0 Pu

1 Ca

2 NAC

3 EXA

4 GPe

5 GPi

6 SNc

7 RN

8 SNr

9 PBP

10 VTA

11 VeP

12 HN

13 HTH

14 MN

15 STH

References for CIT atlas:

If you use the data from this collection please include the following persistent identifier in the text of your manuscript:

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🡺 PBP is “parabrachial pigmented nucleus” - this could be different than the parabrachial nucleus we are interested in for pain

A high-resolution probabilistic in vivo atlas of human subcortical brain nuclei

Wolfgang M. Pauli, Amanda N. Nili & J. Michael Tyszka

Scientific Data volume 5, Article number: 180063 (2018)

Ref for parabrachial nucleus

Michael C. Chiang, Anna Bowen Lindsey, A. Schier Domenico Tupone, Olivia Uddin, and Mary M. Heinricher

Parabrachial Complex: A Hub for Pain and Aversion

The Journal of Neuroscience, October 16, 2019 • 39(42):8225– 8230 • 8225

For LC from Eckert lab:

Keren, N., Lozar, C., Harris, K.C., Morgan, P., Eckert, M.A. (2009). In vivo mapping of the

human locus coeruleus. Neuroimage, 47(4): 1261-1267.

Cord segment positions:

from the German paper: (Lang J, Bartram CT. [Fila radicularia of the ventral and dorsal radices

of the human spinal cord]. Gegenbaurs Morphol Jahrb 1982;128(4):417-462)

Also look at Leijsne 2016 about whether or not the cord is actually segmented

Also used information from this paper, but the template is not yet available, so PBN locations were estimated:

Singh K, Indovina I, Augustinack JC, Nestor K, García-Gomar MG, Staab JP and

Bianciardi M (2020) Probabilistic Template of the Lateral Parabrachial Nucleus, Medial Parabrachial Nucleus, Vestibular Nuclei Complex, and Medullary Viscero-Sensory-Motor Nuclei Complex in Living Humans From 7 Tesla MRI.

Front. Neurosci. 13:1425. doi: 10.3389/fnins.2019.01425

Text for describing the templates and region maps:

The combination of region maps and anatomical reference images (templates) across brain and spinal cord regions (the entire CNS) is as described by De Leener et al. (1). An anatomical reference template was thus created by combining the PAM50 template of the SC, and the MNI152 template of the brainstem/brain. The resulting map was interpolated to 0.5 mm cubic voxels, and can be scaled to lower resolution as needed. For our purposes, and anatomical reference image of the cervical spinal cord and brainstem region (spanning where the two existing templates join) was also created. This was done by spatially normalizing fMRI data from 1440 fMRI data sets in 300 healthy participants to the combined template, and averaging the normalized images to create a single template.

Corresponding anatomical region-of-interest maps (0.5 mm isotropic resolution) were also defined across the entire CNS by combining probabilistic regions maps from multiple sources, and region maps based on anatomical atlases and published descriptions. Brain regions were identified primarily with the region maps provided in the CONN15e software package (2-4). Spinal cord gray matter and white matter maps were obtained from PAM50 template in The Spinal Cord Toolbox(5). In addition, the spinal cord was divided into spinal cord segments, with positions based on the anatomical study done by Lang and Bartram (6), and segments were divided into right/left and anterior/posterior quadrants. Brainstem regions not included in the CONN15e region map were added based on examples and anatomical descriptions (4,7-11), freely shared atlases as described by Pauli et al. (12) (<https://identifiers.org/neurovault.collection:3145>), Keren et al. (13), and Harvard atlases (refs). The resulting region maps are thus probabilistic, and indicate the likely location of anatomical regions of interest within each data set, after it has been spatially normalized.

For the purposes of this study, the brainstem and lower brain regions of interest include the thalamus, hypothalamus, periaqueductal gray (PAG), ventral tegmental area (VTA), nucleus raphe magnus (NRM), nucleus gigantocellularis (NGc), (the NRM and NGc are within the region identified as the rostral ventromedial medulla, RVM), locus coeruleus (LC), parabrachial nuclei (PBN, lateral and medial divisions), nucleus tractus solitarius (NTS), and dorsal reticular nucleus (DRt) of the medulla. This analysis also included the right dorsal region of the 6th cervical spinal cord segment (C6 RD), corresponding to the region of the hand that was stimulated. Potential uncertainty in the region definitions, or individual variations, are addressed by clustering the data based on the functional MRI data, as described below.

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