

情節記憶的神經機制 -- 大鼠動物模式研究

Neural Mechanisms of Episodic Memory – Studies with Rodent Models

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中文摘要

我們的記憶可以分為好幾個不同的類型，而且在大腦中分別由不同的神經迴路來處理。首先學者區別出一種需要海馬回參與的「陳述性記憶(declarative memory)」，所指涉的是我們能夠意識到，而且往往可以用語言描述出來的記憶。在陳述性記憶類型底下，有部分學者又將其再細分為「語義記憶(semantic memory)」和「情節記憶(episodic memory)」。前者指涉的是我們大腦中長期儲存的一般性知識，而後者則專指我們對於親身經歷過的事件，能夠將其發生的具體時、空、環境等細節，完整地回想起來。有部分研究者認為這種複雜的記憶能力乃人類獨有，不過動物實驗學者仍然依照情節記憶的操作要點，將動物整合物體、空間、時間以及場合(What-Where-When/Which; WWW)三要素的能力定義為「類情節記憶(episodic-like memory)」，並且據此設計行為實驗作業以進行神經機制方面的研究。最早被實證出來俱有整合 WWW 三要素之記憶能力的動物是 Scrub Jay，這種鳥類可以記得哪一種食物在多久以前被埋藏在什麼地方，因此滿足了類情節記憶的定義。在鳥類實驗幾年之後，大鼠的類情節記憶作業也成功地建立起來。我們實驗室正好搭上這一波熱潮，很早就接觸這個研究題目。我們一開始的時候先以海馬回為主要的研究目標，發現 CA3 這個子區域在類情節記憶處理中扮演著獨特的角色。後續研究中我們感興趣的腦區範圍漸漸擴大到前額葉，特別是針對海馬回 iCA1 到中前額葉(medial prefrontal cortex; mPFC)這條神經路徑，我們進行了一系列的實驗，探討這條路徑在記憶處理的各個不同階段，分別扮演了何種角色。我們的研究結論，與國外好幾個實驗室在近幾年來的研究發現一致，都指出海馬回-中前額葉-視丘中線連結核(Nucleus reuniens of the thalamus)可能是大腦中，處理情節記憶的核心機制。

Abstract

Previous studies have suggested the division of memory functions into multiple systems. Firstly, a hippocampus-dependent declarative memory could be differentiated from the hippocampus-independent non-declarative memory. Some researchers, e.g. Tulving, further divided the declarative memory into semantic and episodic memory. While the semantic memory refers to the mnemonic processing of general facts, the episodic memory is our ability to recall past experience occurring in a unique spatial and temporal context. Many psychologists believed that episodic memory is unique to human. Nevertheless, some other researchers defined

episodic-like memory of animals as the ability to combine three elements: what, where, and when/which (WWW) to form an integrative entity. Evidences supporting the existence of episodic-like memory in animals were first found in an avian species. Later, several rodent models of episodic-like memory were established. Our lab started our studies on the topic “episodic-like memory” quite early. We observed the spontaneous object exploring behaviors of rats, and found that a small lesion in the CA3 sub-region of hippocampus could selectively damage rat’s ability to integrate the WWW elements, hence impaired the episodic-like memory of rats. In the follow-up studies, we extended the range of our researches to prefrontal cortex. Targeting at the iCA1-medial prefrontal cortex (mPFC) pathway, we have conducted a series experiments to observe the role of this neural pathway on the processing of episodic-like memory of rats for a foot-shock conditioning event. Our findings were consistent with conclusions of many labs from other countries. In short, the neural circuitry hippocampus (iCA1) - mPFC - nucleus reuniens of the midline thalamus might be the core element of the neural mechanism of episodic (episodic-like) memory.

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