Multiscale datasets available in the EBRAINS KG (Tier-3 curated, following FAIR principles) (D2.5 – SGA3)

Figure 1: Adapting amidst adversity: capturing multiscale datasets during the pandemic.

Amidst the COVID-19 pandemic, a neuroscientist at IDIBAPS conducts her research, overcoming challenges to access animal facilities or to collect human data. This image pays tribute to the dedication of experimentalists and analysts who ensured uninterrupted scientific progress during these difficult times. Photo by José Manuel Sánchez Sánchez.

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Description in GA:	Data ranging from dendrites and single cell electrophysiology to full brain imaging (including calcium imaging, multineuronal recording, LFPs, iEEG, microECoG, fMRI) and from different species (human, rodent, monkey) will be made available in the EBRAINS KG. These data will be generated by the different tasks and will be articulated around specific questions (cognitive tasks, brain states, network responsiveness, conscious/unconscious perception) and live papers, along with the associated data-driven and validated models.
Abstract:	The goal of the research described in this deliverable D2.5 is to investigate various aspects of brain function and behaviour using a collection of 45 neuroscientific datasets. These datasets cover a wide range of topics, including multisensory perception, brain connectivity, disorders of consciousness, brain states, decision-making, memory and learning, cognitive processes, among many others. The datasets include various imaging and electrophysiology modalities, enabling researchers to investigate brain function at different spatial and temporal scales. The datasets also include various species, including mouse, rat, ferret, non-human primates, and humans. These datasets have been publicly shared, some under embargo upon publication, in the EBRAINS Knowledge Graph.
Keywords:	Datasets, EBRAINS KG, imaging, electrophysiology, brain states, cognition, multi-scale, multi-species, animal models, human.
Target Users/Readers:	Clinicians, computational neuroscience community, neuroinformaticians, neuroscientific community, neuroscientists, platform users, researchers, scientific community, and students.

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1. Introduction

The deliverable D2.5 comprises a comprehensive collection of neuroscientific datasets, which serves as the culmination of our research efforts in data collection. These datasets are expected to enable other neuroscientists to replicate our findings and potentially discover new insights. The shared datasets cover a wide range of topics, including multisensory perception, brain connectivity, disorders of consciousness, brain states, decision-making, memory and learning, cognitive processes, among others.

As represented in Figure 2, the datasets include different species, brain areas, techniques, and brain research topics, mainly on brain states and cognition. For example, the "Techniques" category includes various imaging and electrophysiology modalities, enabling researchers to investigate brain function at different spatial and temporal scales. Another category, "Species", lists the species studied in our datasets, which include rodent, ferret, non-human primates, and humans. These variety has contributed to the number of datasets made available, given that each one is homogeneous.

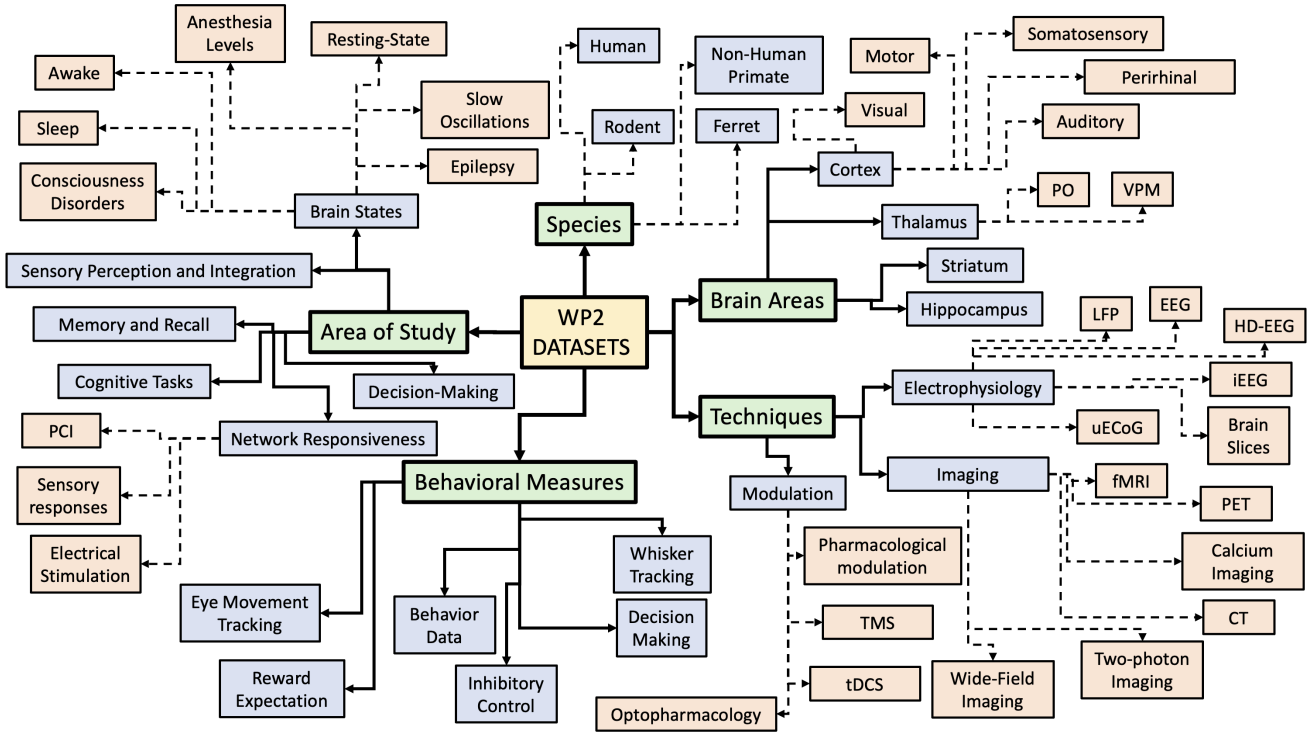

Figure 2: The categories (species, areas, techniques, measures) covered by WP2 datasets

This figure illustrates the different categories covered by WP2 datasets. These categories are Species, Brain Areas, Techniques, Behavioural Measures and Area of study. This classification provides a comprehensive overview of the diverse range of data sources and research areas contributing to our understanding of cognitive science and neuroscience in WP2.

Several communities should be interested in this work, due to its broad and diverse scope in neuroscience and cognitive research. Some of these communities are:

1) Neuroscientists: Our work provides a valuable collection of neuroscientific datasets covering various aspects of brain function, connectivity, and behaviour. Neuroscientists can use this data to explore new research questions, validate existing models, and gain insights into brain dynamics during different states and cognitive processes.
2) Clinical Researchers: The datasets include studies on disorders of consciousness and the effects of natural and artificial interventions, such as sleep and anaesthesia. Clinical researchers can use this data to study brain changes in patients with specific neurological conditions and assess the impact of drugs on brain function.
3) Computational Scientists: The availability of diverse datasets enables computational scientists to develop and validate complex models of brain function. These models can simulate brain

activity, providing a basis for understanding brain dynamics and predicting responses to different stimuli.

4) Brain Atlas Developers: The structural and functional connectivity data collected in the datasets can be instrumental in constructing detailed brain atlases. Developers can utilize this information to create comprehensive reference maps for brain regions and their interactions.

5) Ethical and Regulatory Bodies: As our work involves human and animal research, ethical and regulatory bodies should be interested in the data collection and privacy protection measures undertaken. Our research may have implications for ethical considerations in neuroscience and cognitive studies.

6) Educators and Students: The collected datasets offer a rich resource for educational purposes. Educators can use this data to illustrate various concepts and processes related to brain function, cognition, and consciousness, while students can explore real-world neuroscientific research and gain insights into different research methodologies.

One of the main objectives of WP2 in the Human Brain Project (HBP) was to increase the availability of integrated data supporting brain state transitions, network complexity and cognitive functions (WPO2.1). These datasets would then be shared with the neuroscience community through the EBRAINS Knowledge Graph (KG).

By making these datasets available to the broader neuroscience community, we look forward to:

- Facilitate reproducibility and validation: Open access to the acquired datasets allows other researchers to validate and reproduce the findings, enhancing the credibility and robustness of scientific outcomes. Moreover, researchers can use the datasets to compare results across different methodologies, species, and scales, promoting comprehensive understanding and validation of theories.
- Enable new discoveries: Datasets collected by means of diverse methodologies, and from different species and scales broaden the scope of research possibilities for the neuroscience community. Researchers can leverage these datasets to explore novel hypotheses, develop innovative analytical approaches and uncover new insights into brain structure, function, and pathologies.
- Encourage collaborations and interdisciplinary research: Shared datasets facilitate collaborations among researchers with varied expertise, including neurophysiologists, computational scientists, statisticians, and clinicians. Such collaborations can lead to interdisciplinary breakthroughs, bridging the gap between experimental findings and computational modelling, ultimately advancing our understanding of the brain.

This work is supported by the EBRAINS Knowledge Graph service, facilitating the publication of all collected datasets. Leveraging this service ensures that the datasets are efficiently curated, organized, and made accessible to the scientific community. Researchers can easily access and explore the datasets, promoting collaboration and enhancing knowledge sharing. Additionally, by utilizing the EBRAINS Knowledge Graph service, each dataset is assigned a unique DOI, ensuring proper citation and recognition for the contributors. This integration with EBRAINS goes in line with FAIR principles, further promoting advancements in neuroscience research and cognitive studies.

As WP2 we finally deliver a total of 45 datasets. The majority of WP2 partners (19 partners) and Tasks (10 out of 13 Tasks) are involved in the data collection, resulting in datasets including many different methodologies, scales and species are delivered to the EBRAINS KG.

2. Multiscale datasets available in the EBRAINS KG

In the list below the Partner and Task in charge of collecting the dataset are defined. The title and Knowledge Graph links where the datasets are available are also added.

Table 1: List of WP2 data sets delivered to the EBRAINS KG.

Task	Partner	Title	KG link	Embargo status
T2.1	UvA	Neural Correlates of Multisensory Detection Behavior in Primary and Higher-Order Visual Cortex	https://search.kg.ebrains.eu/instances/Dataset/97d45335-6757-4a42-9824-2d652d9a9721	Public
T2.1	UvA	Multi-area recordings from visual and somatosensory cortices, perirhinal cortex and hippocampal CA1	https://search.kg.ebrains.eu/instances/2077efac-09f6-47c1-aabe-632e08ed148b	Public
T2.1	UvA	Audio-visual change detection change detection task in mice	https://search.kg.ebrains.eu/instances/ba41de6c-1b30-4f48-89c4-a6eb47b2c549	Public
T2.1	UvA	Sensory, perirhinal and hippocampal tetrode recordings during visual, tactile and visuotactile discrimination task in the freely moving rat	https://search.kg.ebrains.eu/instances/d406a98c-ae5c-4fb3-9f0c-4cf4de9b1094	Under embargo upon publication
T2.1	DZNE	Human ultra-high resolution functional imaging data (7 Tesla) on multi-event memories (general raw data)	https://search.kg.ebrains.eu/instances/Dataset/7269d1a2-c7ad-4745-972c-10dbf5a022b7	Public with an EBRAINS account
T2.1	DZNE	Human functional imaging data (7 Tesla) on learning audio-visual scene-object associations	https://search.kg.ebrains.eu/instances/Dataset/a2bcb3e6-227d-4d9d-a5c3-7c27eb49af91	Under embargo upon publication
T2.1	DZNE	Functional imaging data (3 Tesla) on Object-In-Room Recall in healthy, younger adults	https://search.kg.ebrains.eu/instances/Dataset/aaca9deb-6cea-4339-a221-254dffeedcda	Under embargo upon publication
T2.2	UoG	Investigation of the role of context in the processing of low-contrast visual information using 7T	https://search.kg.ebrains.eu/instances/80d67f5a-6cad-4166-a40d-890c9f2a9f06	Under embargo upon publication
T2.2	UoG	Investigating the influence of contextual information on the processing of degraded feedforward visual information	https://search.kg.ebrains.eu/instances/648613d9-c1be-40dd-8eba-b8ffa112a10b	Under embargo upon publication
T2.2	UoG	The effect of learning and memory on contextual feedback to V1 using ambiguous stimuli and 3T fMRI	https://search.kg.ebrains.eu/instances/3ba258ca-0ea6-42a8-a744-d1617bf83bd0	Under embargo upon publication
T2.2	KNAW	Two-photon calcium imaging of layer 2/3 soma and layer 5 dendrites in mouse visual cortex for visual occlusion	https://search.kg.ebrains.eu/instances/ca602c23-364a-4c9b-943b-87d1b09a5821	Public
T2.2	UBER	Dendritic action potentials recordings in human layer 2/3 cortical neurons – derived data	https://search.kg.ebrains.eu/instances/306b1877-a5b3-4663-9e38-f82060020f20	Public
T2.2	UBER	Simultaneous tracking of Eye Movement and Whisking in Head-Fixed Mice Navigating a Plus Maze, videos, and tracking data	https://search.kg.ebrains.eu/instances/cc98a341-2818-4003-87dd-aa0d393fb8d2	Public
T2.2	KNAW	Electrophysiological recordings in macaque V1 during passive viewing of full and occluded natural scenes	https://search.kg.ebrains.eu/instances/1ffac129-39e8-400e-84e8-0fe816f6efa7	Public
T2.3	ULG	FDG-PET/CT data of healthy volunteers and patients with disorders of consciousness	https://search.kg.ebrains.eu/instances/Dataset/68a61eab-7ba9-47cf-be78-b9addd64bb2f	Public with an EBRAINS account

T2.3	ULG	TMS-EEG perturbation in patients with disorders of consciousness	https://search.kg.ebrains.eu/instances/Dataset/ab2d4db0-4c97-442c-82f9-a3dade301e9f	Public with an EBRAINS account
T2.3	ULG	Phase-interaction matrices of the phase relationships of different pathological states of consciousness	https://search.kg.ebrains.eu/instances/Dataset/775c7858-2305-4a56-8bd6-865c4ab5dd4f	Public with an EBRAINS account
T2.3	ULG	BOLD signals of healthy controls during awake, light, and deep Propofol sedation and recovery from sedation	https://search.kg.ebrains.eu/instances/ceac8277-dc73-4083-8b5b-b029d097f400	Public with an EBRAINS account
T2.3	IDIBAPS	Spontaneous Direct Current (DC) modulated activity in in vitro ferret slice	https://search.kg.ebrains.eu/instances/d4460b07-73fd-4bd1-bfd7-01d23f32f8b3	Under embargo upon publication
T2.3	IDIBAPS	Optimisation of photostimulation targeting muscarinic receptors	https://search.kg.ebrains.eu/instances/Dataset/b5998ae0-7237-4626-8ca6-e9fe2e8389c9	Requested embargo lift
T2.4	IDIBAPS	Transitions between different naturally and artificially induced brain states in in vivo rats.	https://search.kg.ebrains.eu/instances/Dataset/e07ab90a-6308-469c-8bc7-a41234103ad3	Requested embargo lift
T2.4	IDIBAPS	Spontaneous cortical activity in human and ferret brain slices	https://search.kg.ebrains.eu/instances/802fcf0c-ba03-47f9-9051-6143600b980a	Under embargo upon publication
T2.4	UiO	Dose-dependent effects of ketamine on spontaneous and evoked EEG activity in rats	https://search.kg.ebrains.eu/instances/Dataset/68bce801-d06a-4b01-8d5a-b0e42f10b86d	Under embargo upon publication
T2.5	IDIBAPS	Perturbational Complexity Index (PCI) protocol in the mouse (in vivo) and ferret (in vitro)	https://search.kg.ebrains.eu/instances/ae138e06-e565-4bc4-910c-b4eded3bb3c1	Under embargo upon publication
T2.5	IDIBAPS	Impact of Thalamic Stimulation on somatomotor cortical areas and striatum in deeply anesthetised mice	https://search.kg.ebrains.eu/instances/4c99a143-b895-4e4b-b996-6e3d0019bd63	Requested embargo lift
T2.5	IDIBAPS	Auditory stimulation during the sleep-wake cycle in the freely moving rat	https://search.kg.ebrains.eu/instances/Dataset/b2337bb8-4c0f-46bf-8304-2207f8a8e15c	Under embargo upon publication
T2.5	LENS	Wide-field imaging of cortical response to sensory stimulation in GCaMP6f mice at different brain states	https://search.kg.ebrains.eu/instances/5fbaeea7-fac2-472e-aefc-556c2cde1218	Public
T2.5	UGA	How Absence Seizures Impair Sensory Perception: Insights from Awake fMRI and Simulation Studies in Rats	https://search.kg.ebrains.eu/instances/d19d8e53-b755-406e-b559-d22e2b6eb89e	Public
T2.5	UMIL	Co-registration of simultaneous HD-EEG and intracranial EEG during single pulse intracerebral stimulation in wakefulness and sleep	https://search.kg.ebrains.eu/instances/Dataset/a3e9cd95-d601-40ed-b5fa-e5a9fd01005a	Under embargo upon publication
T2.5	UMIL	Results for complexity measures and a read-out of the state of cortical circuits after injury	https://search.kg.ebrains.eu/instances/9a05f491-3ef7-47be-93b2-0a6d8cd43ae0	Public with an EBRAINS account
T2.6	UMIL	Simultaneous stereo-EEG and high-density scalp EEG recordings to study the effects of intracerebral stimulation parameters	https://search.kg.ebrains.eu/instances/b1c3e79e-ca4a-4a05-9235-b93cf1cb678d	Public
T2.6	UMIL / CNR	Sensory and intracortical stimulations with simultaneous sEEG and hd-EEG recordings and subjective reports	https://search.kg.ebrains.eu/instances/a12a4d28-ca1c-4e03-9891-3ab696a1ac28	Under embargo upon publication

T2.6	KNAW	1024-channel electrophysiological recordings in macaque V1 and V4 during resting state (v1)	https://search.kg.ebrains.eu/instances/0d9193c5-3ad2-4a15-a967-7b729ef97386	Public
T2.6	KNAW	Population receptive fields in non-human primates from whole-brain fMRI and large-scale neurophysiology in visual cortex	https://search.kg.ebrains.eu/instances/603fba4f-0224-40d1-ae64-713f72af5c2c	Public
T2.6	KNAW	Pop-in: the inversion of pop-out for a feature dimension during visual search in area V4 of the monkey cortex	https://search.kg.ebrains.eu/instances/7757e057-e556-45da-9adf-d1c85c27f5cd	Public
T2.9	UniRoma1	The role of reward expectation in the modulation of inhibitory control: behaviour data and neural recordings from monkey premotor area	https://search.kg.ebrains.eu/instances/10649e9a-8d4b-4f67-8d24-9e42028ea7b4	Under embargo upon publication
T2.9	UZL	Human intracranial recordings of consequential decision-making in the frontoparietal cortex	https://search.kg.ebrains.eu/instances/72062c1b-e10a-4631-ba17-06be45995022	Public with an EBRAINS account
T2.10	CEA	Human EEG recordings of conscious visual perception using statistical learning	https://search.kg.ebrains.eu/instances/9a82643b-02d8-4c96-bd1c-61ee628a8ac8	Public
T2.10	CEA	Ventrolateral prefrontal cortex and posterior parietal cortex multielectrode array recordings during RSVP no-report paradigm	https://search.kg.ebrains.eu/instances/e7253a3e-d51c-4044-a709-d9730587a1fc	Public
T2.10	CEA	Ventrolateral prefrontal cortex and posterior parietal cortex multielectrode array recordings during local-global no-report task	https://search.kg.ebrains.eu/instances/c1f8fad9-0ea8-4a15-aace-e1c11c418f10	Under embargo upon publication
T2.10	CEA	Intracranial electrophysiological recordings from PFC and PPC during wakefulness and anaesthesia under electrical microstimulation	https://search.kg.ebrains.eu/instances/8c17072f-ff13-4467-882c-97a02ff37838	Under embargo upon publication
T2.12	INRIA	Individual Brain Charting (IBC)	https://search.kg.ebrains.eu/instances/Dataset/f968dc40-2058-4178-bcf7-d1ce8db2d7cc	Public with an EBRAINS account
T2.12	INRIA	Pre-processed data from the Individual Brain Charting (IBC) project	https://search.kg.ebrains.eu/instances/3ca4f5a1-647b-4829-8107-588a699763c1	Public with an EBRAINS account
T2.12	INRIA	Contrast maps obtained from Individual Brain Charting	https://search.kg.ebrains.eu/instances/07ab1665-73b0-40c5-800e-557bc319109d	Public with an EBRAINS account
T2.13	DONDERS	Effects of sulpiride and methylphenidate on brain and cognition: a PET pharmaco-FMRI study	https://search.kg.ebrains.eu/instances/d61777ce-a300-4a3e-9cf8-1ec806a081cd	Public

Below are brief descriptions of the datasets available. For a more comprehensive understanding of each dataset, including details about the experimental design, methods of data collection, ethical considerations, and more, please follow the link to the respective entry for each dataset in the EBRAINS Knowledge Graph (KG).

2.1 Neural Correlates of Multisensory Detection Behaviour in Primary and Higher-Order Visual Cortex

This dataset was collected from imaging neuronal activity in V1 and Antero-Lateral (AL) cortical areas of mice during visual, auditory, and audio-visual detection tasks. The animals were trained to respond by licking a lickspout when a stimulus was perceived. The researchers found that AL neurons were more sensitive to weak stimuli compared to V1. Both V1 and AL cells showed changes in visual responses when an auditory stimulus was added. In the case of multisensory stimuli, area AL exhibited stronger responses when the animal reported seeing a stimulus, indicating a correlation between AL and multisensory detection.

Link to the KG: https://search.kg.ebrains.eu/instances/97d45335-6757-4a42-9824-2d652d9a9721

Related publications: P2685: Meijer et al. 2020.

2.2 Multi-area recordings from visual and somatosensory cortices, perirhinal cortex and hippocampal CA1

This dataset includes spiking data from four areas (V2m, S1bf, perirhinal cortex, and hippocampal CA1) recorded simultaneously in freely moving rats during a spatial navigation task with visual discrimination and memory components. Position data of the animals during the task obtained from video tracking is also provided. A more detailed overview of the experimental design and data collection process can be found in the KG entry.

Link to the KG: https://search.kg.ebrains.eu/instances/2077efac-09f6-47c1-aabe-632e08ed148b

Related publications: P3930: Dorman et al 2023.

2.3 Investigating the neural correlates of multisensory perception (ephys)

In this dataset, mice were trained on different versions on an audio-visual change detection task. Silicon probes were used to monitor brain activity in visual cortex, posterior parietal cortex, and cingulate cortex. This set of electrophysiological recordings makes up a rich dataset which can be of interest to any researcher investigating mechanisms of multisensory perception, both at the level of data analysis and as the basis for the development of computational models.

Link to the KG: https://search.kg.ebrains.eu/instances/ba41de6c-1b30-4f48-89c4-a6eb47b2c549

Related publications: P3268: Oude Lohuis et al. 2022 and P3308: Oude Lohuis et al. 2022.

2.4 Sensory, perirhinal and hippocampal tetrode recordings during visual, tactile and visuotactile discrimination task in the freely moving rat

This dataset was recorded from single-unit spiking activity of three different neocortical areas and the hippocampal CA1 regions simultaneously, in rats performing a cross-modal memory recall task. Animals learned to recognize two distinct objects in tactile, visual, and visuo-tactile domain. The aim of the acquired data is to gain insights into cortico-hippocampal interactions involved in fundamental memory recall mechanisms.

Link to the KG: https://search.kg.ebrains.eu/instances/d406a98c-ae5c-4fb3-9f0c-4cf4de9b1094

Related Publications: P3900: Mertens et al. 2023, Ruikes et al. (in revision for eNeuro) and Fiorilli et al. (in revision for Cerebral Cortex).

2.5 Human ultra-high resolution functional imaging data (7 Tesla) on multi-event memories (general raw data)

Ultra-high resolution 7 Tesla functional MRI data (0.8 mm isotropic) was acquired in 30 young humans, healthy adults. During data acquisition, participants performed the encoding and retrieval phase of a multi-element memory task. Data can be reused to answer questions about the functional involvement of medial temporal lobe subregions, structure-behaviour relationships, questions about memory formation and retrieval.

Link to the KG: https://search.kg.ebrains.eu/instances/7269d1a2-c7ad-4745-972c-10dbf5a022b7

Related Papers: P1960: Grande et al. 2019 and **P2414**: Theves et al. 2023.

2.6 Human functional imaging data (7 Tesla) on learning audiovisual scene-object associations

MRI data at 7 Tesla was acquired in 24 healthy adults with ultra-high spatial resolution. During functional data acquisition, participants learned and retrieved scene-object associations of which either element was an auditory or a visual stimulus. Data can be reused to answer questions about the functional involvement of medial temporal lobe subregions, their neocortical interactions, structure-behaviour relationships, multisensory integration, and memory formation.

Link to the KG: https://search.kg.ebrains.eu/instances/a2bcb3e6-227d-4d9d-a5c3-7c27eb49af91

Related papers: A paper that compares auditory and visual scene and object representations and MTL subregional involvement during multisensory integration is in preparation.

2.7 Functional imaging data (3 Tesla) on Object-In-Room Recall in healthy, younger adults

Episodic memories comprise information from various domains (e.g. objects and scenes). Upon retrieval, a unimodal cue can be sufficient to reinstate the multimodal representation of the episode. Here, functional neuroimaging data at 3Tesla was acquired in 25 healthy human adults during cued recall of previously learned object-in-room associations. Data can answer questions about the functional involvement of medial temporal lobe regions, their neocortical interactions, structure-behaviour relationships, and questions about context-object retrieval and memory recollection.

Link to the KG: https://search.kg.ebrains.eu/instances/aaca9deb-6cea-4339-a221-254dffeedcda

Related Papers: A paper that shows specific MTL subregion involvement during cued recall is in preparation.

2.8 Investigation of the role of context in the processing of low-contrast visual information using 7T

Our aim is to understand the role of cortical feedback processing in cognition, from the level of subcellular computations to neuronal responses in animal models of cortical circuits, to laminar fMRI

in humans which has superior spatial resolution. Eight human subjects participated in two 7T fMRI scanning sessions. Subjects were presented a series of greyscale natural images comprised of two parts. The main portion of the image was a full-contrast scene (e.g., a beach) and is referred to as the surround. The bottom right corner of the image (the target region) was shown at threshold-level contrast and depicted a scene that is either consistent or inconsistent with the surround. We will investigate differences in BOLD signal amplitude within the layers of V1 between the five conditions, especially between the consistent and inconsistent conditions. The data addresses whether at near threshold consistent surround will amplify or dis-amplify the near threshold cortical processing.

Link to the KG: https://search.kg.ebrains.eu/instances/80d67f5a-6cad-4166-a40d-890c9f2a9f06

Related Papers: The current dataset is used in Paton et al. *in preparation*.

2.9 Investigating the influence of contextual information on the processing of degraded feedforward visual information

Predictive processing theories claim that disparities between predictions and feed-forward input are passed to the next stage of the cortical hierarchy as error signals, and that matching feedforward and feedback signals are 'explained away', resulting in reduced neuronal processing. We acquired human 3T fMRI data from early visual cortex in 59 human participants, and tested whether top-down, 'predicted', information amplifies low contrast feed-forward input. We used a partial visual occlusion paradigm **(**P818, P2107, P2886**)** in which we presented natural scenes with the lower right quadrant at low contrast (50% or 75% threshold). The content of the lower right image quadrant either matched or did not match the rest of the scene, manipulating the consistency (or predictability) of the contextual information. We also varied the relatedness of inconsistent surround information to be either from the same category or different category. We used retinotopic mapping approaches to locate the cortical region responding to the lower right image quadrant only, in V1 and V2. In these regions of V1 and V2, we will measure how contextual information driven by the image surround, modulates BOLD activity responding to the low contrast portion of the scene.

Link to the KG: https://search.kg.ebrains.eu/instances/648613d9-c1be-40dd-8eba-b8ffa112a10b

Related Papers: P818: Revina et al. 2018, P2107: Morgan et al. 2019 and P2886: Svanera et al. 2021

2.10 The effect of learning and memory on contextual feedback to V1 using ambiguous stimuli and 3T fMRI

Contextual information and prior knowledge facilitate perceptual processing, improving our recognition of distorted or imagined visual inputs (for example, see previous EBRAINS fMRI dataset[1], where we map imagery and perceptual feedback signals onto different layers in human V1 microcircuits). As a result, the processing elicited by identical sensory inputs can vary depending on our pre-existing knowledge or the context in which we encounter those inputs. We used an amodal completion task (i.e., partially occluded) Mooney images, ambiguous two-tone images which are difficult to recognise without prior knowledge of the image content, in a 3T fMRI experiment to measure if contextual feedback signals in early visual areas are modulated by learning. Dissimilarity matrices and mean dissimilarity for feedback activations revealed a significant increase in dissimilarity between individual images in all ROIs for both feed-forward and feedback processing. This suggests that knowledge generates more detailed contextual information carried via cortical feedback to early visual areas to facilitate the recognition of ambiguous images.

Link to the KG: https://search.kg.ebrains.eu/instances/3ba258ca-0ea6-42a8-a744-d1617bf83bd0

[1] https://search.kg.ebrains.eu/instances/648613d9-c1be-40dd-8eba-b8ffa112a10b

Related Papers: Lazarova et al. 2023 under review in Topics in Cognitive Science.

2.11 Two-photon calcium imaging of layer 2/3 somas and layer 5 dendrites in mouse visual cortex during visual occlusion

We previously investigated how areas in the visual hierarchy interact to shape visual perception (P2889) and how neuronal responses to sensory stimuli depend on the context (P2246). Here, we performed two-photon calcium imaging of L2/3 and L5 neurons in primary visual cortex of awake head-fixed mice during the presentation of full-screen and partially occluded greyscale natural images (UVA & UoG). To induce stimulus-specific plasticity, training was performed on a subset of the images and only under full-screen image conditions. In both image sessions (before and after perceptual training), we first mapped receptive fields (RFs) of all imaged neurons to allow for inclusion of neurons based on RF location and properties. This dataset contains two imaging sessions per mouse (pre- and post-training) with responses to two sets of stimuli each (receptive field mapping and occlusion experiments). The data revealed that stimulus identity can be decoded from non-stimulated regions of mouse V1, that training slightly improves decoding accuracy and that training drastically changes single-cell and population responses.

Link to the KG: https://search.kg.ebrains.eu/instances/ca602c23-364a-4c9b-943b-87d1b09a5821

Related Papers: P2889: Roelfsema et al. 2021 and P2246: Vangeneugden et al. 2019

2.12 Dendritic action potentials recordings in human layer 2/3 cortical neurons - derived data

We investigated the dendrites of layer 2 and 3 (L2/3) pyramidal neurons of the human cerebral cortex ex vivo (P2281). Dual somato-dendritic patch clamp and two-photon imaging were used to investigate the active properties of L2/3 dendrites in acute slices from surgically resected brain tissue of the human neocortex in epilepsy and tumor patients (n=30). In human pyramidal neurons, we discovered a class of calcium-mediated dendritic action potentials (dCaAPs) whose waveform and effects on neuronal output have not been previously described. In contrast to typical all-or-none action potentials, dCaAPs were graded; their amplitudes were maximal for threshold-level stimuli but dampened for stronger stimuli. Using a model, we show that dCaAPs enabled the dendrites of individual human neocortical pyramidal neurons to classify linearly non-separable inputs-a computation conventionally thought to require multi-layered networks.

Link to the KG: https://search.kg.ebrains.eu/instances/306b1877-a5b3-4663-9e38-f82060020f20

Related Papers: P2281: Gidon et al. 2020

2.13 Simultaneous tracking of Eye Movement and Whisking in Head-Fixed Mice Navigating a Plus Maze, videos, and tracking data

Neuronal activity can be used to predict behaviour in variety of preparations. Here we show that a class of behaviours can predict decisions. Sensory motor systems in rodents - both whisker movement and eye movement predict decisions and execution of actions that mice make in navigating their environment. The dataset here from 10 male head fixed mice includes video data from whiskers, and eyes, and has been annotated for behavioural stages. Data has been converted into a digital file that has been converted analogue traces of position (P3338). See also P1818, where we tracked the behaviour of head-fixed mice running freely on a floating plus maze. In relation to this behavioural paradigm in rodents (UBER), we have previously used a virtual reality building engine to create an

immersive virtual apartment for human experiments (UoG). We immersed human subjects into virtual reality, used this to explore the temporal precision of predictions in feedback activations to V1 in humans using fMRI (EBRAINS dataset[2]).

Link to the KG: https://search.kg.ebrains.eu/instances/cc98a341-2818-4003-87dd-aa0d393fb8d2

Related Papers: P3338: Bergmann et al. 2022 and P1818: Dominiak et al. 2019

2.14 Electrophysiological recordings in macaque V1 during passive viewing of full and occluded natural scenes

Neuronal activity in the primary visual cortex (V1) is influenced by feed-forward input from the LGN that determines the neurons' receptive field (RF), and it is also modulated by contextual information in regions surrounding the RF. The effect of contextual input occurs rapidly and is challenging to dissociate from feed-forward influences. We recorded a dataset of electrophysiological recordings in V1 of two macaque monkeys during passive viewing in a partial visual occlusion paradigm (P3882). We used a dataset of 24 natural scenes and a version of the same images with the bottom-right quadrant occluded with a white rectangle (from P2107). We recorded multi-unit neuronal activity from 144 recording sites in V1 in 2 monkeys. V1 neurons responded selectively to occluded scenes, in the absence of a visual stimulus in their RF, with a latency of ~78 ms after stimulus onset. These representations of occluded information are correlated between humans and monkeys, suggesting cross-species similarity in the content of perceptual internal models supplied by higher visual areas to V1.

Link to the KG: https://search.kg.ebrains.eu/instances/1ffac129-39e8-400e-84e8-0fe816f6efa7

Related Papers: P2107: Morgan et al. 2019 and P3882: Papale et al. 2022.

2.15 FDG-PET/CT data of healthy volunteers and patients with disorders of consciousness

Cerebral 18F-Fluorodeoxyglucose PET-CT scans allow to (semi)quantify cerebral glucose uptake, one of the most relevant markers for the clinical diagnosis of patients with a DoC. The shared dataset contains the human cerebral 18F-Fluorodeoxyglucose PET-CT scans of 33 healthy volunteers and 2 patients with disorder of consciousness. The data of the healthy volunteers has been normalized to MNI space and smoothed and can be used as control group for assessing regions with relative preserved or reduced glucose uptake in patients with disorders of consciousness after severe brain injury. Two datasets also contain the raw DICOM images of 2 patients with severe brain injury.

A workflow for the analysis of these images is shared through EBRAINS as well (see 3.2) alongside a guide for the interpretation of the glucose uptake maps and standardized uptake values in https://wiki.ebrains.eu/bin/view/Collabs/fdg-pet-analysis-for-doc .

Link to the KG: https://search.kg.ebrains.eu/instances/68a61eab-7ba9-47cf-be78-b9addd64bb2f

Related Papers: P2853: Thibaut et al. 2021.

2.16 TMS-EEG perturbation in patients with disorders of consciousness

This dataset contains data from patients with a DoC includes high-density electroencephalography during stimulation with transcranial magnetic pulses and rest (pre-pulse) and diagnosis based on

[2] https://search.kg.ebrains.eu/instances/b884fb7e-c222-4c29-aa5d-f89f014f7d44

repeated behavioural assessments using the standardized procedures for this population of patients. Patients were kept eyes open for the whole session. The PCI value was computed by compressing the spatio-temporal pattern of cortical responses to the perturbation of the cortex with TMS. Depending on whether the patient's best PCI was above or below the 0.31 threshold, patients were respectively classified as conscious or unconscious as in P1215. With this data set we show that cerebral glucose metabolism as marker for consciousness is associated to the PCI, and that the assessment of the PCI is particularly useful to detect covert consciousness in patients showing preserved metabolism in the absence of conscious behavior at the bedside (P1002). More recently, we have shown that TMS-evoked potentials can be used to quantify not only awareness but also arousal when using a deep learning approach (P3330).

Link to the KG: https://search.kg.ebrains.eu/instances/ab2d4db0-4c97-442c-82f9-a3dade301e9f

Related Papers: P3330: Lee et al. 2022.

2.17 Phase-interaction matrices of the phase relationships of different pathological states of consciousness

To explore the theoretical perspective in the clinical aspect of loss of consciousness, several empirical (model free) measures can be applied on resting state functional MRI data. To this end, we share phase-synchronization matrices that capture the relationships between phases of blood-oxygen-level-dependent (BOLD) signals and have been proven to effectively describe the spatio-temporal dynamics. Ultimately, measures derived from such matrices could be used as biomarkers in clinical practice to identify the level of consciousness, predict outcomes and to form the ethical guideline for patient management.

In our recent work it was demonstrated that low-level states of consciousness were associated with reduced network interactions, together with more homogeneous and more structurally constrained local dynamics (P3131). Furthermore, a reduction of metastability and functional network repertoire was present in UWS compared to MCS patients, co-occurring with a loss of dynamic interplay between structural eigenmodes and emerging time-resolved functional connectivity (P3912). Indeed, the characterization of such BOLD-fMRI brain states by modelling time-dependent dynamics can distinguish different groups of DoC patients (P3915).

Link to the KG: https://search.kg.ebrains.eu/instances/775c7858-2305-4a56-8bd6-865c4ab5dd4f

Related Papers: P3131: López-Gónzalez et al. 2021.

2.18 BOLD signals of healthy controls during awake, light, and deep propofol sedation and recovery from sedation

This dataset was acquired to study the effects of propofol anaesthesia in healthy human volunteers. It contains resting state fMRI BOLD time series from 5 healthy volunteers under 4 different conditions of propofol sedation (awake, W1; light sedation, S1; deep sedation, S2; and recovery from sedation, W2). Depth of sedation was monitored based on behaviour with the Ramsey scale. Alongside the functional data, a structural connectivity matrix is provided based on the average structural connectivity of 20 healthy volunteers. The data is meant to study the effect of propofol (a GABA receptor agonist) and recovery from sedation in model-free and model-based approaches. The data is used in Showcase 1 and in our recent work where we show that propofol induced unconsciousness is associated with reduced network interactions, together with more homogeneous and more structurally constrained local dynamics (P3131).

Link to the KG: https://search.kg.ebrains.eu/instances/ceac8277-dc73-4083-8b5b-b029d097f400

2.19 Spontaneous Direct Current (DC) modulated activity in cortical slices in vitro

The goal of the present study was to explore whether DC stimulation has the potential to modulate cortical activity in vitro and to investigate its properties and underlying mechanisms. We applied exogenous constant electric fields (EF) with different polarities and intensities to in vitro ferret cortical slices expressing slow oscillatory activity. The present model might be useful to better understand the neuromodulation mechanisms of tDCS in the clinical realm. The dataset explores the cortical network dynamics modulation using DC stimulation, as studied in P1316. Positive and negative constant fields of the same magnitude (2 and 5 V/m) were applied for periods of 150s, interspersed with recovering periods of the same duration, resulting in a precise modulation of the emergent activity in the form of a control of the frequency of the cortical rhythmicity.

Link to the KG: https://search.kg.ebrains.eu/instances/d4460b07-73fd-4bd1-bfd7-01d23f32f8b3

2.20 Optimisation of photostimulation targeting muscarinic receptors

Manipulating neural activity, brain rhythms or synchronization is of significant therapeutic interest in several neurological disorders and can be achieved by different means such as transcranial current and magnetic stimulation techniques, and by light through optogenetics, although the clinical translation of the latter is hampered by the need of gene therapy. Here, we directly modulate brain rhythms by using an agonist of a main endogenous neuromodulator, acetylcholine, that has been manipulated to become photo switchable. In this way, the activation of the muscarinic M2-receptors agonist can be controlled with light. Synchronous slow wave activity was transformed into a higher frequency pattern in the cerebral cortex (Fig 3), as described in P2851. These results open the way to the study of the neuromodulation and control of spatiotemporal patterns of activity and pharmacology of brain states, their transitions, and their links to cognition and behaviour, in different organisms without requiring any genetic manipulation. This is a type of technique and drug with potential clinical applications in the future.

Link to the KG: https://search.kg.ebrains.eu/instances/Dataset/b5998ae0-7237-4626-8ca6-e9fe2e8389c9

Related Papers: P2851: Barbero-Castillo et al. 2021

2.21 Transitions between different naturally and artificially induced brain states in chronically implanted rats

The aim of this dataset is to illustrate the cortical and sub-cortical dynamics underlying the naturally induced (sleep) and artificially induced (anaesthesia) conditions in the freely moving chronic implanted rat. The characterization of the transitions between sleep states (Slow Wave Sleep, REM, Awake, …) and between drug-induced states (Awake, Slow Oscillations, Microarousals, Spindles, ...) under these conditions is something that still needs to be further explored and the current dataset could help in that. The dataset contains the entire sessions for 3 different subjects, two of them belonging to anaesthesia (different concentrations of Ketamine + Medetomidine, light and deep) and the other belongs to natural sleep.

Link to the KG: https://search.kg.ebrains.eu/instances/Dataset/e07ab90a-6308-469c-8bc7-a41234103ad3

Related Papers: P2687: Torao et al. 2021 and Manasanch et al. (in preparation)

2.22 Spontaneous cortical activity in human and ferret brain slices

Animal models provide valuable information on cortical mechanisms and dynamics, in both physiological and pathological conditions. Ferret cortical slices are a highly accessible preparation which has been used to unveil important mechanistic insights. Nevertheless, as the complexity of the cellular make-up and function of the human brain is remarkable and distinct from nonhuman species, it is essential to validate findings provided by animal models in human-based systems. The current dataset provides electrophysiological recordings of spontaneous slow wave activity (Local Field Potentials, LFP) performed on ferret (n=4) and human (n=3) brain cortical slices. The recordings were performed with 30 channels (human) and 32 channels (ferret) microelectrode arrays, covering several cortical layers and columns. As such, it is possible to reconstruct the spatiotemporal profile of cortical activity. LFP were collected from the visual cortex of ferret and from temporal resections of epileptic patients requiring surgery due to refractory epilepsy. These recordings are useful not only for improving our knowledge of basic physiology of the human brain tissue but also to bridge the gap between animal studies and clinical applications.

Link to the KG: https://search.kg.ebrains.eu/instances/802fcf0c-ba03-47f9-9051-6143600b980a

Related Papers: Covelo et al. (in preparation)

2.23 Dose-dependent effects of ketamine on spontaneous and evoked EEG activity in rats

This dataset was gathered to test measures and theories of consciousness in rodents, and to identify dose dependent effects of ketamine in cortical activity. The dataset contains recordings of spontaneous and evoked epidural EEG from 6 rats in wakefulness, light ketamine anaesthesia, and deep ketamine anaesthesia. 16 stainless-steel electrodes were chronically implanted, and used for recording while the rats were head-restrained.

Link to the KG: https://search.kg.ebrains.eu/instances/68bce801-d06a-4b01-8d5a-b0e42f10b86d

Related Papers: P2916: Arena et al. 2021, P3783: Arena et al. 2022 and Nilsen et al. 2023 (under review).

2.24 Perturbational Complexity Index (PCI) protocol in the mouse (in vivo) and ferret (in vitro)

Here, by means of two different projects (*in vivo* and *in vitro*), we aimed to assess cortical complexity differences across brain states, anaesthesia levels, and stimulus location using in vitro and in vivo experiments, ultimately contributing to a better understanding of the underlying network dynamics and their modulation. For the *in vivo* dataset, the differences in cortical complexity between the effect of the ventral posteromedial thalamic nucleus (VPM) stimulation and the motor (M1/M2) cortex under different anaesthesia levels were explored. For each anaesthesia level (light and deep), two control recordings were obtained as a baseline prior to cortical or thalamic stimulation. For the *in vitro* dataset, the role of inhibition in cortical complexity was explored. The influence of GABAergic inhibition, mediated by $GABA_A$ or $GABA_B$ receptors, on cortical complexity, departing from a desynchronized state that mimics wakefulness, was explored.

Link to the KG: https://search.kg.ebrains.eu/instances/ae138e06-e565-4bc4-910c-b4eded3bb3c1

Related Papers: P2975: Barbero-Castillo et al. 2021 and Casas-Torremocha et al. (in preparation).

2.25 Impact of Thalamic Stimulation on somatomotor cortical areas and striatum in deeply anesthetized mice

Manipulating neural activity and brain states is of significant therapeutic interest in several neurological disorders and can be achieved by electrical stimulation. In this context, this data set provides a characterization of the impact of the thalamic electrical stimulation on the cortical and striatal activity in deeply anesthetized mice. For that, we electrically stimulated ventral posteromedial thalamic nucleus to analyse the spontaneous slow oscillation activity and the evoked responses in the striatum and cortex. These results open the way to the study the role of the thalamus in the spatiotemporal patterns of activity of brain states, their transitions, and their links to cognition and behavior.

Link to the KG: https://search.kg.ebrains.eu/instances/4c99a143-b895-4e4b-b996-6e3d0019bd63

Related Papers: Rodríguez-Urgellés et al. (in review)

2.26 Auditory stimulation during the sleep-wake cycle in the freely moving rat

The aim of the present experiments is to explore the cortical dynamics during the three main stages of the sleep-wake cycle: Wakefulness, Slow Wave Sleep (SWS) and Rapid-Eye Movement sleep (REM), in the presence of distinct auditory stimuli. More specifically, to analyse the specific cortical responses to auditory stimulation from primary (Au1) and secondary (Au2) auditory cortex, related and non-related regions (M1 and V1) together with associative (PtA) and higher order (PrL) cortical areas in the distinct stages of the sleep-wake cycle. The dataset contains data for three different subjects with 4 sessions each. For each session, a csv file containing the manual detection of the sleep dynamics is also included.

Link to the KG: https://search.kg.ebrains.eu/instances/b2337bb8-4c0f-46bf-8304-2207f8a8e15c

Related Papers: Suárez et al. (in preparation)

2.27 Wide-field imaging of cortical response to sensory stimulation in GCaMP6f mice at different brain states

This study aims to investigate the brain-state dependence of the broadcasting of sensory-evoked activity. To this end, we recorded activity over both cortical hemispheres in mice at increasing isoflurane levels using wide field optical imaging in mice expressing the fluorescent calcium indicator GCaMP6f. We compared the cortical activity dynamics following whisker stimulation in two conditions: deep and medium anaesthesia in the same chronically implanted mice. Combining level-dependent modulation of slow wave, optical imaging, and whisker stimulation, it was possible to perform large-scale spatial correlation between cortical regions during a response evoked by sensory stimulation.

Link to the KG: https://search.kg.ebrains.eu/instances/5fbaeea7-fac2-472e-aefc-556c2cde1218

Related Papers: Montagni et al. (in preparation)

2.28 How Absence Seizures Impair Sensory Perception: Insights from Awake fMRI and Simulation Studies in Rats

Electroencephalographic (EEG) and functional magnetic resonance imaging (fMRI) data was recorded simultaneously from awake GAERS, a rat model of absence epilepsy. Visual and whisker stimulation was experimentally applied, and visual stimulation was simulated during interictal and ictal states and whole brain hemodynamic and neural responsiveness was compared between states.

Link to the KG: https://search.kg.ebrains.eu/instances/d19d8e53-b755-406e-b559-d22e2b6eb89e

Related Papers: Stenroos et al.[3] (submitted to eLife).

2.29 Coregistration of simultaneous HD-EEG and intracranial EEG during single pulse intracerebral stimulation in wakefulness and sleep

At the mesoscale level, we combined for the first time in this dataset (Pigorini et al., in preparation) intracortical single pulse electrical stimulation (SPES) in humans undergoing pre-surgical evaluation, with simultaneous intracortical recordings (stereo-EEG) and high-density electroencephalography (hd-EEG, 256 channels) during both wakefulness and sleep. Local perturbations with SPES allow studying bistable dynamics (down states in the Local Field Potential) and their effects on local cortico-cortical interactions (Pigorini et al. 2015). Adding simultaneous hd-EEG links these intracortical events to overall connectivity and complexity as assessed at the scalp level (Casali et al. 2013) and to compare the effects at the whole brain level of the invasive vs non-invasive stimulation (Comolatti et al. in preparation).

The data is organised in two conditions (sessions): wakefulness and sleep. Subjects were patients that were undergoing intra-cranial monitoring for surgical planning due to refractory epilepsy.

Link to the KG: https://search.kg.ebrains.eu/instances/a3e9cd95-d601-40ed-b5fa-e5a9fd01005a

Related Papers: Parmigiani et al. 2022 P3254, Cattani et al. 2023 P4081 and Pigorini et al. and Comolatti et al. (both in preparation)

2.30 Results for complexity measures and a read-out of the state of cortical circuits after injury

Transcranial magnetic stimulation (TMS) combined with electroencephalography (EEG) measures the brain's response to perturbations in cortical areas. During wakefulness, TMS induces complex EEG patterns, while in NREM sleep, the patterns become simpler. The perturbational complexity index (PCI) accurately distinguishes conscious and unconscious states in healthy human subjects, as well as in severely brain-injured patients unable to communicate. It has shown a sensitivity of 94.7% in detecting patients in a minimally conscious state and offers potential insights into consciousness levels in unresponsive wakefulness syndrome (previously vegetative state).

Link to the KG: https://search.kg.ebrains.eu/instances/9a05f491-3ef7-47be-93b2-0a6d8cd43ae0

Related Papers: P1215: Casarotto et al., 2016, P1516: Rosanova et al., 2018 and Comolatti et al., in preparation.

[3] https://www.biorxiv.org/content/10.1101/2023.07.26.550701v1.abstract

2.31 Simultaneous stereo-EEG and high-density scalp EEG recordings to study the effects of intracerebral stimulation parameters

Cortico-cortical evoked potentials (CCEPs) recorded through stereo-electroencephalography (SEEG) offer valuable insights into brain reactivity and connectivity. However, SEEG's spatial sparsity limits cross-subject comparisons and detecting whole-brain effects of intra-cortical stimulation in relation to EEG responses from non-invasive stimuli. This study demonstrates that CCEPs recorded by high-density electroencephalography (hd-EEG) provide additional valuable information beyond SEEG alone. The curated dataset includes SEEG and hd-EEG recordings from 36 drug-resistant epileptic patients during Single Pulse Electrical Stimulation (SPES) with various parameters. Hd-EEG better captures differences in pulse duration, angle, and stimulated cortical area. It also reveals site-specific responses that resemble EEG responses to transcranial magnetic stimulation (TMS). The study highlights that SPES, though unperceived by subjects, elicits scalp responses much larger than typical sensory stimulations in awake humans. In conclusion, simultaneous recording of CCEPs with SEEG and hd-EEG allows for reliable assessment of SPES effects and comparison of intra-cortical stimulation to non-invasive stimulations in humans.

Link to the KG: https://search.kg.ebrains.eu/instances/b1c3e79e-ca4a-4a05-9235-b93cf1cb678d

Related Papers: P2919: Mikulan et al., 2021, P3254: Parmigiani et al., 2022 and Comolatti et al., *in preparation.*

2.32 Sensory and intracortical stimulations with simultaneous sEEG and hd-EEG recordings and subjective reports

The mechanistic underpinnings of somatosensation have been studied since the early days of modern neuroscience. Despite the large body of knowledge regarding the involved pathways, stages and brain areas, the neural correlates of the conscious perception of tactile stimuli are still unclear. On one hand, intracranial studies have shown that brain responses to stimulation of the median nerve are characterized first by a phasic component of gamma-band activity mostly located on the primary somatosensory cortices, and later by a tonic component predominantly in insulo-opercular areas. The latter component has been associated with conscious perception whereas the former can occur independently from it. On the other hand, non-invasive EEG studies have suggested the existence of a specific correlate of tactile perception, the Somatosensory Awareness Negativity (based on the N140 EEG component), which corresponds to a negative deflection with a peak latency of ~120-180 ms. In the present study, we take advantage of simultaneous recordings of intracranial and high-density scalp EEG to assess whether these two proposed correlates are related. Our results not only show their temporal and spatial correspondences, but also demonstrate that performing an SEEG-informed source localization of the scalp EEG signals retrieves strikingly similar topographical patterns to those extracted from a large cohort of intracranial recordings. By bridging invasive and non-invasive recordings, our results provide an integrated picture of the putative neural correlates of somatosensory perception and open new avenues for both clinical and research applications.

Link to the KG: https://search.kg.ebrains.eu/instances/a12a4d28-ca1c-4e03-9891-3ab696a1ac28

Related Papers: Mikulan et al., *in preparation*, P3109: Del Vecchio et al., 2022 and Comolatti et al., *in preparation*

2.33 1024-channel electrophysiological recordings in macaque V1 and V4 during resting state (v1)

Co-variations in resting state activity are thought to arise from a variety of correlated inputs to neurons, such as bottom-up activity from lower areas, feedback from higher areas, recurrent processing in local circuits, and fluctuations in neuromodulatory system. Most studies have examined resting state activity throughout the brain using MRI scans or observed local co-variations in activity by recording from a small number of electrodes. We carried out electrophysiological recordings from over a thousand chronically implanted electrodes in the visual cortex of non-human primates, yielding a resting state dataset with unprecedentedly high channel counts and spatiotemporal resolution. Such signals could unravel the intrinsic functional architecture of the visual cortex, for instance by observe brain waves across larger regions of cortex, offering a temporally detailed picture of brain activity. In this data-paper (P3250), we provide the dataset, describe the raw and processed data formats and data acquisition methods, and indicate how the data can be used to yield new insights.

Link to the KG: https://search.kg.ebrains.eu/instances/0d9193c5-3ad2-4a15-a967-7b729ef97386

Related papers: P3250: Chen et al. 2022.

2.34 Population receptive fields in non-human primates from whole-brain fMRI and large-scale neurophysiology in visual cortex

Population receptive field (pRF) modelling is a popular fMRI method to map the retinotopic organization of the human brain. While fMRI-based pRF maps are qualitatively similar to invasively recorded single-cell receptive fields in animals, it remains unclear what neuronal signal they represent. We addressed this question in awake non-human primates comparing whole-brain fMRI and large- scale neurophysiological recordings in areas V1 and V4 of the visual cortex. We examined the fits of several pRF models based on the fMRI blood-oxygen-level-dependent (BOLD)signal, multi-unit spiking activity (MUA), and local field potential (LFP) power in different frequency bands. We found that pRFs derived from BOLD-fMRI were most similar to MUA-pRFs in V1 and V4, while pRFs based on LFP gamma power also gave a good approximation. fMRI-based pRFs thus reliably reflect neuronal receptive field properties in the primate brain. In addition to our results in V1 and V4, the whole- brain fMRI measurements revealed retinotopic tuning in many other cortical and subcortical areas with a consistent increase in pRF size with increasing eccentricity, as well as a retinotopically specific deactivation of default mode network nodes similar to previous observations in humans. This dataset contains all (pre-processed fMRI and electrophysiology data, as well as the scripts to process the data and create the figures used in the paper. Data can be reused to investigate additional details about the retinotopic organization of the primate brain and the relation between the fMRI signal and the underlying neuronal activity.

Link to the KG: https://search.kg.ebrains.eu/instances/603fba4f-0224-40d1-ae64-713f72af5c2c

Related papers: P3222: Klink et al. 2021

2.35 Pop-in: the inversion of pop-out for a feature dimension during visual search in area V4 of the monkey cortex

During visual search, it is important to reduce the interference of distracting objects in the scene. The neuronal responses elicited by the search target stimulus are typically enhanced. However, it is equally important to suppress the representations of distracting stimuli, especially if they are salient and capture attention. We trained monkeys to make an eye movement to a unique “pop-out” shape

stimulus among an array of distracting stimuli. One of these distractors had a salient colour that varied across trials and differed from the colour of the other stimuli, causing it to also pop-out. The monkeys were able to select the pop-out shape target with high accuracy and actively avoided the pop-out colour distractor. This behavioural pattern was reflected in the activity of neurons in area V4. Responses to the shape targets were enhanced, while the activity evoked by the pop-out colour distractor was only briefly enhanced, directly followed by a sustained period of pronounced suppression. These behavioural and neuronal results demonstrate a cortical selection mechanism that rapidly inverts a pop-out signal to "pop-in" for an entire feature dimension thereby facilitating goal-directed visual search in the presence of salient distractors. The data shared here allows additional inspection of detailed behavioural and neuronal dynamics involved in the suppression of visual distractors.

Link to the KG: https://search.kg.ebrains.eu/instances/7757e057-e556-45da-9adf-d1c85c27f5cd

Related papers: P3886: Klink et al. 2023

2.36 The role of reward expectation in the modulation of inhibitory control: behaviour data and neural recordings from monkey premotor area

We recorded single unit activity from the dorsal premotor cortex (PMd) of primates (n = 3) trained in different version of a decision task where reward estimation and action consequences on future reward delivery were experimentally controlled and evaluated in the animal behaviour. The results show that PMd is considering reward computation and future prospect as cognitive signals in the process of motor decision. The dataset also contains eye positions and pupil responses during the task.

Link to the KG: https://search.kg.ebrains.eu/instances/d67cf4c9-611f-4ddb-9893-d4e39897c00d

Related Papers: *Neurons in Premotor cortex of primates compute the level of the future reward during decision making* (in preparation).

2.37 Human intracranial recordings of consequential decision-making in the frontoparietal cortex

In goal-oriented interactions with the environment, organizing actions into sequences is vital to anticipate outcomes in complex decision-making processes, even if it means prioritizing long-term gains over immediate convenience. We performed invasive human recordings in the frontoparietal cortex, to understand how the brain activity in these areas reflects the evaluation of consequences in multi-step processes. Four patients with refractory neuropathic facial pain were implanted with 16-channel epidural electrode grids (Specify 5-6-5, Medtronic) targeting the primary motor cortex (M1) and covering a broad region of the central frontoparietal cortex. We recorded from 80 channels in total (patient 2 was implanted with 2 grids that covered bilateral frontoparietal cortex). The patients performed a consequential task aimed at maximizing cumulative reward through decision sequences. The trials were organized into independent sessions or grouped into episodes of one or two trials. The subjects were required to discover the optimal strategy leading to the highest cumulative reward. We share both behavioural (reaction times, and performance) and neural data (pre-processed Local Field Potentials). The invasively recorded data from patients provides an invaluable opportunity to impose physical constraints on computational models, and refine and validate them, ensuring alignment with actual neural processes observed in the human and shedding light on the neural mechanisms underlying decision-making.

Link to the KG: https://search.kg.ebrains.eu/instances/72062c1b-e10a-4631-ba17-06be45995022

2.38 Human EEG recordings of conscious visual perception using statistical learning

This dataset was collected by researchers at the Max Planck Institute for Empirical Aesthetics in Frankfurt/Main (Germany). It contains whole-brain high-density electroencephalography (EEG) recordings (i.e., 128 channels) of 37 adult volunteers, who completed one of two versions of a visual statistical learning paradigm.

In brief, abstract fractals were presented in a rapid serial visual stream. Unbeknownst to the subjects, in some of these streams (i.e., structured condition), transition probabilities between fractals were manipulated, such that consecutive fractals formed a higher-order structure: either duplets (in Experiment 1) or triplets (in Experiment 2). In addition to the data of these structured streams, the current dataset also includes the data of two unstructured localizer runs performed before and after those structured streams to assess neural representations before and after incidental learning as well as the data of a familiarity test run, during which participants' implicit sequence knowledge was tested. A random control condition without any structure (but otherwise identical to the structured streams) is also included. The data contained in this dataset may be useful for other researchers interested in visual processing, sequence learning, or, more generally, time-series analysis.

Link to the KG: https://search.kg.ebrains.eu/instances/9a82643b-02d8-4c96-bd1c-61ee628a8ac8

Related publications: A paper is in preparation.

2.39 Ventrolateral prefrontal cortex and posterior parietal cortex multielectrode array recordings during RSVP no-report paradigm

This dataset features multiunit activity (MUA) recordings from two adult male macaque monkeys, captured via Utah arrays implanted in specific brain regions: the ventrolateral prefrontal cortex (vlPFC, area 45a) and the parietal cortex (PPC, areas 7a/7b). The recordings were made as the monkeys engaged in a visual task, where they were required to maintain their gaze on a central fixation point while a sequence of images was displayed. These images were presented in two distinct formats: a rapid serial visual presentation (RSVP) with a stimulus onset asynchrony (SOA) of 100 ms, and a slower-paced presentation with SOAs of 400 ms for Monkey H07 and over 900 ms for Monkey A11.

The primary aim of collecting this data was to investigate how the vlPFC encodes visual stimuli under two different conditions: one that allows time for cognitive reflection on each image (slow-paced) and another that likely precludes such reflection due to rapid presentation (RSVP). Additionally, PPC data was gathered to compare the decoding signal strength across an equivalent number of recording channels. For Monkey A11, PPC and vlPFC data were collected concurrently, whereas for Monkey H07, the PPC data was obtained in separate sessions.

The dataset is versatile and well-suited for future research in visual perception and neural dynamics. It also includes local field potential recordings and uncalibrated eye movement data, enriching its potential for a wide range of studies.

Link to the KG: https://search.kg.ebrains.eu/instances/e7253a3e-d51c-4044-a709-d9730587a1fc

Related publications: P3232: Bellet et al. 2022

2.40 Ventrolateral prefrontal cortex and posterior parietal cortex multielectrode array recordings during local-global no-report task

This dataset features multiunit activity (MUA) recordings from two adult male macaque monkeys, captured via Utah arrays implanted in specific brain regions: the ventrolateral prefrontal cortex (vlPFC, area 45a) and the parietal cortex (PPC, areas 7a/7b). The recordings were made as the monkeys engaged in a visual task, where they were required to maintain their gaze on a central fixation point while a sequence of images was displayed. These images were presented within a 2x2 local-global design.

The primary aim of collecting this data was to investigate how the vlPFC encodes sequences and their violations, which would be used to understand neural activity from within the predictive coding framework. Additionally, PPC data was gathered to compare the decoding signal strength across an equivalent number of recording channels. For Monkey A, PPC and vlPFC data were collected concurrently, whereas for Monkey H, the PPC data was obtained in separate sessions.

The dataset is versatile and well-suited for future research in visual perception and neural dynamics. It also includes local field potential recordings and uncalibrated eye movement data, enriching its potential for a wide range of studies.

This dataset is under embargo until after peer-review and publication, when it will be made publicly available online.

Link to the KG: https://search.kg.ebrains.eu/instances/c1f8fad9-0ea8-4a15-aace-e1c11c418f10

Related publications: P3166: Bellet et al 202 and contributed to event E4734.

2.41 Intracranial electrophysiological recordings from PFC and PPC during wakefulness and anaesthesia under electrical microstimulation

This dataset features multiunit activity (MUA) and LFP recordings from two adult male macaque monkeys, captured via Utah arrays implanted in specific brain regions: the ventrolateral prefrontal cortex (vlPFC, area 45a) and the parietal cortex (PPC, areas 7a/7b). The recordings were made under wakefulness and different depths of anaesthesia with electrical microstimulation. The primary aim of collecting this data was to investigate how information transfer and communication is altered under different states of consciousness, using wakefulness and different depths of anaesthesia as a proxy. We also wished to investigate meso-scale neuronal dynamics in these states. Finally, this dataset is well-suited for modelling, specifically to constrain models at different scales.

This dataset is under embargo until after peer-review and publication, at which point it will be made publicly available online.

Link to the KG: https://search.kg.ebrains.eu/instances/8c17072f-ff13-4467-882c-97a02ff37838

Related publications: Disseminated in E4726

2.42 Individual Brain Charting (IBC)

The Individual Brain Charting (IBC) project has collected a high-resolution multi-task-fMRI dataset to provide an objective basis for a comprehensive atlas of brain responses. The data refer to a cohort of human participants performing many different tasks. Acquiring many tasks on the same subjects yields a precise mapping of the underlying functions, free from both inter-subject and inter-site variability. Additionally, the dataset comes with high-resolution anatomical and diffusion images, to achieve a fine anatomical characterization of these brains.

Links to the KG:

- Individual Brain Charting (IBC): https://search.kg.ebrains.eu/instances/Dataset/f968dc40-2058-4178-bcf7-d1ce8db2d7cc
- Pre-processed data from the Individual Brain Charting (IBC) project: https://search.kg.ebrains.eu/instances/3ca4f5a1-647b-4829-8107-588a699763c1

- Contrast maps obtained from Individual Brain Charting: https://search.kg.ebrains.eu/instances/07ab1665-73b0-40c5-800e-557bc319109d

Related publications: P1408: Pinho et al. 2018, P1579: Varoquaux et al. 2018, P2607: Pinho et al. 2020, P2622: Dadi et al. 2020, P2708: Dohmatob et al. 2021, P2709: Pinho et al. 2020, P2984: Bazeille et al. 2021, P2985: Mensch et al. 2021, P3848: Menuet et al. 2022.

2.43 Effects of sulpiride and methylphenidate on brain and cognition: a PET pharmaco-fMRI study

The large variation observed in the effects of dopaminergic drugs poses a major problem for neuropsychiatry, where therapeutic drugs may be ineffective or detrimental in a proportion of patients, but also for the healthy population. We have conducted a pharmaco-fMRI/PET study in 100 healthy human participants to investigate the neural and neurochemical mechanisms of this variability. We studied the cognitive effects of methylphenidate and sulpiride across various cognitive domains. To establish the baseline dopamine-dependency of the drug effects, all participants underwent an [18F] DOPA positron emission tomography scan to quantify their baseline striatal dopamine synthesis capacity. In addition, multiple putative proxy measures of striatal dopamine activity were acquired.

Link to the KG: https://search.kg.ebrains.eu/instances/d61777ce-a300-4a3e-9cf8-1ec806a081cd

Publications: P3335: Van den Bosch et al. 2022 and P3889: Van den Bosch et al. 2023.

3. Looking forward

These datasets represent the culmination of our data collection efforts and have the potential to drive substantial progress in various areas of neuroscience and cognitive research. Openly sharing these datasets is important. It enables fellow researchers to validate and replicate our findings, which is fundamental for trustworthy scientific outcomes. Furthermore, the diversity of these datasets also encourages the discovery of new insights and innovative hypotheses. Researchers from various backgrounds can use this information to explore new avenues of research, develop cutting-edge analytical approaches, and gain fresh perspectives on brain function and disorders.

The integration of these datasets into the EBRAINS Knowledge Graph ensures efficient curation and accessibility. Researchers can easily access and explore the datasets. Additionally, assigning unique DOIs to each dataset promotes proper citation and recognition for contributors, aligning with FAIR principles and further advancing neuroscience research and cognitive studies.

In essence, sharing these diverse neuroscientific datasets signifies a commitment to transparency, collaboration, and innovation within the scientific community. By doing so, we not only validate our research but also pave the way for new discoveries, interdisciplinary collaboration, and ongoing progress in our understanding of the brain and cognition.

The following datasets have already been collected and are currently under the last stages of the curation process. They will be published in the EBRAINS Knowledge Graph after the SGA3 period:

- The effect of tau-pathology on multi-sensory integration and recall (DZNE, T2.1)
- Human consciousness is supported by dynamic complex patterns of brain signal coordination (ULG, T2.3)
- Decreased Evoked Slow-Activity After tDCS in Disorders of Consciousness (ULG, T2.3)

Looking forward, we will maintain our commitment to data sharing, with a strong emphasis on FAIR principles. We expect the EBRAINS Knowledge Graph to continue being a cornerstone for data sharing, facilitating scientific advancement.

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