

OpenMind – An Open Database of Anesthetic Effects in Preclinical Research (and Beyond)

Demand for Better Information Exchange on Anesthetic Effects

Understanding the effects of different anesthetics on brain function and physiology has huge scientific and clinical impact.

- (1) In **basic research**, neuroscientists apply various drugs to sedate animals for preventing stress and distractions, knowing that anesthetics interfere with the very subject of their investigation: brain function, from single neurons to large-scale networks. Better knowledge of anesthetic effects and refinement of anesthetic protocols is key to produce meaningful findings that can be translated to awake humans (Reimann and Niendorf, 2020).
- (2) In **clinical practice**, novel anesthetic protocols are on the test bench, especially as a substitute for opioids in light of the current opioid crisis in the US (Brown et al., 2018).
- (3) Cognitive scientists employ anesthetics to probe the brain's functional architecture and the **neural correlates of consciousness** (Mashour and Hudetz, 2018).

All these disparate fields share a common question: what are the exact mechanisms of anesthesia and how to balance different anesthetics to achieve customized protocols that meet their specific needs? All these fields produce valuable data that should be taken into account across research domains in pursuit of a deeper understanding of anesthetic effects on brain functions.

Accessing knowledge on anesthetic effects is not always straightforward. Valuable information is buried in publications that use anesthesia only as an experimental tool. Many observations remain unpublished “lab lore” and are not available to the community. Having access to this information could substantially accelerate progress in detailing anesthetic effects to develop novel anesthetic protocols, tailored for the demand of the respective field and application.

An Open Solution for the Community, by the Community

A community-driven open database of key observations – collected from publications and lab notes – would make this information more accessible, promoting reproducibility and preventing research groups from running into the same “dead ends” already discovered by others. Here we introduce a web-based infrastructure for such an open initiative across neuroimaging communities, to facilitate the exchange of this information: **OpenMind**.

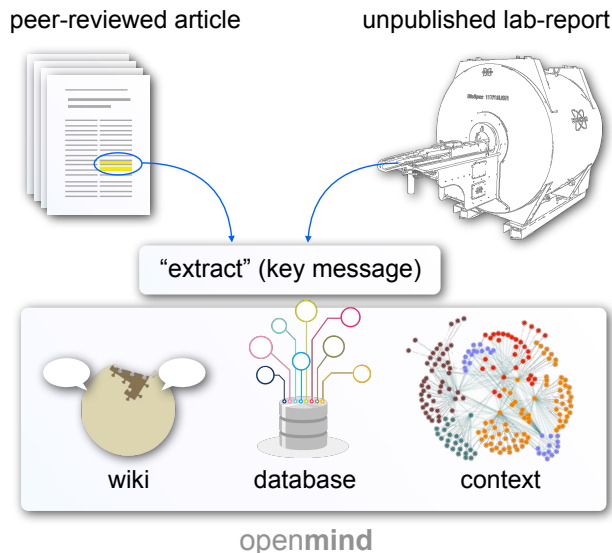
What is OpenMind?

OpenMind is an open hub of scientific findings on anesthetic effects across depth and classes, species, monitoring techniques and modalities. It combines the wiki principle (dynamic creating, correcting, commenting by members of the community) with a powerful and dynamic databank approach (fast and easy search, network visualization of related findings).

OpenMind provides (1) convenient data upload, (2) fast and efficient search and filter functions, (3) embedding of findings in a larger dynamic context, and (4) low maintenance in a free and open environment. Particular care was taken to make the contribution a swift and pleasant experience – to lower the hurdle for every researcher to actively contribute, growing and expanding the network toward a reliable encyclopedia for anesthesia across fields.

Functional Architecture at a Glimpse

OpenMind deals in **extracts**: brief takeaways of about one sentence summarizing a single main finding. A corresponding figure shows a graphical representation of the underlying data. Sources may include preprints and peer-reviewed articles with one article potentially engendering multiple extracts, or unpublished lab notes with optional link to the original data (stored at external open repositories like e.g., openneuro.org and bids.neuroimaging.io).



OpenMind provides an infrastructure for sharing, searching, and contextualizing scientific findings around anesthetic effects. Findings are isolated into key messages (so-called **extracts**) that are extracted from peer-reviewed articles and preprints, or unpublished lab-notes.

The infrastructure combines elements from the **wiki** approach (creation, correction, discussion of dynamic content) with a dynamic **database** (fast and powerful search and ranking) and dynamic creation of **context** (connecting related findings, network visualization and mind maps) – all swift and easy to handle.

Search for Extracts: Fast and Specific

A specified filter system permits to *tag* and find extracts based on their content, including species, anesthetic class and level, modalities (single neuron recordings to large-scale fMRI), applications (like sensory, resting-state, optogenetics), and physiology (blood pressure, heart rate, respiration). Each tag provides a limited number of subtags that enable to refine the search. One can query, for instance, only extracts that report on effects of low doses of ketamine and xylazine in mice using fMRI with somatosensory stimuli. You can specify your search for lab notes or published articles, peer-reviewed or preprint. *Search by expression* across the library is, of course, also possible.

Create Extracts: Easy and Convenient

A major focus of the project is to keep each process as swift and convenient as possible to make contributing a pleasant experience. Implemented features include a simple and intuitive interface (for desktop and mobile use), linkage to open data repositories, automated recognition of peer-reviewed articles *via* pubmed link, and figure upload by drag-and-drop. Other features will follow along these lines. Commenting on and modifying extracts fosters a dynamic discourse while the extract's history is kept.

Relate Extracts: Dynamic Context and OpenMindMaps

An essential feature of OpenMind is to generate dynamic context by connecting extracts, either 'related to' (neutral), 'confirmed by' or 'in contrast to' other extracts. These relations make it easy to organize knowledge in a way that meets the requirements for contemporary research: capturing complex relations and contradicting results in a fast and comprehensive way. A visualization option to display extract relation networks (and create OpenMindMaps) will be implemented, which allows for a comprehensive overview on a specific finding embedded in a dynamic scientific discourse that clarifies the big picture. Sounds complex? **We keep it simple.**

3 Steps to Build, Test & Refine, and Benefit from OpenMind

Motivated by the leading idea to share information by and with the community for mutual benefit, OpenMind is a three stage endeavor: (1) identifying the challenge and building an infrastructure, (2) **contribution** of pioneers who support the project by generating a **critical mass** of content and providing constructive **feedback** for further refinement, and (3) releasing a powerful platform built by the community for the benefit of the community.

Let's Join Forces to Make this Vision our Research Reality

After completion of the OpenMind early development phase we are now looking forward upon the faith and constructive feedback of contributing pioneers and early adopters from the community.

Anticipated Stage 2 Beta Release:
August 8th 2020

Thanks for your interest.
We're keeping you updated &
looking forward to your contribution!

Henning M. Reimann, PhD, neuroscientist
Thomas Getgood, programmer & web-developer

Acknowledgements

OpenMind was born as an intellectual child of the MRathon, a hackathon for open science worldwide that was hosted in 2019 by the Polytechnique Montréal and the Open Source Imaging Initiative as a satellite event to the ISMRM. We thank the organizers for bringing the team behind OpenMind together and the participants for their support and invaluable feedback.