

A novel 11.7T ultra-high field dmri connectivity atlas of the japanese quail

Raïssa Yebga Hot, Marine Siwiaszczyk, J. Beaujoin, D. A. Barrière, I. Uszynski, Scott Love, Ludovic Calandreau, B. Mulot, Elodie Chaillou, C. Poupon

▶ To cite this version:

Raïssa Yebga Hot, Marine Siwiaszczyk, J. Beaujoin, D. A. Barrière, I. Uszynski, et al.. A novel 11.7T ultra-high field dmri connectivity atlas of the japanese quail. 25th Annual Meeting of the Organization for Human Brain Mapping, Jun 2019, Rome, Italy. , 2019. hal-02786121

HAL Id: hal-02786121 https://hal.inrae.fr/hal-02786121

Submitted on 4 Jun2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



#Th749 : A novel 11.7T ultra-high field diffusion MRI structural connectivity atlas of the Japanese quail

R. Yebga Hot^{1,2,3}, M. Siwiaszczyk⁴, J. Beaujoin^{1,3}, D. A. Barrière^{1,3} I. Uszynski¹, S. Love⁴, L. Calendreau⁴, B. Mulot⁵, E. Chaillou⁴, C. Poupon^{1,2,3}

¹CEA/Joliot/NeuroSpin/UNIRS, Gif-sur-Yvette, France; ²Université Paris-Saclay, Orsay, France; ³FLI/Noeud Paris-Sud, Orsay, Nouzilly, France; ⁴INRA CNRS IFCE Université François Rabelais Tours, Nouzilly, France; ⁵Beauval Nature (ZooParc de Beauval), Saint-Aignan, France



The Japanese quail (Coturnix japonica)

This little nidifugous bird presents a quantifiable response to fear : tonic immobility^[1]. This behavioral characteristic leads to two breeding lines of quails :

- The short time immobility (STI)
- The long time immobility (LTI)

A Japanese quail showing tonic immobility

Research hypothesis: The two lines do not show the same cerebral organization, and more specifically for

Material and methods

The cohort : 21 male and sexually mature Japanese quails including 11 LTI and 10 STI scanned post mortem **MRI system :** Preclinical Bruker 11.7T MRI scanner (G_{max}=780mT/m) **Protocol scan :** 16 hours of acquisition per sample including:

- Anatomical MRI: 2D T₂-weighted spin echo, 150 μ m, TE/TR=16ms/9s
- Diffusion MRI: 3D segmented EPI using PGSE, 75 directions, 200µm, TE/TR=23.88ms/250ms, 18 segments, *b*=4500s/mm²

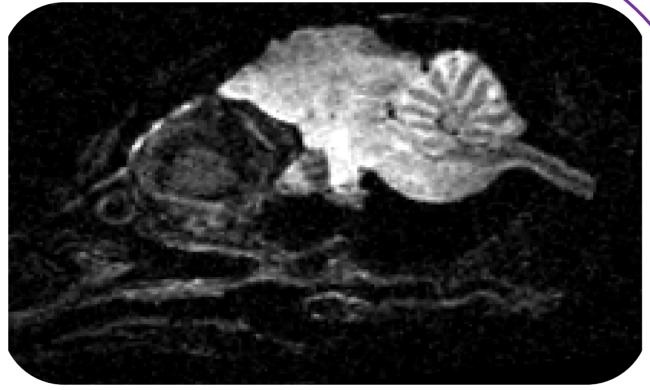
Post-processing :

- No preprocessing required (high SNR level and very few artifacts)
- Definition of a template space using the subject that is the closest to the others as the reference (affine registrations and a scaling criterion)

the emotional fear circuit.

Goal: Establishing a structural connectivity atlas of the Japanese quail using diffusion magnetic resonance imaging (dMRI) to compare lineages.



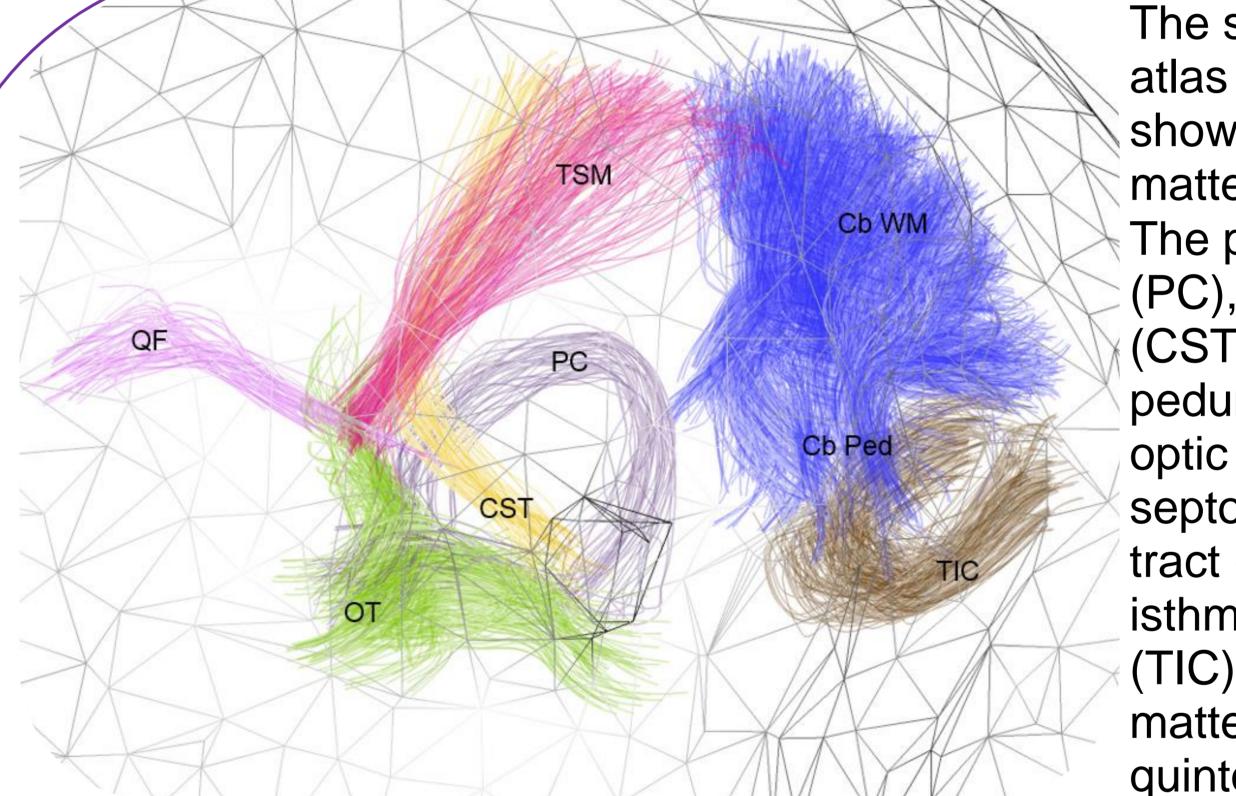


Sample before and after plucking for scanning

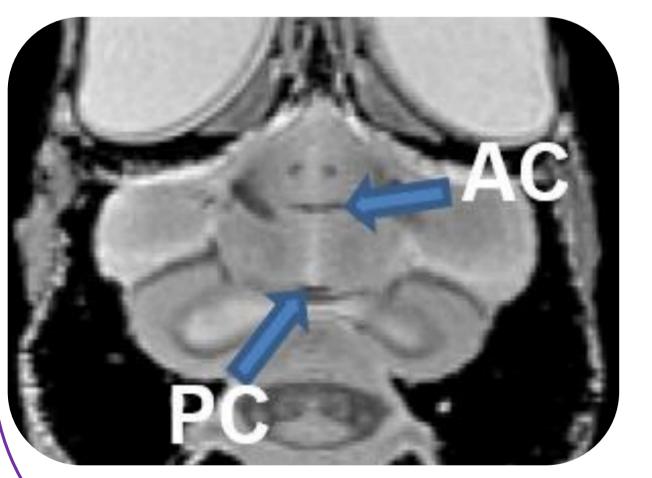
200µm diffusion-weighted MRI

From sample preparation to anatomical and diffusion data at 11.7T

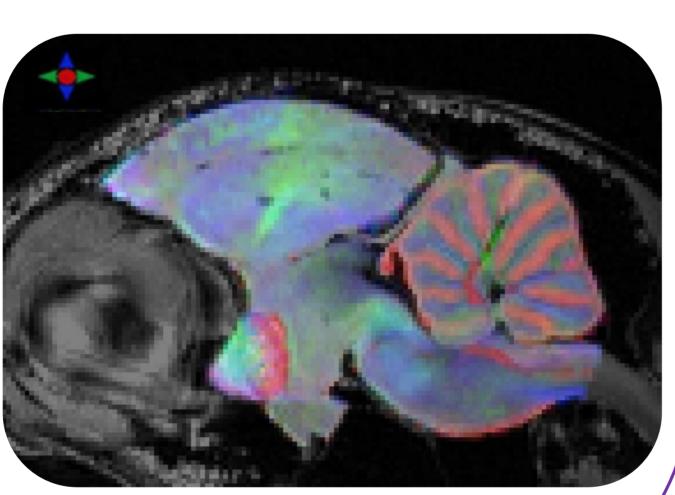
- Reorientation of the scans in AC-PC frame (anterior and posterior commissures)
- Manual segmentation of the brain masks
- Local modeling of the diffusion process with DTI and analytical QBI^[2] (SH=8; λ=0.006)
- Streamline regularized deterministic tractography in Connectomist^[3]
- Fiber clustering at the individual and population scales^[4]
- Labeling of the inter-subject centroids to create an atlas



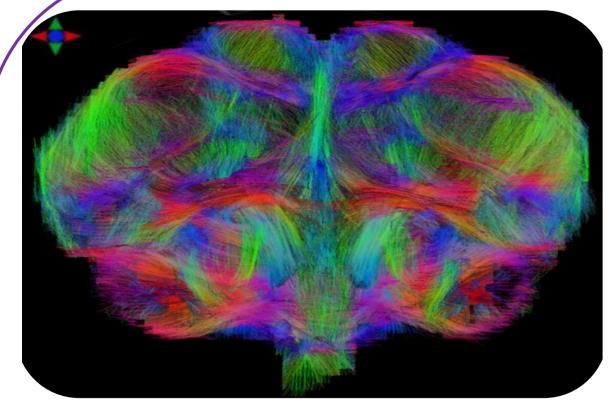
The structural connectivity atlas of the Japanese quail showing 8 major white matter bundles: The posterior commissure (PC), the corticospinal tract (CST), the cerebellar peduncles (Cb Ped), the



150µm anatomical MRI



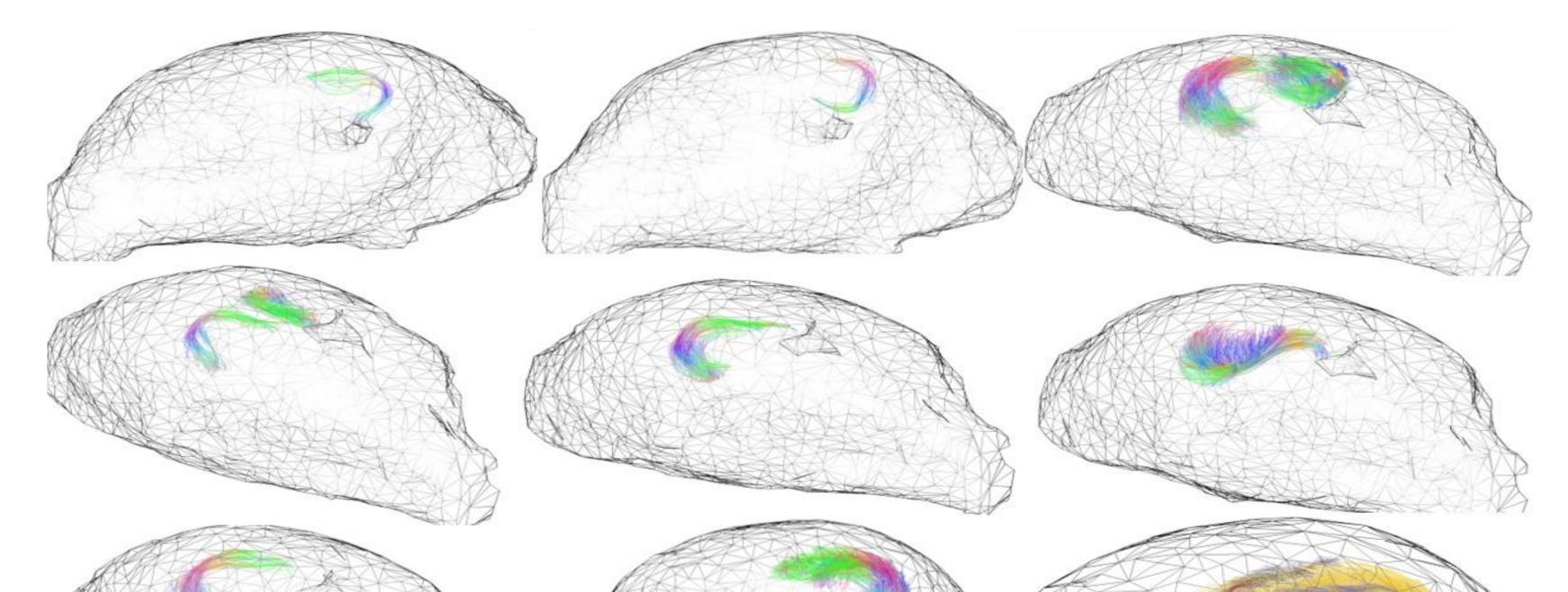
RGB diffusion direction map

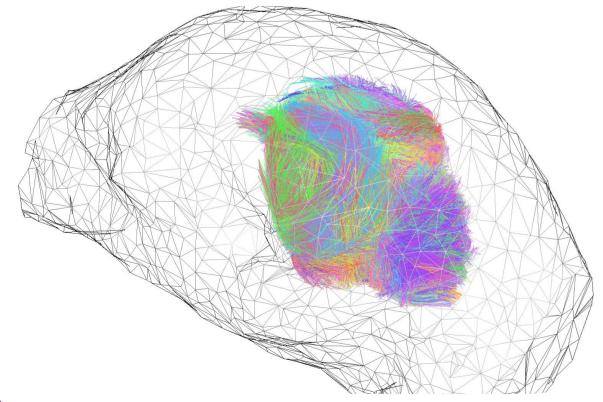


Intra-subject fiber clustering

optic tract (OT), the septopallio-mesenphalic tract (TSM), the isthmocerebellaris tract (TIC), the cerebellum white matter (Cb WM), and the quintofrontal tract (QF).

The structural connectivity atlas of the Japanese quail and the connections of its emotional fear circuit





Connectogram

From connectograms to inter-subject fiber clustering

223 clusters found

Inter-subject fiber clustering

The connections of the emotional fear circuit of the Japanese quail. Two structures specifically involved: the arcopallium and the nucleus taenia of amygdala (TnA).^[5]

Prospects

- Methodological optimization (diffeomorphic registration)
- Combining this atlas with a 3D anatomical atlas of the Japanese quail to understand how its neuroanatomical structures communicate

[1] Mills and Faure, 1991 [2] Tuch, 2004 [3] Perrin et al., 2005

References

[4] Guevara et al., 2011 [5] Saint-Dizier, 2008



This work received funding from the Centre-Val de Loire regional council (Neuro2Co, France) and from the European Union's Horizon 2020 Framework Program for Research and Innovation (Grant Agreement No 720270, Human Brain Project SGA2)

Contact : raissa.yegbahot@cea.fr