OP-063 [Bee Biology]

The Development of Brain Structure in Worker Honey Bees: A Micro-CT Study of Neuropil Volume Dynamics

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Understanding brain plasticity in honey bees is crucial due to their complex social behavior and division of labor. Previous studies have shown that neuropil volume increases between nurse bees and foragers, and these changes are not only caused by the increased external stimulation from foraging. However, previous research primarily focused on comparing brain volumes between nurse bees and foragers, leaving a gap in our understanding of how brain volume changes throughout adulthood. Moreover, most studies concentrated on the mushroom body, with a lack of data on volume changes in other brain regions of honey bees.

To establish the growth pattern of brain volume, we used micro-computed tomography to measure the neuropil volume of various brain regions in worker honey bees across different ages. We also reared newly emerged worker bees without older bees, which initiated foraging precociously at seven to eight days old. We measured the neuropil volumes of these precocious foragers and compared these measurements with those of same-aged controls.

Our results revealed changes in the volume of various brain regions during the nurse bee stage, with volumes increasing and decreasing at specific age intervals. Three-day-old precocious workers exhibited brain volume differences compared to three-day-old controls. These findings demonstrate the substantial plasticity of brain volume in worker honey bees within a short period, highlighting the continuous changes in brain structure during the nurse bee stage. This study provides a more complete picture of the growth pattern of brain volume in worker honey bees. These findings contribute to our understanding of the mechanisms of division of labor and task transitions in these social insects.

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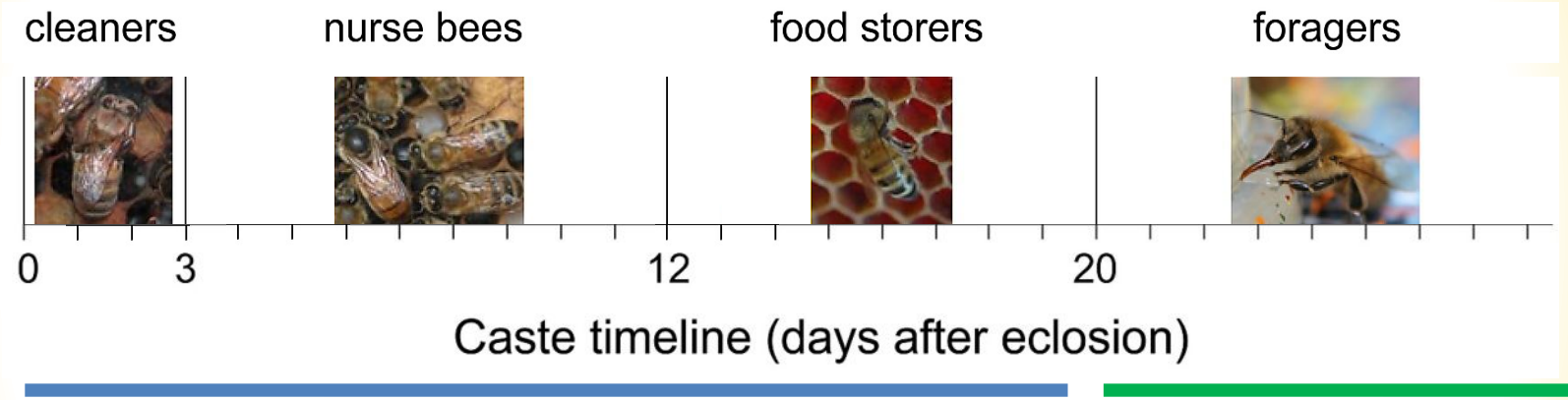
Age polyethism in honey bee

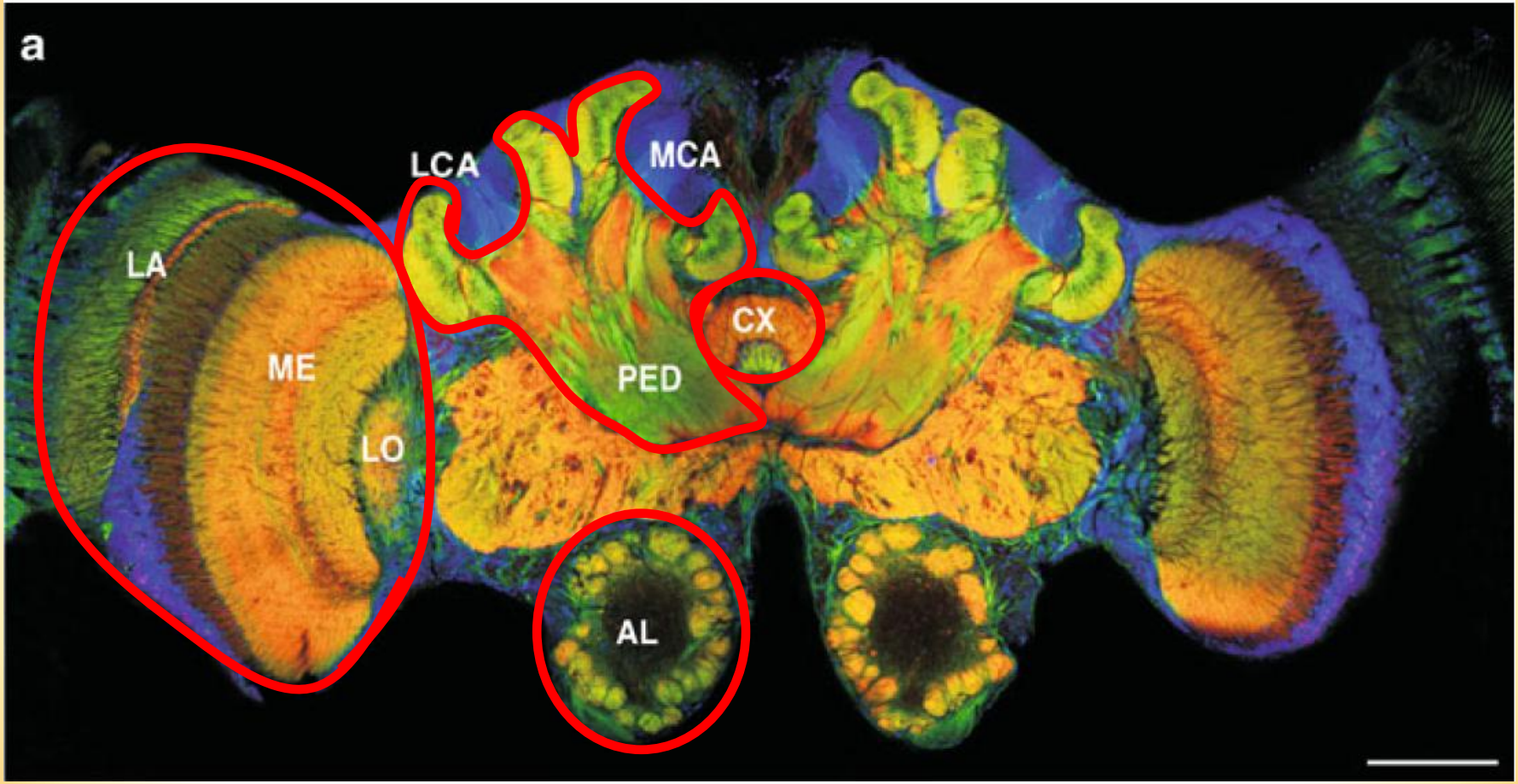


Inside the hive **Outside the hive**

Winston ML. 1987

Will the worker's brain structure change?

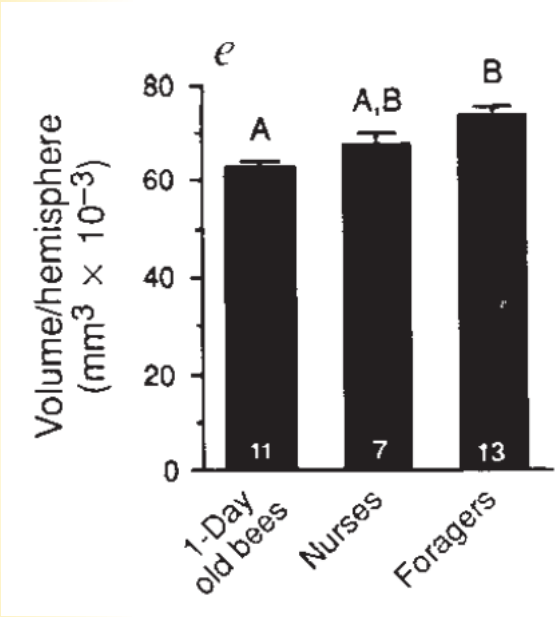
Section of honey bee's brain

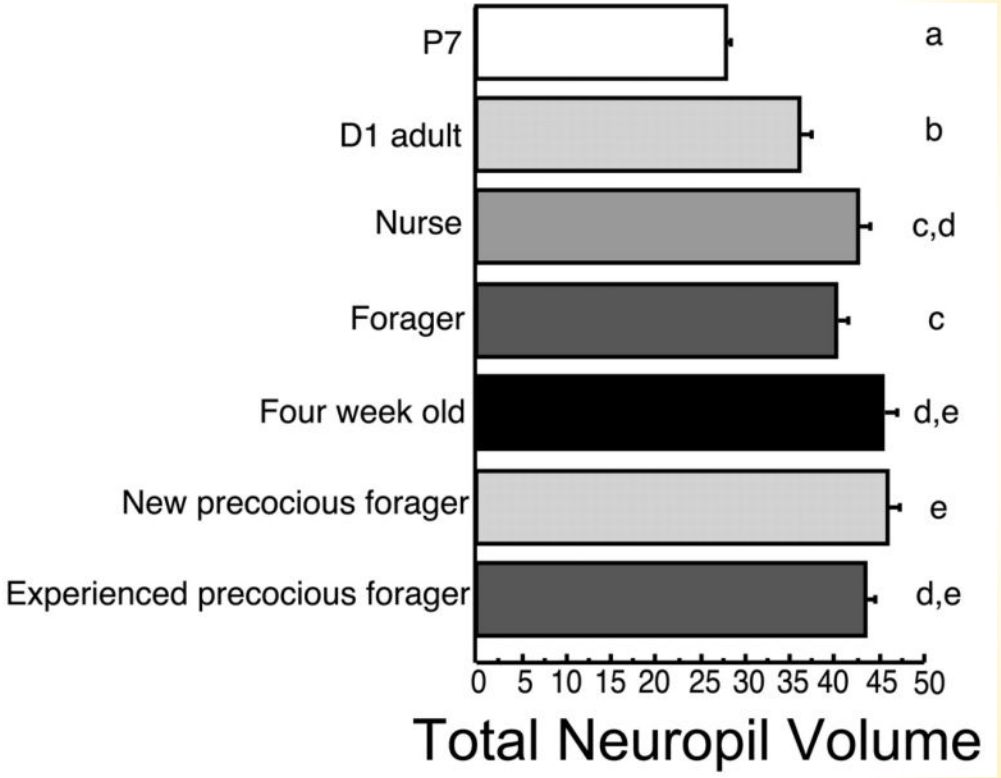


LA: laminar, ME: medulla, LO: lobula, AL: antenna lobe, CX: central complex,
PED: pedunculus, LCA: lateral calyx, MCA: medial calyx

Rössler W. and Groh C. 2012

Change in mushroom body





Withers GS, Fahrbach SE, Robinson GE. 1993

Farris SM, Robinson GE, FahrbachSE. 2001

Lack of research

- Volume change in other parts of the brain

  Optic lobe, antenna lobe, central complex

- Time series

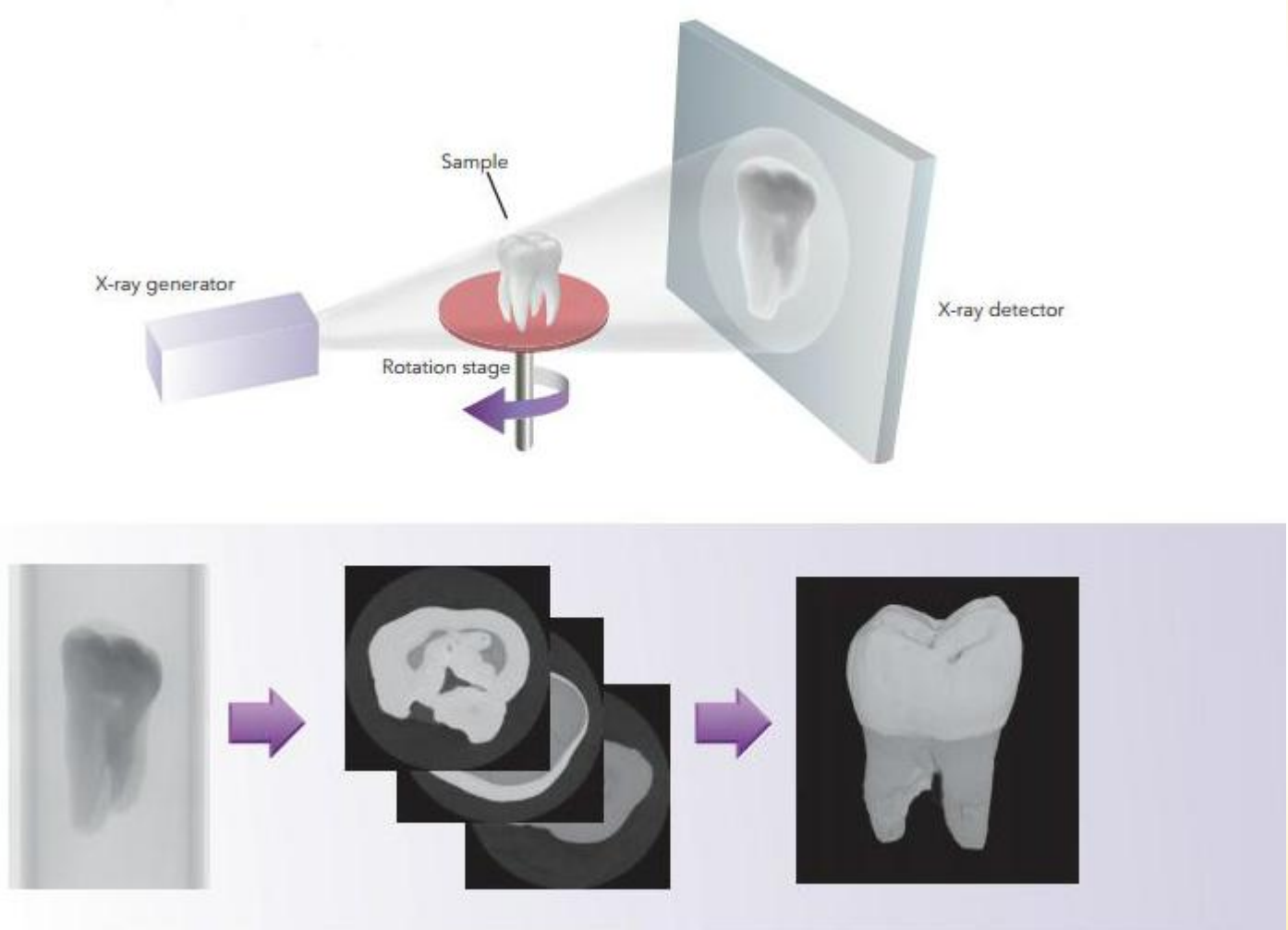
  Higher temporal resolution

Reveal the structure changes of honey bee worker's brain

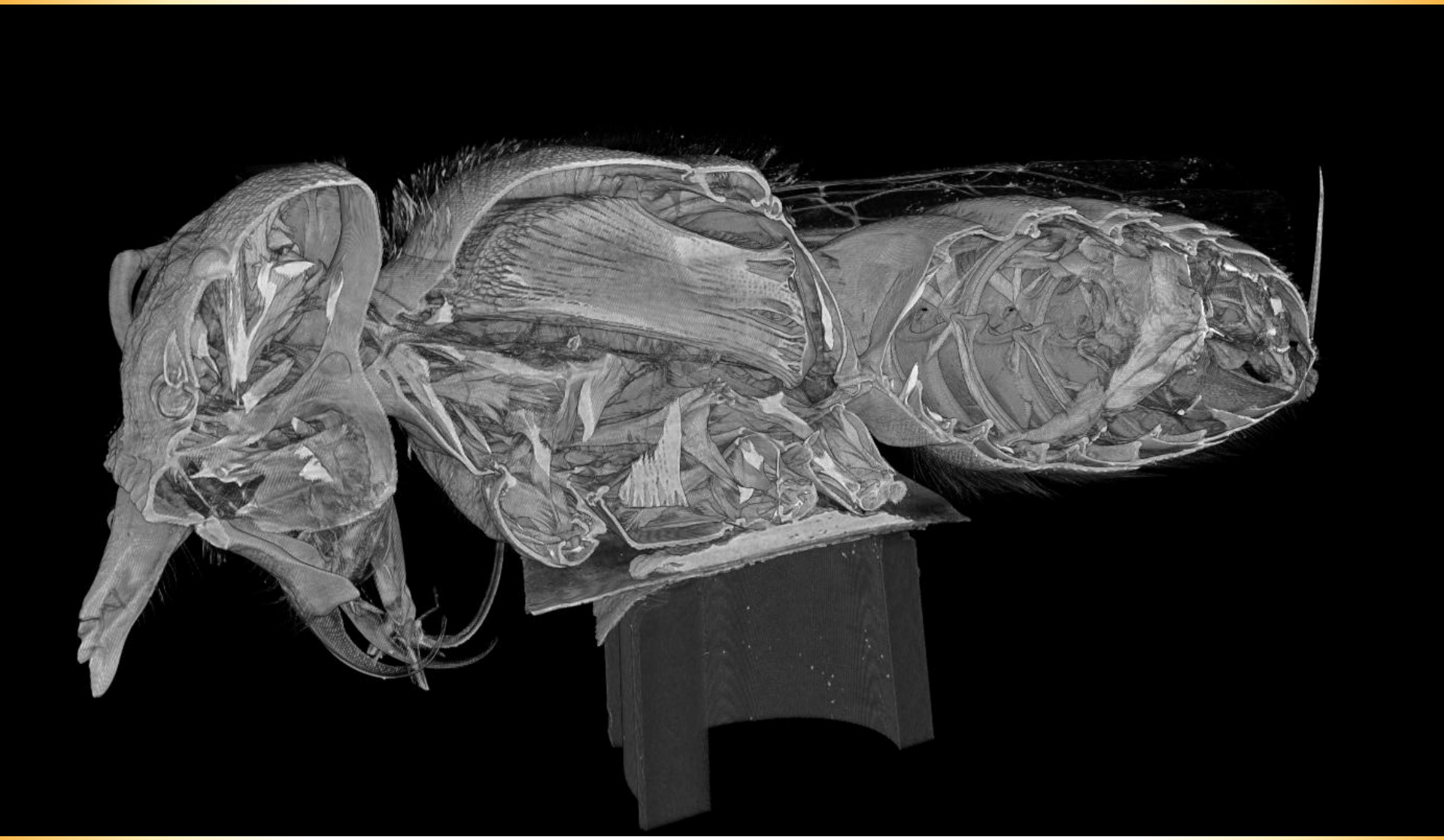
→Micro-computed tomography (micro-CT)
(in Industrial Technology Research Institute)

工業技術研究院
Industrial Technology
Research Institute

Micro-CT

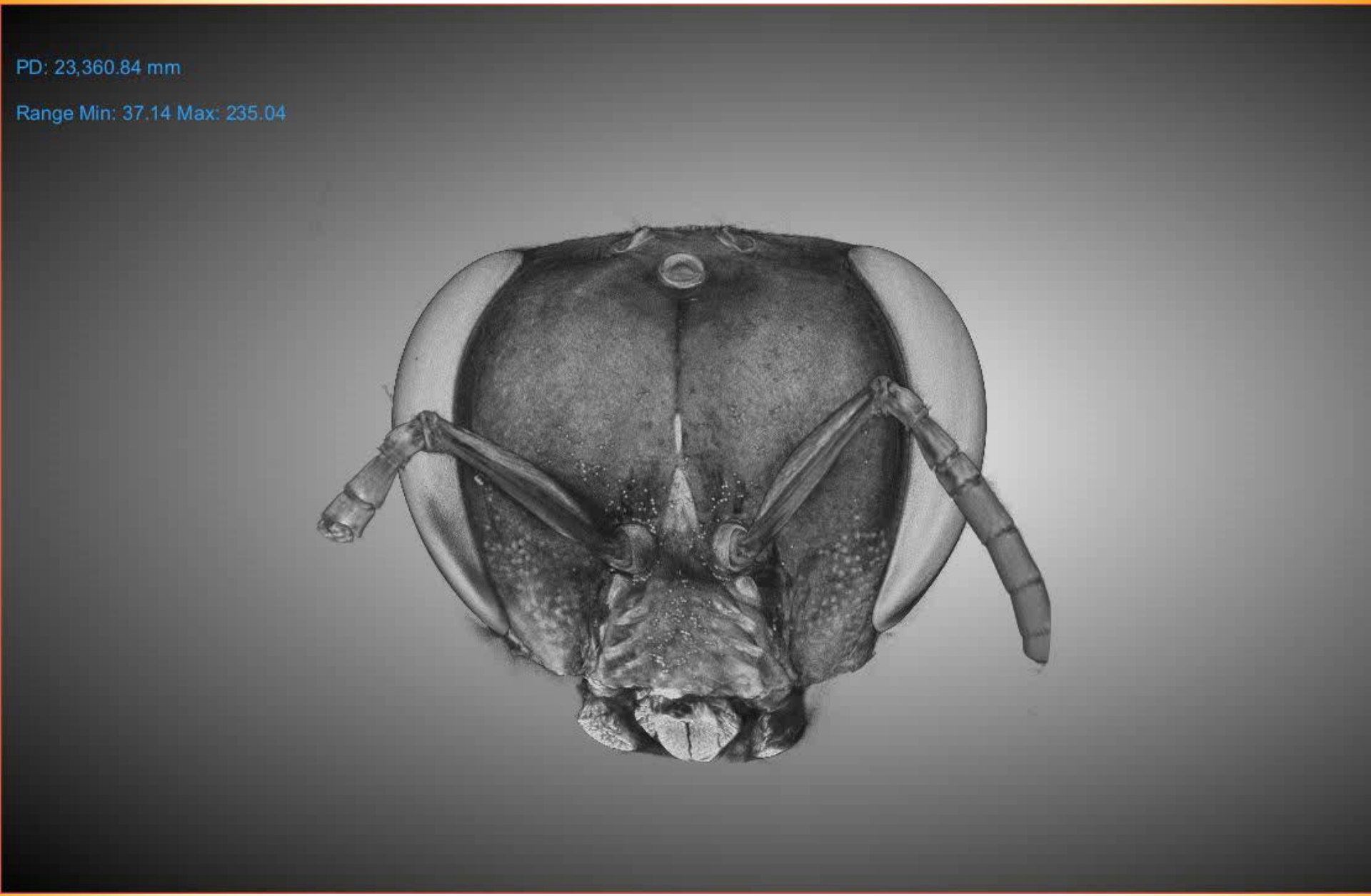


https://www.microphotonics.com/what-is-micro-ct-an-introduction/



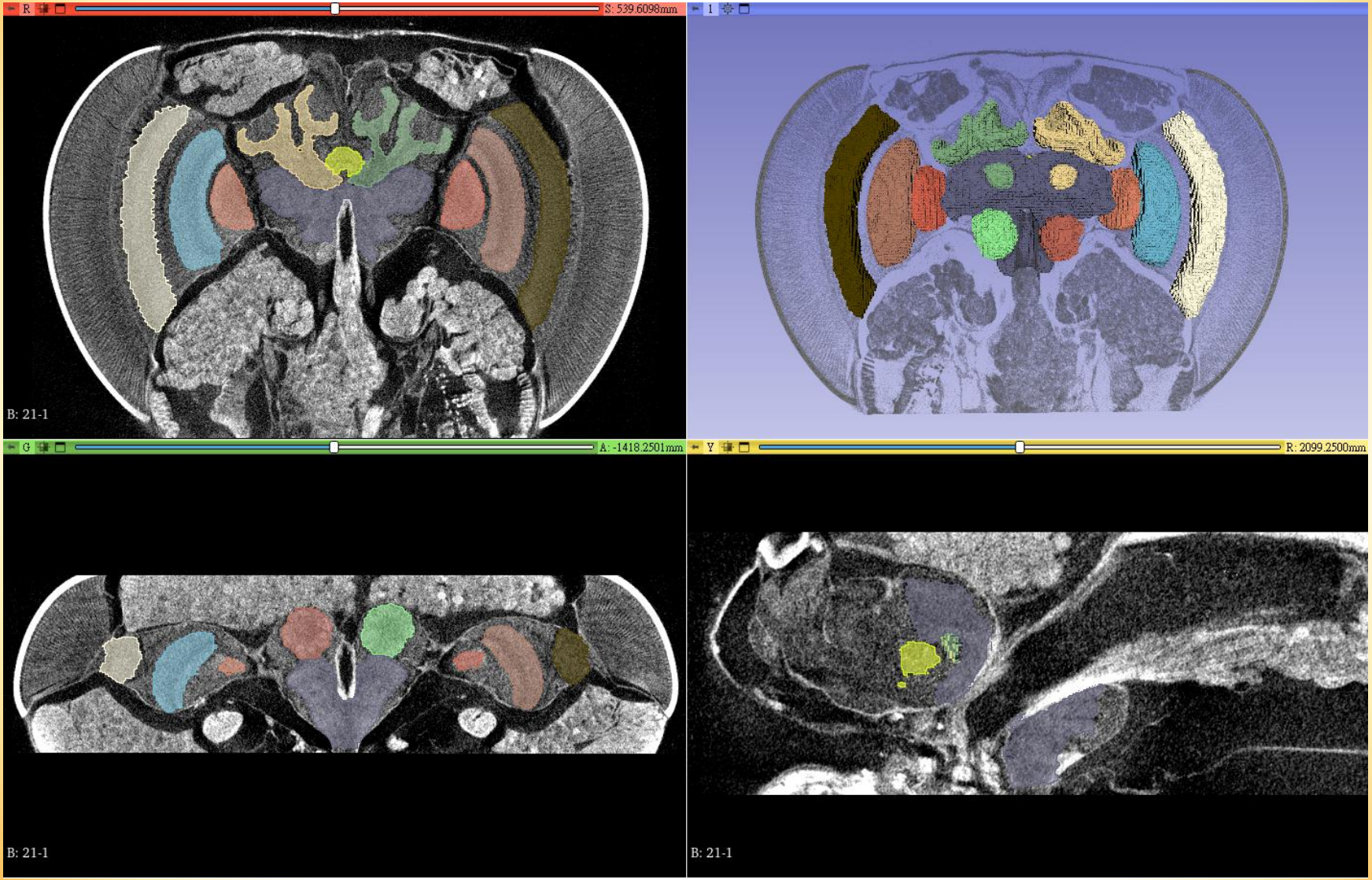
My new protocol can solve the shrinking problem and generate a better image.

Shang-Jui Fu, En-Cheng Yang,
Neuroplasticity in honey bee brains: An enhanced micro-computed tomography protocol for precise mushroom body volume measurement,
Journal of Neuroscience Methods, Volume 403, 2024,



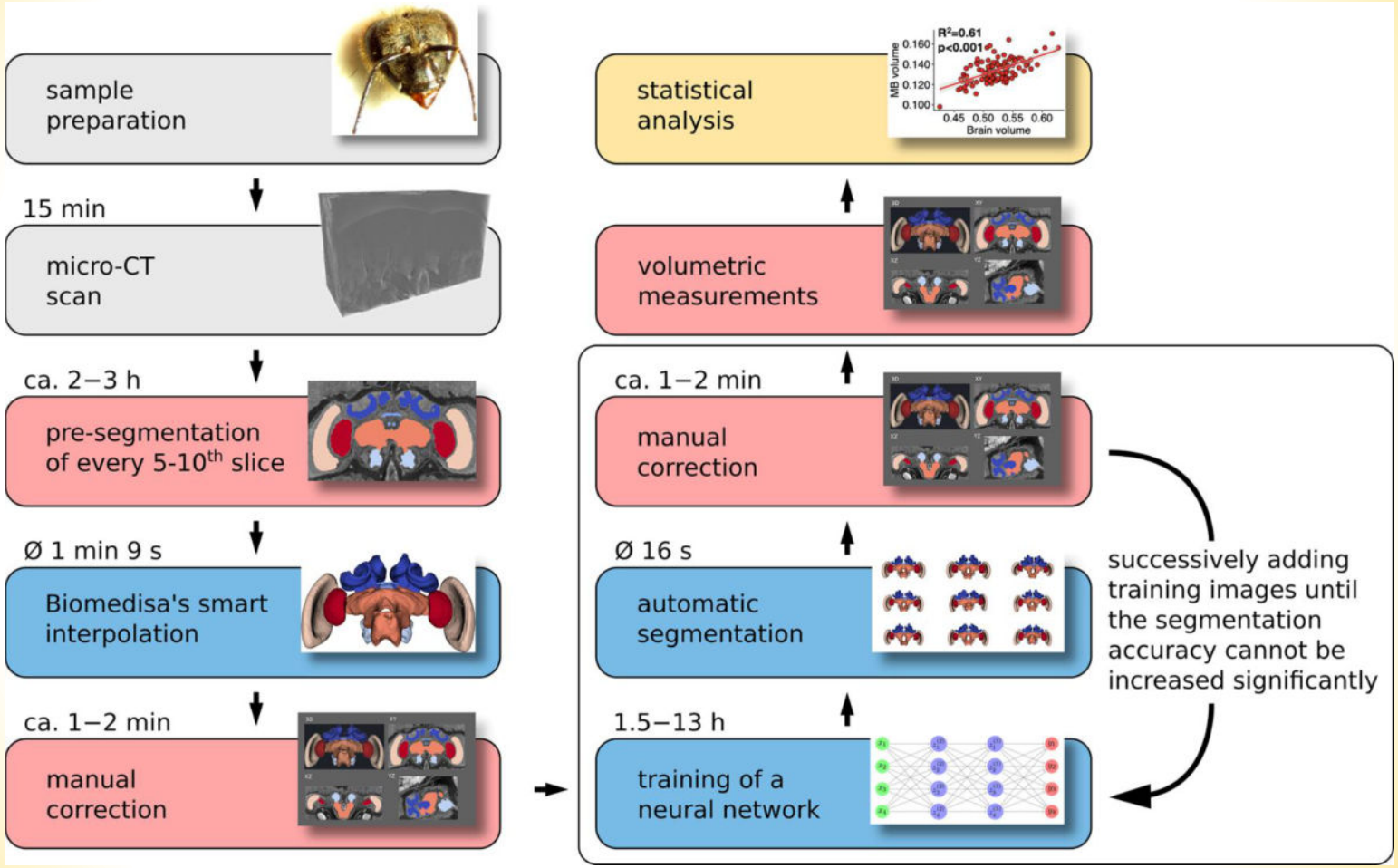
Software: Dragonfly, Object Research Systems

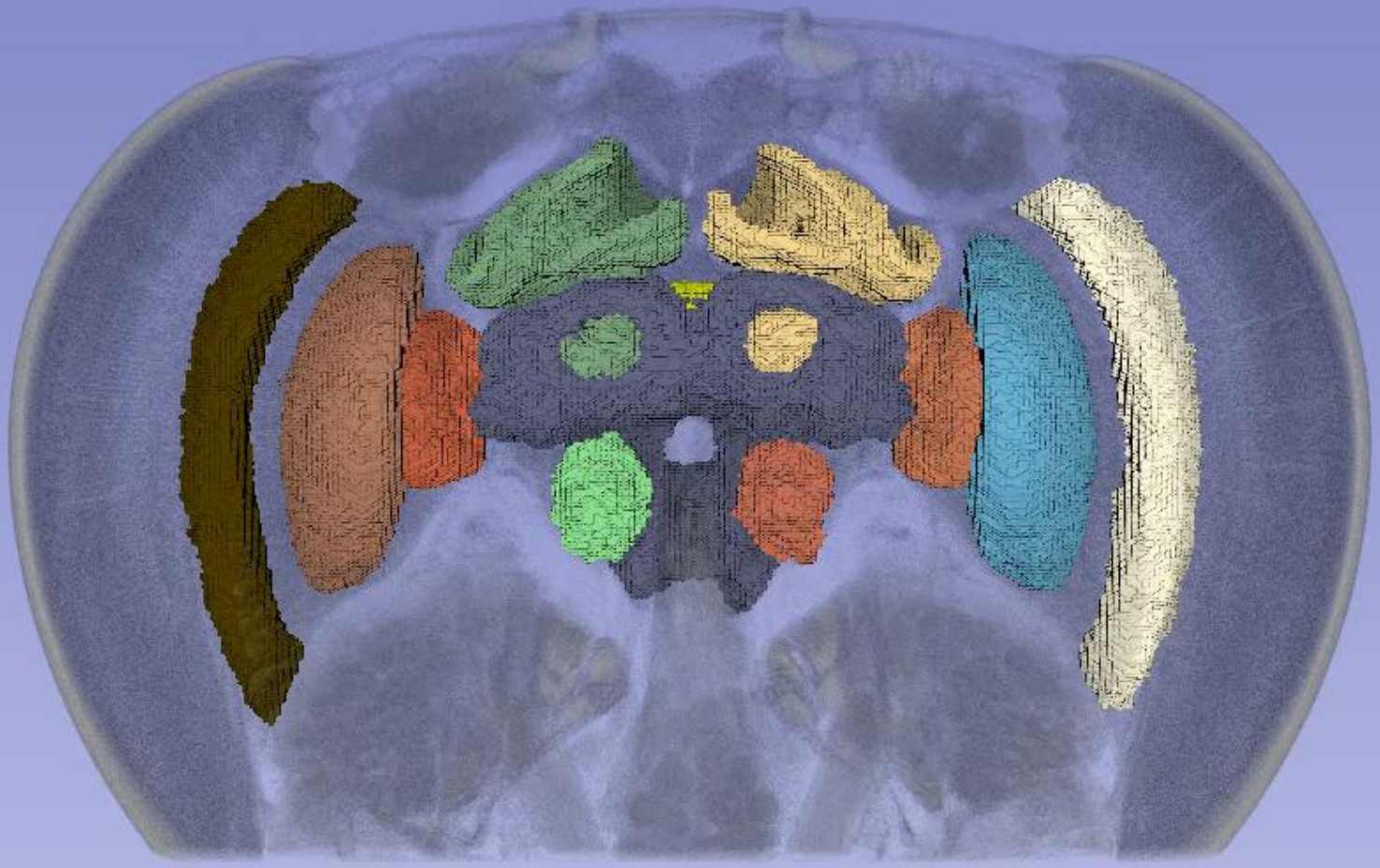
Segmentation



Software: 3D Slicer

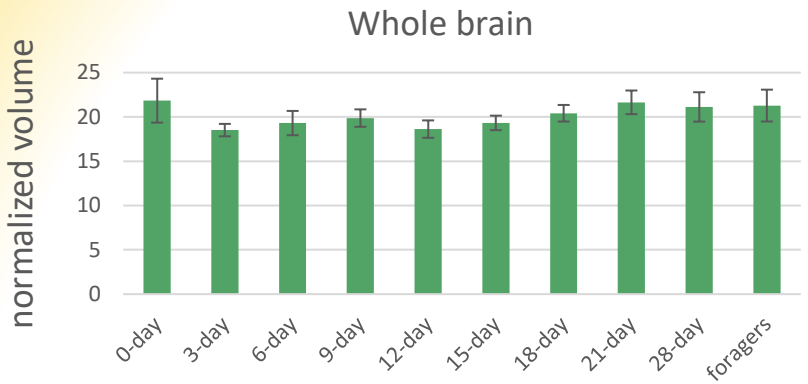
AI Segmentation

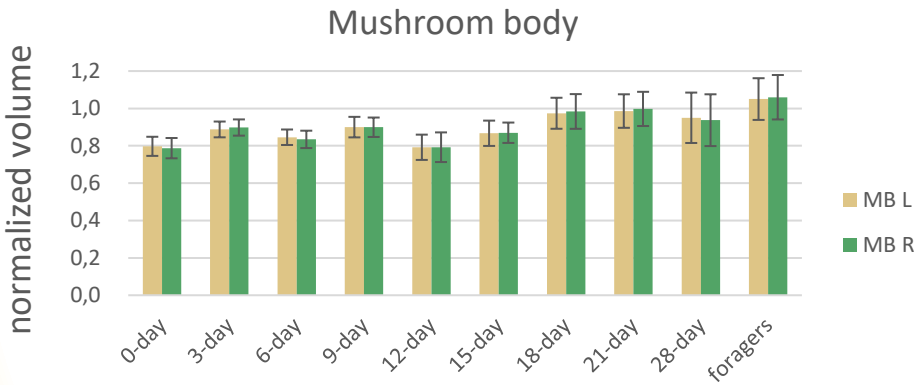


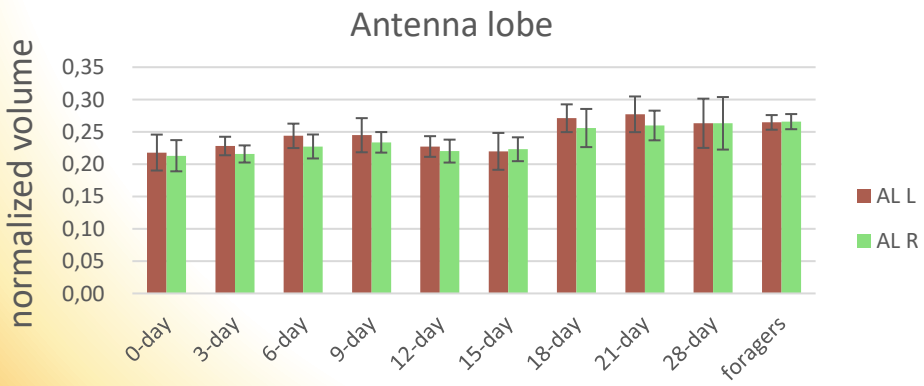


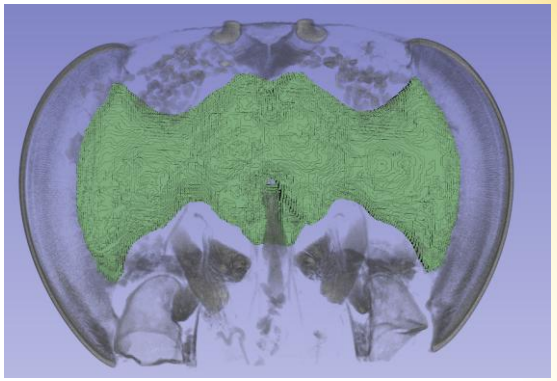
Software: 3D Slicer

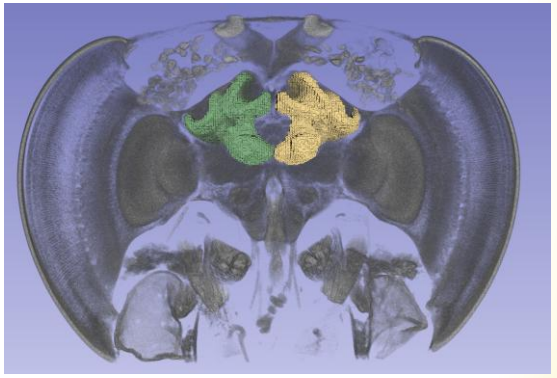
Brain volume

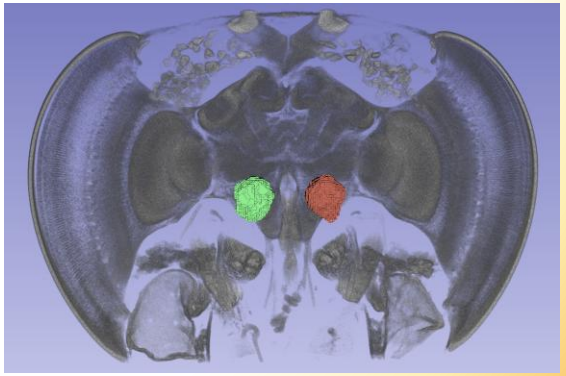




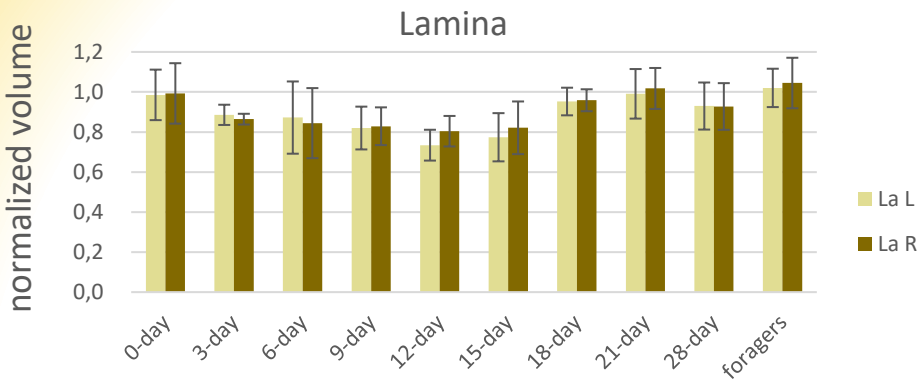


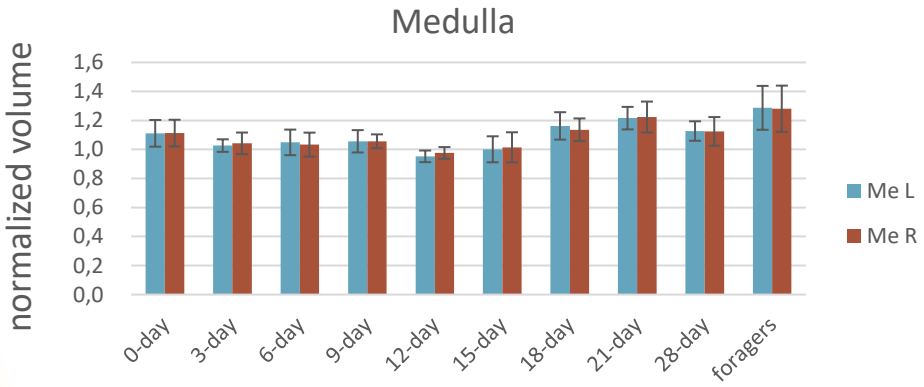


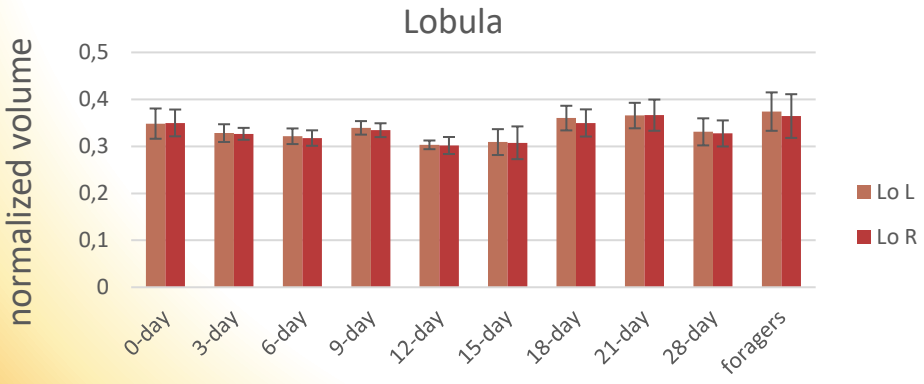


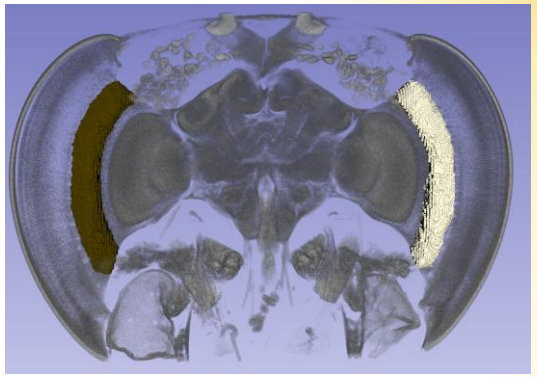


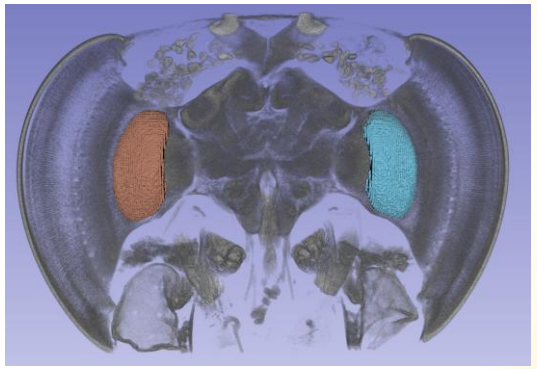
Brain volume

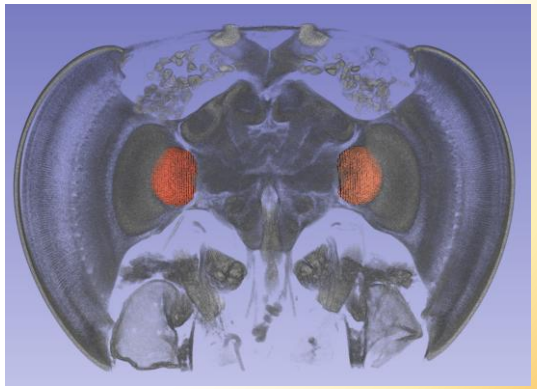












Thank you for listing