University of Amsterdam

NTNU
Norwegian University of Science and Technology

Hippocampal Connectomics Revisited: An Improved (Para)Hippocampal Connectome Database Bridging Diverse Anatomical Nomenclatures

NM van Strien[1], JJ Geisler[1], JMJ Murre[1], MP Witter[2], NLM Cappaert[1]

[1] UvA: University of Amsterdam, Amsterdam, The Netherlands
[2] NTNU: Norwegian University of Science and Technology, Trondheim, Norway

308.09

download

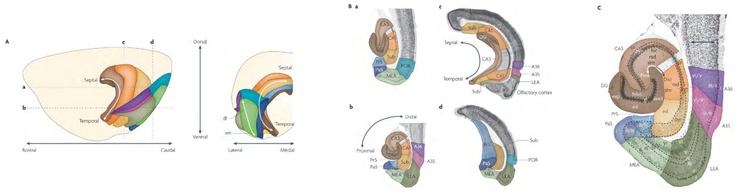
ok - photo

Key topics

- An improved connectome of the (para)hippocampal region
- Brain terminology is stored in author's original nomenclature
- Author's original nomenclature is standardized
- Database ready for multiple species and visualization techniques
- More meta-data available for searches

Introduction

1. The (para)hippocampal region is intricately connected.



2. Many attemps have been made to map brain connectivity.

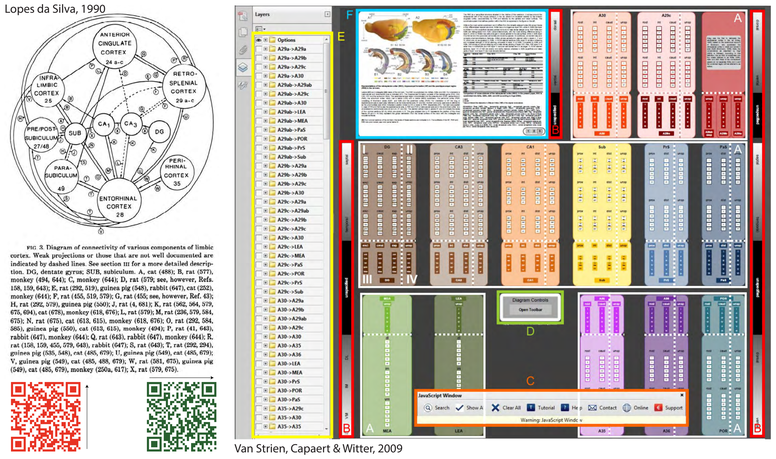
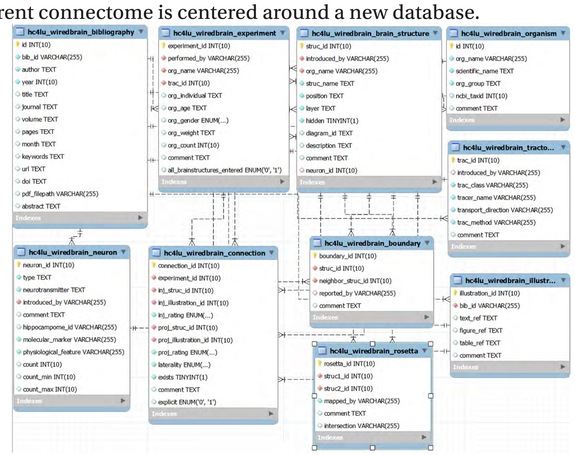


FIG. 3. Diagram of connectivity of various components of limbic cortex. Weak projections or those that are not well documented are indicated by dashed lines. See section III for a more detailed description. DG, dentate gyrus; SUB, subiculum. A, cat (486); B, rat (377), monkey (494, 644); C, monkey (644); D, rat (379; see, however, Refs. 158, 159, 643); E, rat (292, 519), guinea pig (648), rabbit (647), cat (252), monkey (644); F, rat (455, 519, 379); G, rat (455; see, however, Ref. 43); H, rat (292, 379), guinea pig (300); J, rat (4, 681); K, rat (562, 564, 379, 675, 676), cat (678), monkey (618, 676); L, rat (379); M, rat (226, 379, 584, 675); N, rat (675), cat (613, 615), monkey (618, 676); O, rat (292, 584, 585), guinea pig (550), cat (613, 615), monkey (694); P, rat (41, 643), rabbit (647), monkey (644); Q, rat (643), rabbit (647), monkey (644); R, rat (158, 159, 455, 579, 643), rabbit (647); S, rat (643); T, rat (292, 294), guinea pig (525, 548), cat (485, 679); U, guinea pig (549), cat (485, 679); V, guinea pig (549), cat (485, 488, 679); W, rat (581, 675), guinea pig (549), cat (485, 679), monkey (250a, 617); X, rat (379, 675).

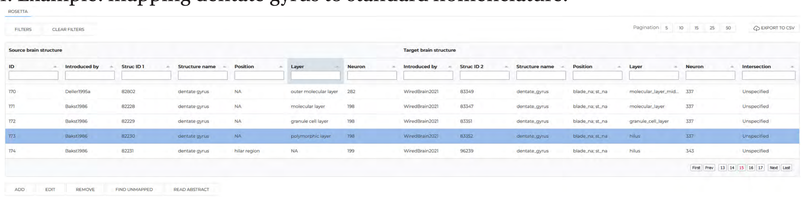
Van Strien, Capaert & Witter, 2009

3. Our current connectome is centered around a new database.

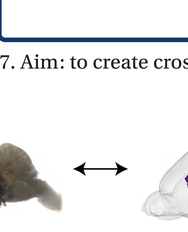


Original nomenclature to Standard nomenclature

4. Example: mapping dentate gyrus to standard nomenclature.



5. Example: mapping entorhinal subfields to standard nomenclature.

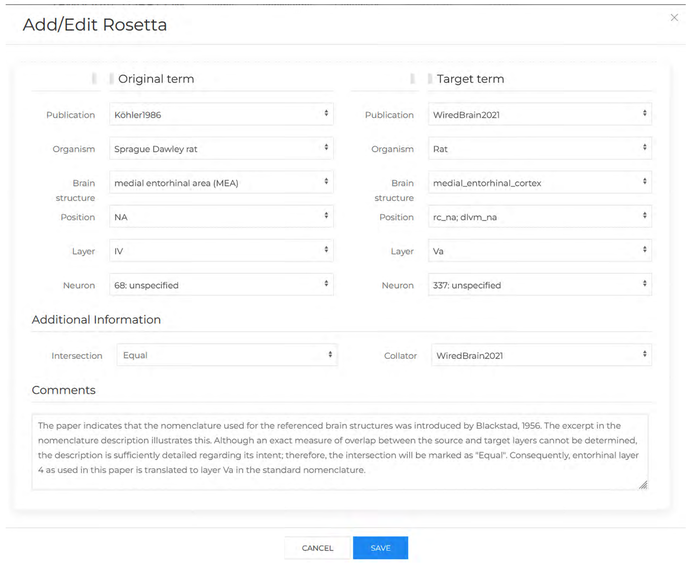


Unfolded maps of the entorhinal cortex after Insausti et al., 1997.

Abbreviations:
AE, amygdaloentorhinal transitional field
CE, caudal entorhinal field
DLE, dorsal lateral entorhinal field
DIE, dorsal intermediate entorhinal field
ME, medial entorhinal field
VIE, ventral intermediate entorhinal field

Figure after Burwell and Agster, 2008

6. Example: mapping Köhler MEA layer IV to standard nomenclature.



Comparative neuranatomy

7. Aim: to create cross-species mappings of nomenclatures.

Rat
original nomenclature

Rat
standard nomenclature

Non-human primate
standard nomenclature

Human
standard nomenclature

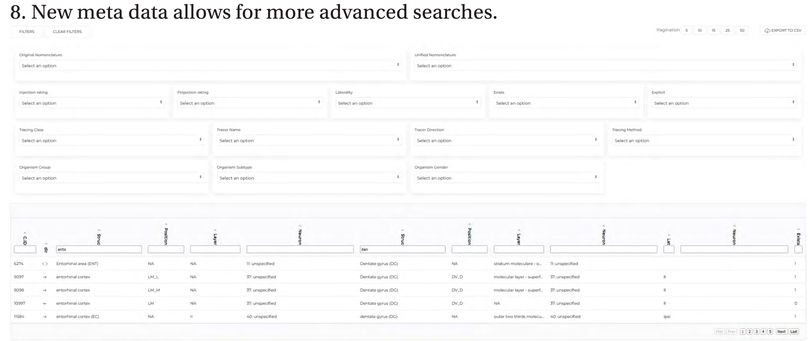
Take Home message

A connectome of the rat (para)hippocampal region exists: www.temporal-lobe.com.
A new, improved version will be released that includes:

1. Reversible nomenclature mappings.
2. Connections that were described to 'not exist' or inferred by the curators.
3. Separation of curator interpretation and claims made by authors.
4. Quotations of original results, so that each connection can be understood in context.
5. Additional meta-data for filtering connectome data, including connection ratings.

Expanded set of meta data

8. New meta data allows for more advanced searches.



Ratings

Injection/Origin Rating		Projection/Connection Rating
injection outside target layer / area OR injection too large	1	only stained fibers in the white matter are reported (likely passing fibers)
author claims that injection is restricted to one area, multiple layers involved, but does not show evidence or evidence is flawed/wrong	2	A single stained fiber does get scored, but gets a low rating because if this connection is a chance find. Evidence in a table with density / % termination: mean - sem <= 0
author claims that injection is restricted to one area, multiple layers involved, but evidence is unclear to collator, evidence consists of atlas image in which injections are indicated	3	author claims termination in layer II, without evidence or evidence is flawed/wrong or evidence in a table (with density / % termination: mean - sem > 0)
author claims that injection is restricted to one area, multiple layers involved, clear evidence with picture of slice with injections site or neurolucida drawings with injection site	4	author reports labeling in layer II, with clear evidence (i.e. picture of stained slice, neurolucida drawings), but these fibers could be passing or indicate termination.
well isolated injection in one area, only in single layer, with clear evidence (single neuron)	5	author reports termination (or projection) in layer II, with clear evidence (i.e. picture of stained slice, neurolucida drawings)

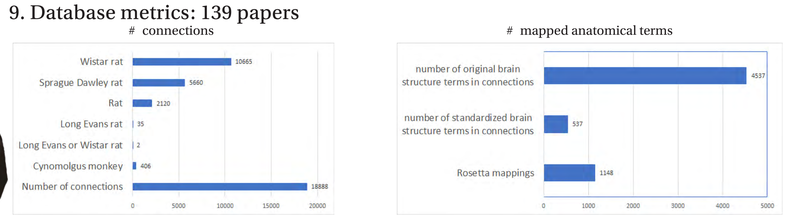
Connection exists / not exist/ not reported

There is an essential distinction between connections that are reported as non-existent and those that are simply not mentioned. For instance, if a study indicates, "Terminations are found in layers I, II, and III, but not in layers IV, V, and VI," the curator logs connections for layers I, II, and III and the absence of connections for layers IV, V, and VI. On the other hand, if the report only states, "Terminations are found in layers I, II, and III," there is no clarity about the presence or absence of connections in other layers. In such cases, the curator can only confirm connections for layers I, II, and III, leaving the rest undefined. This distinction underscores the significance of logging 'non-existing' connections. However, it's important to understand that labeling a connection as 'non-existing', is not an absolute confirmation of its absence.

Connection explicit / inferred

The language used to describe brain connections often lacks clarity. While some descriptions are unequivocally clear, often a curator must interpret the author's intention. This interpretation introduces the potential for curator bias and errors. To address this, we log for each connection if it was explicitly (unequivocally) identified in a study or inferred by the curators. This descriptor can be used to filter searches, for example to include only those connections that were explicitly identified. Furthermore, our website offers guidelines for authors to promote clearer descriptions of experimental brain connectivity results. You can find these recommendations at https://www.temporal-lobe.com/connectome/connection-reporting-guide or scan the QR code.

9. Database metrics: 139 papers



Acknowledgements:
This work was supported by a grant from the Netherlands Research Council: Opens Science Fund 203.001.058
Some connections were added to the database by students Daniel Camphuijsen, Inge Bieger, Nynke Boiten, Esmee vd Ent and project volunteer Dr. Julia Dawitz.