tools and intervention strategies. In 2024, the work of the platform focused on public outreach, raising awareness and providing information and material on dyslexia and dyscalculia for various target groups: affected individuals and their families, teachers, professionals and researchers. Furthermore, it actively engaged in teaching and education and maintained close relationships with institutions for diagnostics and therapy. It also established close cooperation with various national and international professional bodies - for example the working group LONDI from Germany. In the next years, dedicated research projects will be established, allowing for the active generation of new scientific insights.

3.2 Research projects

3.2.1 PATH 1: From molecules to behavior

Workpackage leaders: Esther Stoeckli, Ruxandra Bachmann-Gagescu and Martin Müller

Following a bottom-up approach, in Path 1 we study molecular mechanisms underlying neural circuit development. In collaborative projects, we study the role of genes associated with developmental delay in neural circuit formation and function, and improve technologies to study neural circuit architecture across spatial scales from the subsynaptic to the circuit level. We also analyze the distribution of specific cell types in the developing brain using both MRI and light-sheet microscopy. Furthermore, we follow up on mechanisms that allow for rewiring circuits in the adult mouse brain and want to investigate consequences on learning and memory. Neuronal rewiring may be a prerequisite for an eventual improvement of intellectual disabilities. Last, but not least, we are further characterizing our newly developed hippocampal organoids to study human brain development. A more detailed description of the projects can be found on our website.

In the last year, we reached the following milestones:

- We published a paper (Noble et al, 2024) showing that zebrafish mutants for ciliopathy genes have altered primary cilia throughout the brain, normal brain morphology, but impaired locomotion and postural control. Further, they show a dysregulated expression of genes that may regulate neuronal function, indicating that primary cilia in the zebrafish may be required for neural circuit function.
- We aim to use iPSCs to study the role of primary cilia in neural circuit establishment. We started performing a systematic analysis of cilia in various iPSC-derived neuronal models in collaboration with the iPSC platform seed ([Hänseler et al, 2025](#))
- We have established several Expansion Microscopy protocols and integrated them with super-resolution light microscopy techniques, across different experimental systems. Furthermore, we have begun to combine expansion microscopy with stimulated emission depletion (STED) super-resolution microscopy, as well as electron microscopy (Nair, Bollmohr et al., 2024) to investigate nano-architecture of synapses. Using these techniques, we are investigating several genes involved in neurodevelopmental disorders.
- We further characterized the distribution and apoptosis dynamics of different populations of Cajal-Retzius cells (CRs), transient neurons that play a key role in shaping the developing brain. A manuscript is in preparation.
- We characterized network dynamics after circuit rewiring and saw that rewiring can improve certain aspects of hippocampal-based learning and memory.
- We are currently confirming the development of our newly developed hippocampal organoids using RNA sequencing and immunohistochemistry.

Since summer 2024, we have been extensively planning new projects for phase 2, building up on new insights from phase 1 and on methods that we have developed in the last years. PhD Students will be enrolled in the first half of 2025. New projects will focus on:

- Quantification of neural connectivity in wild-type and Autism Spectrum Disorder (ASD) model mouse by combining and refining developed technologies (tissue expansion, mesoSPIM microscopy, data analysis). We also plan to probe functional rewiring in the ASD model.
- Investigation of the role of primary cilia in neural circuit formation in iPSC cultures. Further, comparison of in vitro human iPSC-based neuronal models for different ASD genes with respect to synaptic formation, composition, structure and function. Among others, 2D and 3D (organoid) in vitro systems will be created using iPSC-generated neurons from different ASD groups responding or poorly responding to therapy.
- Study of associations between prenatal human connectome and autistic traits, and on the comparison with connectome in ASD mouse models.

3.2.2 PATH 2: From behavior to molecules

Workpackage leaders: Fritjof Helmchen and Anita Rauch

Following a top-down approach, in Path 2 we investigate, mainly in animal models, multi-sensory learning and decision-making to reveal the underlying circuit mechanisms. In collaborative projects, we track dendritic activity during learning in mice and develop behavioral tasks for comparison with measurements in humans. Further, we study multi-sensory learning and maturation of the prefrontal cortex in adolescent mice. Finally, we are improving computational models of brain development that may help comparison between species. A more detailed description of the projects can be found on our website.

In the last year, we reached following milestones:

- We developed a new behavioral paradigm for quantification of multisensory learning in mice in collaboration with the research groups, who apply similar tasks in human experiments (see [PATH3](#)). We now started behavioral training sessions with mice, and plan to use the tasks to measure dendritic activity and its learning-related changes during stimulus presentation and during reward-based learning.
- We studied the development of learning-memory-reversal memory during adolescence and the effects of social isolation thereon, using a new behavioral paradigm for quantification of visual and somatosensory learning and 24-hour memory in mice. We saw that learning-memory-reversal learning for visual stimuli develops between adolescence and adulthood; social isolation during this period impairs development of the adult level of memory for visual stimuli. Further, we applied a new method we had established for quantification of immuno-histochemical images of synaptic puncta and could show an increase in glutamate synapses in the prefrontal cortex during adolescence in mice. We also gained first insights into how somatosensory cues activate frontal regions prior to eye-opening. Using a combination of calcium imaging and optogenetic tools we are collecting data to investigate how sensory stimuli are represented in the brain, how these representations are influenced by inputs from the frontal regions and how representations are transformed into actions.
- We further characterized our computational models of brain development. Our analysis suggests that a large part of variability in brain-wide activity is internally driven. Additionally, we find that these internally generated activity patterns are remarkably consistent across different animals, with the same brain areas activating in the same temporal order. Furthermore, learning influences the timing of these patterns—some gradually align with specific task events as the animals’ performance improves.

Since summer 2024, we have been extensively planning new projects for phase 2, building up on new insights from phase 1 and on methods that we have developed in the last years. PhD Students will be enrolled in the first half of 2025. New projects will focus on:

- Investigation of how models of the world are learned through active exploration.
- Investigation of multisensory salience processing in brain circuits of healthy mice and ASD mouse models.
- Study of multisensory memory consolidation in hippocampal-cortical circuits in mice and human.

3.2.3 PATH 3: From humans to animals and back

Workpackage leaders: Christian Ruff and Bea Latal

In Path 3, we study human learning with the goal to relate findings from humans to animals and back. We eventually want to improve diagnosis and treatment strategies for developmental and learning disorders. Our goal is to study the neuro-computational basis of learning and the differences between individuals with and without learning disorders. During the last four years, we especially focused on language and number processing disorders, which may relate to deficient multi-sensory learning. We developed tasks to assess multi-sensory learning in humans and combined them with fMRI measurements in adults and children. In a first clinical trial, we aim to apply our knowledge to evaluate an intervention. Further, we are establishing techniques to create novel 3D atlases of human brain combining meso- and macro-scale imaging, which will improve our understanding of the underlying neuroanatomical basis of developmental disorders. Impairments of brain connectivity likely play a role in developmental delay. In one of our studies, we found negative effects of early childhood trauma on grey matter substance IQ. A more detailed description of the projects can be found on our website.

In the last year, we reached following milestones:

- We finished developing a task to assess both reward-based and statistical multisensory learning in healthy adults. By combining this task with fMRI and non-invasive brain stimulation methods, we identified involved cortical areas and demonstrated that multisensory learning relies on both statistical and reinforcement learning. Variants of this task are employed in AdaBD projects in mice (see [PATH2](#)) and typically and atypically developing children.
- We applied tasks testing integration of different sensory inputs to children with typical development and with developmental language delay during behavioral and neuroimaging assessments. We saw that children required more information and needed more time to process tactile-visual stimuli compared to audio-visual stimuli. We also see age-related improvements. Further, meaningful, congruent audiovisual information facilitated audiovisual speech integration (*one manuscript submitted in Winter 2025, one manuscript in preparation*). Data in children with Developmental Language Delay is currently being collected and will be analysed soon.
- We finished collecting data to investigate how precisely the brains of adolescents diagnosed with dyscalculia represent abstract magnitude information and how this affects their risk-taking behavior in financial decisions. We are currently analysing the data and writing several manuscripts.
- Our collaboration partners at the Institute of Education have successfully developed an intervention to improve numerical understanding in adolescents and adults affected by developmental dyscalculia. To assess the specific effects of the intervention, we are currently conducting behavioral and magnetic resonance imaging (MRI) assessments on study participants with developmental dyscalculia and typically developing controls before and after the intervention, as well as after a waiting control period.
- Towards the goal to create a new open-source digital 3D atlas that characterizes the distribution of intrathalamic inhibitory interneurons (ITINs), we further developed microscopy techniques, optimized tissue processing protocols, and established a customized imaging protocol (hardware and software) on the 9.4T animal MRI scanner to image brain connections and structure at very high resolution.
- In collaboration with the HDDA Platform, we analyzed genetic, neural and behavioral data obtained in a prospective epidemiological study of 500,000 individuals (UKBiobank) to identify mechanistic links between Early Childhood Trauma (ECT), neural development, and long-term educational and professional attainment. Our analysis indicates a reduction in grey matter substance across the whole brain and a significantly lower IQ after ECT. Further, we found that air-raids within 2km radius of self-reported birth location within the last trimester of pregnancy exhibit a significant impact on grey matter volume mostly in frontal brain areas and cerebellar structures.

Since summer 2024, we have been extensively planning new projects for phase 2, building up on new insights from phase 1 and on methods that we have developed in the last years. PhD Students will be enrolled in the first half of 2025. New projects will focus on:

- Continuation of studies on integration of different sensory inputs in children: Children enrolled in Phase 1 will be tested again in longitudinal follow-ups to characterize individual developmental trajectories. In addition, a cohort of children with high-functional ASD will be tested.
- Examination of the multisensory integration of numerical information and the influence of stress on numerical performance in children and adults with Developmental Dyscalculia and ASD.
- Study of neural circuit mechanisms underlying multisensory salience processing in humans.
- Study of multisensory and neurocognitive circuit mechanisms underlying different symptom profiles in adolescents with ASD. Further, evaluation of a therapeutic intervention addressing sensory oversensitivity and prediction of therapy success.
- Study of how sensory processing difficulties in Global Developmental Delay impact thinking and emotions
- Study on the impact of sleep on sensory integration, cognitive function and emotion regulation in children with ASD.

4. Scientific Activities and Outreach

4.1 Scientific activities

We continued the well-established **bi-weekly online seminar series**, with the goal to present the AdaBD research groups and to discuss progress of research projects. The [program](#) of the online seminar series can be found on our website.

One **Special Seminar** has been organized: On October 25, 2025, Prof. Dr. Philipp Sterzer from University of Basel held a presentation about his research with the title “Now you see it... now you don’t: Temporal fluctuations in perceptual inference and their role in psychosis” at Campus Irchel UZH.

On April 16 and 17, 2024, the **evaluation** of our URPP took place. The evaluation included a symposium where our co-directors *Fritjof Helmchen* and *Esther Stoeckli* explained the structure and aims of the URPP and several AdaBD group leaders summarized the goals of our three research paths. The symposium was followed by a poster session of our young researchers and three site visits where the evaluators visited different laboratories. The apero and the dinner in the evening were a great opportunity to get to know each other better. All AdaBD researchers and employee have been invited. On the second day the evaluators had the chance to ask questions to the Steering Committee and to give feedback and input for the second phase of the URPP.

To prepare the poster session of the evaluation, we organized a **poster rehearsal event**. All posters were presented, and the young researchers got feedback both by peers as well as by group leaders. This was a great opportunity for our PhD students to improve their poster design and presentation skills and to learn how to present to an interdisciplinary audience. Further it stimulated discussions on possible collaborations.

On October 23, 2024, our second **retreat** took place at Kartause Ittingen. At the retreat, the new group leaders presented their research and ideas for the URPP. Further, we intensely discussed the planning of the second phase, including specific research projects, fundraising strategies, the application for an exhibition in the [Science Pavilion](#) of the Faculty of Science, and events for young researchers.

C. Földy co-organized the [International Winter Neuroscience Conference](#) in Sölden, Austria, 7. - 10.04.2024 and gave a talk on “Learning and memory in the rewired adult hippocampus”.

S. Jessberger co-organized the [3rd Neurogenesis Conference: Implications for Lifelong Development](#) which took place in Cacun, Mexico, 8. – 11.02.2024.

S. Jessberger co-organized the [5th Eurogenesis conference](#) in Bordeaux, France, 12. – 14. 06. 2024.

N. Vladimirov was the main organizer of the *Benchtop mesoSPIM bootcamp*, an informal 3-day-hands-on workshop at the University of Zurich, 15. – 17.01.2024.

N. Raschle was chair at the *Open Theatre Session on "Science Literacy: How the Neuroscience Community Can Contribute"* at the FENS Forum 2024 in Vienna, 25. - 29.6.2024

Activities related to open science are listed in [chapter 6.2](#).

4.2 Outreach activities

4.2.1 Outreach in the science community

Several AdaBD PIs and PhD students presented research projects of the URPP AdaBD at international congresses and seminars. PIs and students have been asked to acknowledge funding by the URPP AdaBD as well as their affiliation to the network. This enables us to increase our visibility in the scientific community. Due to space limitations, we refrain from listing all oral and poster presentations. Below, we list invited talks and keynote lectures:

N. Cruz-Ochoa gave a talk at the [Molecular and Cellular Neurobiology Conference](#) in Lucca, Italy, 25. - 26.05.2024.

N. Cruz-Ochoa gave a talk at the Giessbach@Rasses Meeting 2024 in Rasses, Switzerland, 28. – 30.08.2024.

S. Jessberger gave a keynote lecture at the 12th BeFri Research Retreat (annual retreat of students, postdocs, group leaders from Bern and Fribourg) in Kandersteg, Switzerland, 16.03.2024 on “How to generate neurons in the adult mammalian brain”.

S. Jessberger gave a keynote lecture at the [Brain & Mind Symposium 2024](#) in Helsinki, Finland, 25.10.2024 on “How new neurons are generated throughout life in the mammalian brain”.

F. Helmchen gave a seminar at the University of Oxford, UK, 26.4.2024 on “New views on cleared tissue and live dendrites”.

F. Helmchen gave a keynote lecture at the Freie Universität Amsterdam, Netherlands, 24.5.2024 on “Multi-area cortical dynamics during sensory discrimination”.

F. Helmchen gave a symposium talk at the FENS Forum 2024 in Vienna, Austria, 29.6.2024 on “Behavior-relevant top-down cross-modal predictions in mouse neocortex”.

F. Helmchen gave a symposium talk at the Barrels Meeting in Chicago, IL, 3.10.2024 on “Barrel cortex interactions with posterior parietal cortex”.

F. Helmchen gave a plenary lecture at the Society for Neuroscience Annual Meeting in Chicago, IL, 7.10.2024 on “Neural Circuit Adaptation Underlying Behavioral Learning”.

F. Helmchen gave a symposium talk at MIT, Boston, MA, 20.11.2024 on “Innovative microscope objectives and ultra-flexible electrodes for neuroscientific research”.

K. Kucian hold a workshop at the [Annual Conference in Muttenz](#), Switzerland, 23.04.2024 on “Neuropsychology of dyscalculia”.

K. Kucian hold a workshop at the [21. Bundeskongress des BVL](#) in Würzburg, Germany, 08. – 10.03.2024 on “Neuropsychology of dyscalculia”.

K. Kucian hold a webinar at [Gesellschaft für Neuropsychologie Österreich \(GNPÖ\)](#) on “Neuropsychologie Rechenstörung”.

K. Kucian hold a keynote lecture at [2nd international congress on diagnostic problems and solutions for dyscalculic children 2024](#), University of Ankara in Turkey on “Early detection, development, and prevention of dyscalculia”.

N. Vladimirov gave an invited talk at the [Advanced fluorescence imaging techniques course, EMBL](#) in Heidelberg, Germany, 12. – 17.05.2024.

N. Vladimirov gave an invited talk at the [Vincina Microscopy Core Facility \(VMCF\)](#) in Prague, Czech Republic, 05.08.2024 on the Benchtop mesoSPIM project.

N. Vladimirov gave an invited talk at the [Swiss Microscopy Facility](#) in Basel, Switzerland, 12.09.2024 on the Benchtop mesoSPIM project.

V. Mante gave an invited talk at the [Swiss Computational Neuroscience meeting](#) in Crans-Montana, Switzerland, 31.01.2024 – 02.02.2024.

M. Müller gave an invited talk on “Post-tetanic stabilization of synaptic transmission” at the Gordon Research Conference of Synaptic Transmission in Lucca, Italy, 14.-19.7.2024

B. Grewe gave a talk at Oxford University, 25.7.24 on “Learning in Biological and Artificial Neural Networks”.

B. Grewe gave a talk at Columbia University, 16.10.24 on “Learning in Biological and Artificial Neural Networks”.

B. Grewe gave a talk at Harvard University, 17.10.24 on “Learning in Biological and Artificial Neural Networks”.

C. Ruff gave an invited talk at the University of Newcastle, Australia, 11.7.2024 on “Dyscalculia and Risk Aversion”

C. Ruff gave an invited talk at the University of Melbourne at the Economics Department, Australia, 18.7.2024 on “Dyscalculia and Risk Aversion”

C. Ruff gave an invited talk at the University of Melbourne at the Cognitive Neuroscience Hub, Australia, 19.7.2024 on “Dyscalculia and Risk Aversion”

C. Ruff gave an invited talk at the Max Planck Institute for biological cybernetics, Tübingen, Germany, 4. / 5. 12. 2024 on the project “FuncMechanisms”.

C. Ruff gave an invited talk at the Wilhelm-Wundt Symposium, Leipzig, Germany, 2. - 4. 5. 2024 on “Dyscalculia and Risk Aversion”.

C. Ruff gave an invited online talk to the Transcontinental Computational Psychiatry [Workgroup](#), 11.07.2024 on “Neurocomputational Underpinnings of Altered Mentalization in Autism”

C. Ruff gave a keynote lecture at the International Conference on Neuroeconomics and Neuromanagement, Hangzhou, China, 15.11.24 on the project “Dyscalculia and Risk Aversion”.

C. Ruff gave an invited talk at the [EPFL BMI seminar](#), Lausanne, Switzerland, 28.02.2024 on how stress changes risk taking.

C. Ruff gave an invited [talk at the University of Hamburg](#), Germany, 28.11.2024 on the project “Dyscalculia and Risk Aversion”.

C. Ruff gave a keynote lecture at Summer [school of Computational Social Cognition](#), Birmingham, UK, 16.07.2024 on the project “The effect of early childhood and in-utero trauma on brain development.”

C. Ruff gave a keynote lecture at Summer School SFB TRR 135 Cardinal Mechanisms of Perception, Giessen, Germany, 19.09.2024

4.2.2 Public Outreach

In the reporting year, the URPP AdaBD and its members engaged in several outreach events with the goal to increase visibility in the society and to inform the public on new insights from our research. Public events are also a great opportunity to feel the needs of society, which helps our strategic planning. For instance, the exchange with families affected by learning disorders motivates us to expand our research in this direction and to create structures for better support. Following AdaBD members and students contributed to outreach activities:

S. Jessberger had an [Art and Science Talk](#) at the Zurich Art Weekend in Switzerland, 04.06.2024.

K. Kucian gave several workshops, webinars and lectures on dyscalculia (related to the AdaBD projects NumRisk and SMILE) at several institutions and in the context of continued education courses: Kirchliche Pädagogische Hochschule Stams Austria, Kantonale Weiterbildung für die deutschsprachigen Logopäd:innen, Zwecksverband Kreisschule Gäu.

N. Vladimirov co-organized a visit for high-school students from Rämibühl in Zurich, Switzerland, 12.11.2024 focused on Light-sheet microscopy.

B. Grewe gave a talk for ETH [unterwegs](#) at Kantonsschule Burggraben, St. Gallen, to young students, 13.11.24 about medial prefrontal cortex function and development.

C. Ruff gave a talk at the Volkshochschule [Zürich](#), 20.11.2024, with the title “Sind Pessimisten realistischer? Wie Entscheidungen von der eigenen Wahrnehmung abhängen”. He presented insights from research projects on dyscalculia.

N. Raschle gave a talk at Schule Bühl, Zürich on “Growing Brains: Gehirnentwicklung bei Kindern und Jugendlichen”, 30.10.2024

N. Raschle gave a keynote lecture at the Fachtagung Adoleszenz der Berufs-, Studien- und Laufbahnberatung Zürich, Paulus Akademie on “Erwachsen werden: was im Gehirn geschieht”.

N. Raschle gave a keynote lecture at the [SIKJM Jahrestagung](#), 25.09.2024 with the title “Wieso unser Gehirn Geschichten braucht”.

N. Raschle gave a talk at the Gymnasium Bäumlhof, Basel, 12.03.2024 on “Development and Brain”

Our [webpage](#) has been expanded with a subpage for the general public explaining in a simple way what we are doing ([AdaBD made easy](#)). Furthermore, we supplemented the descriptions of the research projects on our website with easy-to-understand research questions and explanations. We applied for an exhibition at the Science Pavilion with start in 2026. The application has been accepted in February 2025. We continued regularly using our LinkedIn account and published two new issues of our own **AdaBD Newsletter** for the science community and the interested general public. The newsletters can be [downloaded](#) from our website. For a **Press review**, see [Chapter 6.3](#).

In addition, we financially supported some events of the [Developmental Science Network Zurich](#) (DSN-ZH): A [panel discussion](#) with the title “Entwicklung und Lernen von Kindern und Jugendlichen im digitalen Wandel”, which took place on 05.11.2024 with, among others, AdaBD member *Silvia Brem*.

[Meet the experts](#) events in fall 2024

Organisation of a network meeting on data protection, which was held on February 4, 2025

In the next year, we plan to expand our collaboration with the DSN-ZH by co-organizing public outreach events (e.g. a panel discussion on the topic “Autism” on June 10, 2025).

5. Academic Career Development

5.1 Academic career development

AdaBD invested financial resources for a total of six PhD positions in 2021, 14 in 2022, 16 in 2023, and 16 in 2024. In Phase 1 we financed – in some cases partially - a total of 20 PhD Students. Additional students are working on URPP research projects while being financed with UZH or third-party funds. Two PhD Students had the opportunity to receive own funding through a UZH Candoc grant.

Young academics in our research groups can profit from an interdisciplinary environment, symposia, online seminars and support from the platform managers. This year, they had the opportunity to majorly contribute to the evaluation of our URPP. To help prepare for the poster presentation to an interdisciplinary audience, we organized a test-run, where young researchers got feedback from each other, from our group leaders as well as from the members of the coordinating office. The posters were greatly improved, and we believe that they learnt a lot for further presentations.

Our second URPP AdaBD Retreat took place in October, and it was a great opportunity for our young academics to connect to each other and actively participate in workshops on outreach and fundraising. An extra PhD-postdoc workshop was organized by A. Speckert (student representative) at the retreat.

Further, *A. Speckert* and *S. Kollmorgen* (students and platforms representatives) organized two informal networking events for PhD Students (29.02.2024 and 23.10.2024).

Several members of the URPP (*R. Bachmann, F. Helmchen, N. Vladimirov*) participated in a block course for bachelor and master students on “Modern microscopy in Life Science research” organized by the URPP member *M. Müller. N. Vladimirov*, manager of the mesoSPIM platform, co-organized a workshop termed “Demystifying microscopy” during which the students gained hands-on experience in light microscopy.

As of December 2024, three URPP members are young **group leaders and assistant professors** (*A. Jakab, K. Kucian, N. Raschle*). *R. Bachmann* was appointed as Associate Professor for Developmental Genetics starting in 2023 and the URPP AdaBD kept supporting her professorship with 70% of the salary and with a contribution to her global budget also in 2024. Further, the URPP financially supported the assistant professorship for *A. Jakab* with 10% of the salary. We are in the process of establishing the new tenure-track assistant professorship position in the field of “Modeling Neural Diseases using Stem Cell technology”.

5.2 Gender equality development

The URPP AdaBD commits to a favorable gender balance and has the goal to provide family friendly working conditions. Also in this reporting year, the AdaBD general manager *S. Huber-Reggi* acted as **representative for gender equality** in the steering committee. We mention our equal opportunity efforts in job advertisements. Further, when planning seminars and symposia, we always ensure gender balance. We believe that we achieved high standards regarding equal gender representation at all levels. In 2024, among the **PIs**, the proportion of women was 42%. Within the **steering committee**, the proportion of women was 56% and within the **advisory board** 40%. Eighty percent of the **PhD students** and 60% of the **Postdocs** financed by the URPP in the last four years are women. We established a new platform for learning and learning disorders with two women as platform leaders (*Karin Kucian* and *Silvia Brem*). The Platform Coordinator position has been filled in May 2024 with a woman (*Leonie Holste*) working part-time (50%) due to family commitments. Of our additional platforms, one platform manager out of four is a woman and worked part-time due to family commitments (80%). Two PIs are working part-time due to family commitments. Two women working part-time due to family commitments run the coordinating office.

6. Publications

6.1 List of publications

The list contains only publications in which the URPP is mentioned in the acknowledgements. The URPP is mentioned if data collection and analysis has been possible thanks to the financial support of the URPP (salaries, running costs, method development). In addition, we asked our PIs to generally indicate the AdaBD affiliation in their publications. However, here we do not list publications that are not related to the URPP. URPP researchers are underlined. * *Shared Authorship*; # *Open Access*

Peer-reviewed publications

[Aydogan G & Ruff CC](#) (2024). New Insights from Gene Expression Patterns on the Neurobiological Basis of Risky Behaviour. *Nature Mental Health*.

<https://doi.org/10.1038/s44220-024-00333-y>

[Cai L, Argunsah AÖ, Damilou A, Karayannis T](#) (2024). A nasal chemosensation-dependent critical window for somatosensory development. *Science* 384:6696, pp. 652-660.

<https://doi.org/10.1126/science.adn5611>

[Damilou A](#), Cai L, Argunsah AÖ, [Han S](#), Hanley O, Kanatouris G, [Karatsoli M](#), Gesuita L, [Kollmorgen S](#), [Helmchen F](#), [Karayannis T](#) (2024). Developmental Cajal-Retzius cell death contributes to the maturation of layer 1 cortical inhibition and somatosensory processing. *Nature Communications* 15(1):6501.

<https://doi.org/10.1038/s41467-024-50658-6>

[Ehrler M](#), O’Gorman R, Wehrle FM, [Speckert A](#), [Jakab A](#), Kretschmar O, [Latal B](#) (2024). Learning from those who thrive: protective factors and neuroimaging markers in adolescents with complex congenital heart disease and with a favorable neurodevelopmental profile. *Child Neuropsychology*, 1-22.

<https://doi.org/10.1080/09297049.2024.2419048>

[Ehrler M](#), [Speckert A](#), Kretschmar O, Tuura O’Gorman R, [Latal B](#), [Jakab A](#) (2024). The cumulative impact of clinical risk on brain networks and associations with executive function impairments in adolescents with congenital heart disease. *Human Brain Mapping*, 45(14), e70028.

<https://doi.org/10.1002/hbm.70028>

[Han S](#), [Helmchen F](#) (2024). Behavior-relevant top-down cross-modal predictions in mouse neocortex. *Nature Neuroscience* 27:298–308.

<https://doi.org/10.1038/s41593-023-01534-x>

[Holfeld A](#), Schuster D, Sesterhenn F, ..., [Haenseler W](#), ..., Picotti P (2024). Systematic identification of structure-specific protein-protein interactions, *Mol Syst Biol*. 20(6):651-675.

<https://doi.org/10.1038/s44320-024-00037-6>

[Ji H](#), Payette K, [Speckert A](#), Tuura R, Grethen P, Kottke R, ... , [Latal B](#), Spina Bifida Study Group Zurich & [Jakab A](#) (2024). Thalamic connectivity topography in newborns with spina bifida: association with neurological functional level but not developmental outcome at 2 years. *Cerebral Cortex*, 34(1), bhad438.

<https://doi.org/10.1093/cercor/bhad438>

Kolokotronis K, Suter A-A, Ivanovski I, Frey T, Bahr A, [Rauch A](#), Steindl K (2024). DPF2-related Coffin-Siris syndrome type 7 in two generations, *European Journal of Medical Genetics* 69.

<https://doi.org/10.1016/j.ejmg.2024.104945>.

[Nair AG*](#), [Bollmohr N*](#), Schökle L, Keim J, Mateos Melero JM, [Müller M](#) (2024). Presynaptic quantal size enhancement counteracts post-tetanic release depression. *Journal Physiol*.

<https://doi.org/10.1113/JP286176>

[Noble AR](#), Masek M, Hofmann C, Cuoco A, Rusterholz TDS, Ozkoc H, Greter NR, Phelps IG, [Vladimirov N](#), [Kollmorgen S](#), [Stoeckli E](#), [Bachmann-Gagescu R](#) (2024). Shared and unique consequences of Joubert Syndrome gene dysfunction on the zebrafish central nervous system. *Biol Open* 13(11): bio060421.

<https://doi.org/10.1242/bio.060421>

[Speckert A](#), [Ji H](#), Payette K, Grethen P, Kottke R, Ackermann S, ... , [Jakab A](#) (2024). OSBA: An open neonatal neuroimaging atlas and template for spina bifida aperta. *Data*, 9(9), 107.

<https://doi.org/10.3390/data9090107>

[Speckert A](#), Payette K, Knirsch W, [von Rhein M](#), Grethen P, Kottke R, ... , [Latal B](#) & [Jakab A](#) (2025). Altered Connectome Topology in Newborns at Risk for Cognitive Developmental Delay: A Cross-Etiologic Study. *Human Brain Mapping*, 46(1), e70084. (preprint from 2024)

<https://doi.org/10.1002/hbm.70084>

#Toyofuku A, [Ehrler M](#), Naef N, Schmid AS, Kretschmar O, [Latal B](#), O'Gorman Tuura R (2024). Heart rate variability and cognitive functions in adolescents with complex congenital heart disease. *Pediatr Res*. Epub ahead of print.

<https://doi.org/10.1038/s41390-024-03432-9>

[Vladimirov N*](#), Voigt FF*, Naert T, ..., Ziegler U, [Stoekli E](#), Baudis L, Lienkamp SS, [Helmchen F](#) (2024). Benchtop mesoSPIM: a next-generation open-source light-sheet microscope for cleared samples. *Nature Communications*, 15(1), p.2679.

<https://doi.org/10.1038/s41467-024-46770-2>

Voigt FF, Reuss AM, Naert T, Hildebrand S, Schaettin M, Hotz AL, Whitehead L, Bahl A, Neuhauss SC, Roebroek A, [Stoekli ET](#), Lienkamp SS, Aguzzi A, [Helmchen F](#) (2024). Reflective multi-immersion microscope objectives inspired by the Schmidt telescope. *Nature Biotechnology*, 42(1), pp.65-71.

<https://doi.org/10.1038/s41587-023-01717-8>

[Yusifov E](#), Schaettin M, Dumoulin A, [Bachmann-Gagescu R](#), [Stoekli ET](#) (2024). The primary cilium gene CPLANE1 is required for peripheral nervous system development. *Dev Biol*. Epub 2024 Dec 16.

<https://doi.org/10.1016/j.ydbio.2024.12.008>

Preprints

Bürgi N., [Aydogan G.](#), Konovalov A., [Ruff CC.](#) (2024). A neural fingerprint of adaptive mentalization. *PsyArXiv*.

<https://osf.io/preprints/psyarxiv/npqy8>

Bürgi N., [Aydogan G.](#), Konovalov A., [Ruff C.C.](#) (2024). Neurocomputational characterization of altered mentalization in autism. *PsyArXiv*

[De Hollander G.](#), Grueschow M., Hennel F., [Ruff, C.C.](#) (2024). Rapid Changes in Risk Preferences Originate from Bayesian Inference on Parietal Magnitude Representations. *Biorxiv*

<https://doi.org/10.1101/2024.08.23.609296>

[Han S](#), [Helmchen F](#) (2024). Coordinated multi-level adaptations across neocortical areas during task learning. *BioRxiv*

<https://doi.org/10.1101/2024.09.26.615162>

[Ji, H.](#), Wu, Z., [Speckert, A.](#), Tuura, R., Hagmann, C., [Latal, B.](#), ... & [Jakab, A.](#) (2024). Developmental trajectory of thalamus topography during the late preterm and perinatal period in normal development, after premature birth and in congenital heart defects. *bioRxiv*.

<https://doi.org/10.1101/2024.08.27.608544>

Naert T, Yamamoto T, [Han S](#), Horn M, Bethge P, [Vladimirov N](#), Voigt F, Figueiro-Silva J, [Bachmann-Gagescu R](#), [Helmchen F](#), Lienkamp SS (2024). Pythia: Non-random DNA repair allows predictable CRISPR/Cas9 integration and gene editing. *BioRxiv*

<https://doi.org/10.1101/2024.09.23.614424>

[Schoenfeld G](#), [Kollmorgen S*](#), Tsai MC*, [Lewis C](#), [Han S](#), Bethge P, Reuss AM, Aguzzi A, Senn W, [Mante V](#), [Helmchen F](#) (2024). Unsigned temporal difference errors in cortical L5 dendrites during learning. *bioRxiv*

<https://doi.org/10.1101/2021.12.28.474360>

6.2 Activities to promote open science

Open Access publishing

Peer-reviewed publications marked with a # have been published open access (see [Chapter 6.1](#)).

Open research data

Data handling complies with the FAIR principle. In the reporting year, some measures have been implemented:

- FAIR compliant datasets of the mesoSPIM Platform: [Vladimirov N](#), Voigt F, Naert Th., ..., Ziegler U, [Stoeckli E](#), Baudis L, Lienkamp SS, [Helmchen F](#), The Benchtop mesoSPIM: a next-generation open-source light-sheet microscope for large cleared samples. *BioStudies*, S-BIAD963: <https://www.ebi.ac.uk/biostudies/bioimages/studies/S-BIAD963>
- The mesoSPIM Platform deposited a repository with hardware blueprints, under GNU General Public License v3.0: <https://github.com/mesoSPIM/benchtop-hardware>
- The mesoSPIM Platform deposited a repository with open-source software under GNU General Public License v3.0: <https://github.com/mesoSPIM/mesoSPIM-control>
- The project on the developing human brain connectome published
 - a data paper and a neuroimaging atlas, which is openly available on Zenodo (aggregated, averaged data): [Speckert, A.](#), [Ji, H.](#), Payette, K., Grethen, P., Kottke, R., Ackermann, S., Padden, B., Mazzone, L., Moehrlen, U., SPINA BIFIDA STUDY GROUP ZURICH, & [Jakab, A.](#) (2024). Open Spina Bifida Aperta Atlas (1.0) [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.11469304>
 - the structural connectome pipeline: https://github.com/annspe/connectome_pipeline
- The project on consequences of Joubert Syndrome gene dysfunction on the zebrafish central nervous system deposited the RNA sequencing data from the large transcriptomics experiments under <http://www.ncbi.nlm.nih.gov/bioproject/1070872>.
- The project NumRisk made all the analysis code openly available on github (e.g. https://github.com/Gilles86/risk_experiment/). All collected data are immediately converted to the standard BIDS format for fMRI datasets and are or will be shared on the openneuro-platform after publication (e.g., <https://openneuro.org/datasets/ds004259>).

Most projects are still collecting data. Whenever possible, we will make data, codes and methods openly available.

Further Open Science measures

The [mesoSPIM](#) initiative further flourished this year. In 2024 alone, there were 28 publications (globally) that used mesoSPIM, 12 of them used the URPP mesoSPIM platform microscopes, including 3 PhD dissertations. 5 new mesoSPIM setups have been built around the world. Nikita Vladimirov gave several workshops and students trainings for technology dissemination (see [Chapter 4](#))

The LLD Platform is committed to establishing a database that prioritizes the FAIR principles, ensuring that researcher data is managed transparently and sustainably.

Tools of the HDDA Platform will be made available to the scientific community as open-source projects. Opening of the repository is planned for 2025.

Both the computational cognitive model of number cognition developed within the project NumRisk, as well as the machine learning methods to probe the neural codes underlying number representations have been implemented as easy-to-use Python packages with generic functions that can be used outside of the scope of our own projects alone (i.e., <https://github.com/ruffgroup/bauer/tree/main>). They are currently freely available on

GitHub and future work will develop extensive documentation of the packages using the readthedocs-platform to further improve dissemination within and outside the university. We have already been contacted by researchers at the University College London and the Spinoza Centre for Neuroimaging in Amsterdam that are interested in using our models and code base, allowing for further collaboration.

6.3 Articles on UZH News and press review

The list contains articles on topics related to the URPP and in which the URPP is mentioned.

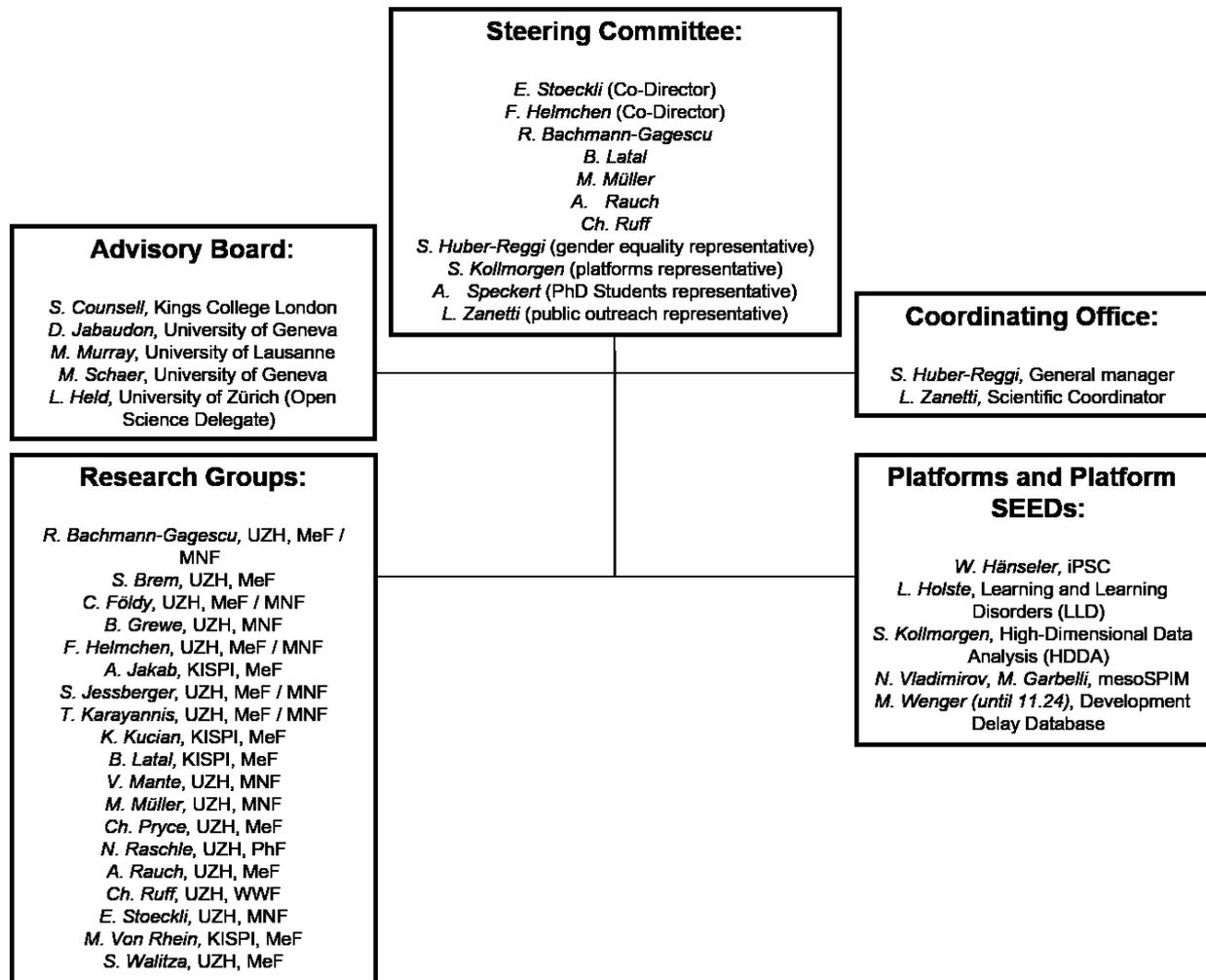
“[Dyskalkulie: Was bei Rechenschwäche im Gehirn abläuft](#)”, Bayrischer Rundfunk, 11.03.2024
Interview with AdaBD-member Karin Kucian on dyscalculia

«[Ich brauchte drei Stunden für eine einzelne Matheaufgabe](#)», 20 Minuten, 28.11.2024
Interview with AdaBD-member Karin Kucian and with Florian, who has been diagnosed with dyscalculia.

“[Erste Woche nach Geburt ist entscheidend für Entwicklung der Sinnesorgane](#)”, UZH Medienmitteilungen, 11.06.2024
On publication Cai et al., 2024 (see [Chapter 6.1](#))

“[Unraveling brain adaptability](#)”, ZNZ Newsletter, 02.10.2024,
Interview with AdaBD co-director Fritjof Helmchen on the URPP AdaBD

7. Structures



31.12.2024