学　位　論　文　内　容　の　要　旨

博士の専攻分野の名称　博士（生命科学）　氏　名　　XIN QIUHONG

学　位　論　文　題　名

Neuroethological studies of the patch use behavior in socially foraging chicks
(社会採餌するニワトリ雛のパッチ利用行動に関する神経行動学研究)

【序論】**General introduction**

This thesis is composed of three chapters with general introduction and general discussion. In the General introduction, I will briefly review neuroethological studies of the patch use behavior in social foraging. I will introduce behavioral ecology of social foraging, patch use behavior and prefrontal cortex, neural substrates of social foraging, evolution of the avian and mammalian brains, the use of domestic chick as a model and finally specify the goal of the present study.

【第一章】**Behavioral study: patch use behavior of socially foraging chicks**

In Chapter I, to investigate how animals select action while foraging among food patches, I tested domestic chicks in an I-shaped maze equipped with two terminal patches of food. One patch delivered food three times as frequently as the other. Each patch was composed of two food trays, and each tray supplied a grain of millet according to a variable interval schedule. The maze was partitioned into two lanes, so that paired chicks fictitiously perceived interference, but did not experience actual competition of food resource. I compared the foraging effort (running distance) and the matching of stay time to the food delivery rate (patch use ratio) among three groups of chicks; paired, mirror and single (control). Chicks of the paired group showed a facilitated running distance and a significantly better matching compared with chicks of the single group. On the other hand, chicks of the mirror group showed a facilitated running distance, suggesting that visual perception of own image was sufficient. However, the level of matching in the mirror group was as low as the single control. When the feeding rate reversed between the two patches, the patch use ratio quickly switched similarly in all groups of chicks. As soon as they were introduced to the maze, even before the feeding was turned on, chicks started to run based on the memorized value of patches. The patch use ratio during this period was significantly higher in the paired group than the other two groups, suggesting an improved patch memory in the paired chicks. The present study demonstrates adaptive modification of patch use behavior in group-foraging animals, which could lead to the emergence of collective intelligence in swarms.

【第二章】Localized brain lesion study: selective contribution of the telencephalic arcopallium to the social facilitation of foraging efforts in domestic chicks

In Chapter II, to investigate the neural basis of socio-economic behavior in birds, I examined the effects of bilateral electrolytic lesions of arcopallium (the major descending pallial area of the avian telencephalon) and the surrounding nuclei in domestic chicks. I tested foraging effort (running distance) in an I-shaped maze with two food patches that delivered food in a biased manner according to a variable interval schedule. Normally, chicks run back and forth between the patches, and the patch use time matches the respective food delivery rate. In the paired phase, even without actual interference of food, chicks showed social facilitation of running effort compared with the single phase, as described in Chapter I. Chicks with lesions in the arcopallium and lateral arcopallium showed significant reduction in the social facilitation. The lesion effect of the lateral arcopallium was particularly selective, as it was not accompanied by change in running distance in the single phase. Lesions of the nidopallium and nucleus taeniae of the amygdala produced no changes in foraging behavior. On the other hand, the arcopallium lesion did not impair social facilitation of operant peck latency. The arcopallium, particularly the lateral arcopallium should selectively contribute to the social facilitation of foraging effort.

【第三章】Neuroanatomical tract tracing study: distinct projection pattern of the lateral and medial arcopallium

In Chapter III, I examined efferent projections of arcopallium sub-regions by focal infusions of anterograde tracer (biotinylated dextran amine, BDA), trying to relate the efferent projections with our lesion data in Chapter II. Anterograde tracing revealed characteristic projections from the lateral arcopallium to the extended amygdala, hippocampus, and septum, as well as wide areas of limbic nuclei in the hypothalamus and medial areas of the striatum including the nucleus accumbens. Efferents from the lateral arcopallium could enable chicks to overcome the extra effort investment of the social foraging.

【考察】General discussion

After ~300 million years of separated evolution, birds have evolved distinct brain structures from those in mammals. Despite the differences, our findings suggest functional and anatomical analogies of the avian arcopallium to the anterior cingulate cortex and basolateral amygdala in mammal. These findings in domestic chicks may give us a hint for understanding the convergent evolution of social neuro-economic systems in higher amniotes, birds and mammals.