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Cytoarchitectonic Maps of the Human Metathalamus in 3D space

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Introduction
The human metathalamus plays an important role in processing visual and auditory information. Understanding its layers and subdivisions is important to gain insights in its function as a subcortical relay station and its involvement in various pathologies. Yet, detailed histological references of the microanatomy in 3D-space are still missing. Here, we aim at providing whole brain cytoarchitectonic maps of the medial geniculate body (MGB) and its subdivisions in the BigBrain –a high-resolution 3D-reconstructed histological model of the human brain1, as well as probabilistic cytoarchitectonic maps of the lateral geniculate body (LGB) and MGB in ten postmortem brains.

Methods
We identified and delineated three MGB subdivisions (ventral MGB - MGBv, medial MGB - MGBm, dorsal MGB - MGBd) based on cytoarchitectonic criteria on every 5th section of the BigBrain dataset. A deep-learning based tool2 was subsequently applied to map the MGB and its three subdivisions on the remaining sections of the dataset. The maps were subsequently 3D-reconstructed. The LGB and MGB were furthermore identified in nine additional postmortem brains and volumes, as well as probabilistic cytoarchitectonic maps in the MNI "Colin27"and MNI ICBM152 reference spaces were calculated.

Results
The deep-learning based tool was able to identify delineations of the three MGB subdivisions on 132 sections of the left and 165 sections of the right hemisphere in the BigBrain. Resulting 3D-reconstructions disclose the shape and extent of the MGB and its subdivisions at cellular precision (Fig. 1.; https://interactive-viewer.apps.hbp.eu/). A volumetric analysis of the LGB and MGB in the ten postmortem brains did not reveal significant effects of gender or hemisphere. The resulting probabilistic cytoarchitectonic maps showed an overall low interindividual variability in topography and extent (Fig 2.).

Conclusions
The probabilistic cytoarchitectonic maps are part of the integrative atlas framework of the Julich-Brain4 atlas. They can be linked to other aspects of human brain organization and used as an anatomical reference for diagnostic, prognostic and therapeutic neuroimaging studies of healthy brains and patients. In addition to previously generated maps of the LGB3, the high-resolution MGB BigBrain maps provide a basis for data integration, brain modelling and simulation to bridge the larger scale involvement of thalamocortical and local subcortical circuits.

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