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DEGLI STUDI DI TRIESTE
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TSPC2015

Proceedings of the
Trieste Symposium on Perception and Cognition
November 13



edited by
Paolo Bernardis
Carlo Fantoni
Walter Gerbino

EUT

eISBN 978-88-8303-721-4



Opera sottoposta a peer review
secondo il protocollo UPI - University Press Italiane



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Neuronal basis of numerical cognition in the domestic chick

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Keywords: Number cognition, Immediate early genes, Neurobiology, Avian brain, Domestic Chick

Numerical cognition is a “core knowledge” shared among different species and probably relying on mechanisms conserved through evolution [1]. In humans and non-human primates higher-order integrative cortices, such as the prefrontal cortex and the posterior parietal lobes, host populations of neurons devoted to the numerical processing [2]. Only one study investigated the neural basis of numerical cognition in avian species lacking layered cortex, but with differently organized pallial structures: in corvids, number-related neurons were found in the caudolateral nidopallium (NCL), a high-level association area of the avian telencephalon [3].

Here we study neuronal correlates of numerical sense in the domestic chick. Twenty animals were trained to pay attention to a fixed quantity of objects on a screen and habituated for multiple days to this procedure. At test, animals were then divided into two groups: a Number group which was presented with a novel and variable quantity of the same items of the training phase, and a Control group which was presented with novel items but of the same quantity as during familiarization. We quantified the neuronal activation by measuring the expression of c-Fos protein in different areas such as hippocampus, septum, visual wulst and NCL.

A significantly higher number of immunoreactive cells was found in the dorso-lateral hippocampus in the right hemisphere and in the dorsal septum in the left hemisphere of the Number group if compared to the Control group. Dorsolateral hippocampus in birds is considered to be homolog to the entorhinal cortex in mammals, which is a part of parahippocampus [4]. This is particularly interesting, because in humans parahippocampal areas are connected to the intraparietal cortex, which is involved in numerical cognition [5].

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