

10 May, 2007

Crows are smart!
**Research group at Keio University succeeds in
drawing up the world's first stereotaxic atlas of a crow**

It has been known that the brain of a crow weighs 10-13g, very large compared to its total body weight. However, the details, such as which part of the brain is largely developed, were not clear. Prof. Shigeru Watanabe and Associate Prof. Eiichi Izawa of the Faculty of Letters and their group became the first in the world to succeed in drawing up a stereotaxic atlas of a crow. Recent observations had shown that crows have intelligence comparable to primates and have skills of tool-making and deceiving others. Prof. Watanabe and Associate Prof. Izawa clarified the total picture of the crow brain in detail to prove these observations, and the research can be applied in neuroscientific experiments in the future. These findings can be a breakthrough to finding out the brain evolution of animals including human beings.

1. About the stereotaxic atlas

The stereotaxic atlas is indispensable for studies of the brain. This is similar to a 3-dimensional map of a cross-section of the brain of fixed coordinates. By using this method, it is possible to identify the exact placements inside the brain. This stereotaxic atlas of the jungle crow will be released on http://www.cirm.keio.ac.jp/db/bird_brain from 14 May, and will appear in "Integration of comparative neuroanatomy and comparative cognition" (Keio Univ. Press) to be published in the near future.

2. Characteristics of the crow brain

The crow is known to have a large brain compared to its body weight, and to have outstanding cognitive abilities (see [encephalo-index] on page 2). The stereotaxic atlas of the crow shows that brain areas called 'pallium' corresponding to the mammalian cortex, which controls thinking, learning and feeling, makes up a large portion of the brain, and within the 'pallium', the dorsal part which is related to intellectual activities, is large and well developed. This area is thought to be relevant to the association area (where multiple information such as visual or auditory signals are integrated) of the cerebral cortex in mammal brains including humans, and enables the crow to process complicated information. Crows are known to be smart, and the new completion of the stereotaxic atlas of the crow proved this.

3. Methods for drawing up the stereotaxic atlas

The research started with developing a stereotaxic holder to keep the crow brain in a fixed position. Stereotaxic holders for mice/rats and pigeons are commercially available, but for crows, it had to be custom-made. The brain was frozen under -20 and sliced into thin plates. The plates were then stained with cresyl violet for Nissle substance and luxol fast blue for myelinated fibers. The plates were examined under a microscope to separate the nerve cells according to density. At the same time, imaging of the plates were done to create an atlas and to name each group of nerve cells. The same process was repeated for all the plates of the crow brain from the front to the back, sliced in the thickness of 1mm. The atlas was completed by combining these data.

This research is part of the 21st Century COE Program Keio University Graduate School Toward an Integrated Methodology for the Study of the Mind. The Center of Excellence was selected by the 21st Century COE (Center of Excellence) Program of the Ministry of Education, Culture, Sports, Science and Technology toward an integrated methodology for the study of the mind. The newest findings in neuroscience, behavioral genetics are combined with philosophy, linguistics, information science and representational theories.

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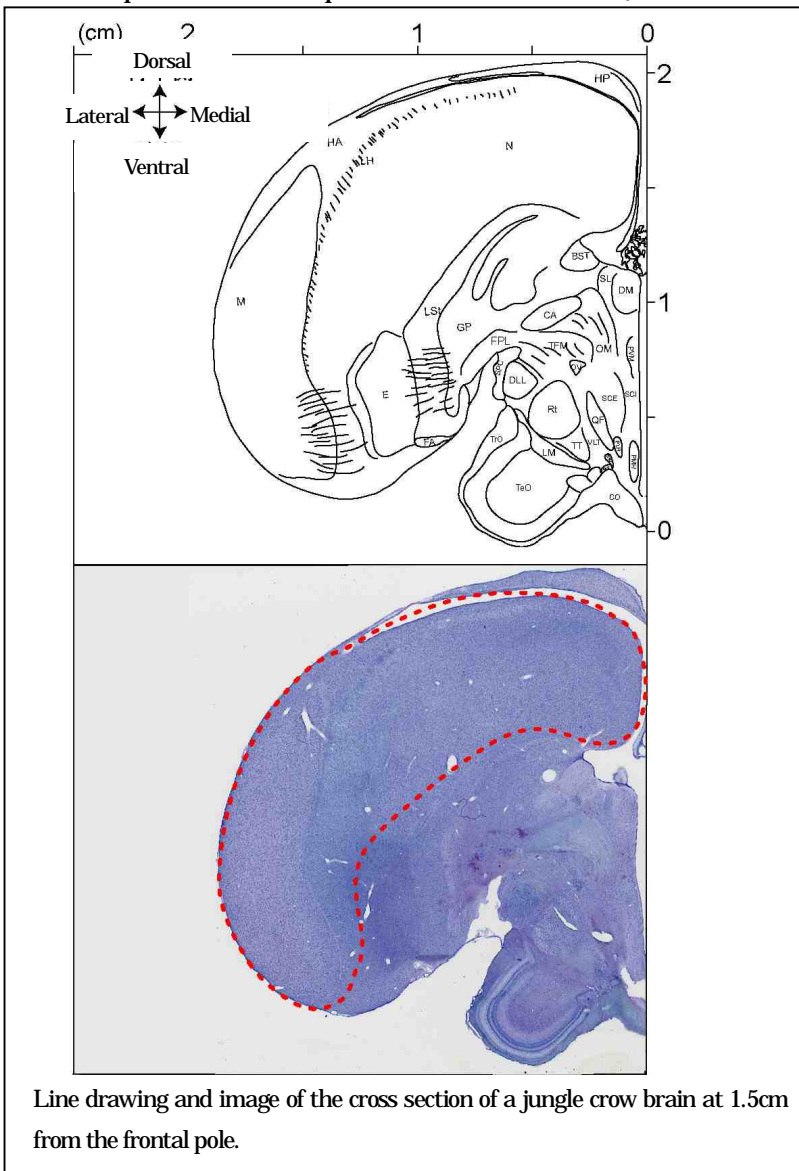
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【encephalo-index】

This index is used to indicate the degree of brain development based on the comparison between actual brain weight and predicted value from body weight. A larger value indicates higher development of the brain. Note that values could deviate depending on the calculating formula and data samples.

Type of animal	index
human being	10.0
chimpanzee	4.3
crow	2.1
monkey	2.0
mouse	0.6
pigeon	0.4
chicken	0.2

【An example of stereotaxic plates of the crow brain】 (The dotted area of the photo is the dorsal pallium)



Line drawing and image of the cross section of a jungle crow brain at 1.5cm from the frontal pole.