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Experience

2024–present: Assistant Professor, National Sun Yat-sen University

2024: Postdoctoral Researcher, National Cheng Kung University

2020-2023: Assistant Researcher, National Tsing Hua University, Center for Brain Science

2017-2020: Assistant Research Scholar, Ministry of Science and Technology

2018-Present: Adjunct Assistant Professor, National Tsing Hua University, Institute for Systems Neurobiology

2017: Visiting Scientist, Dart NeuroScience company, USA

2013-2017: Postdoctoral Researcher, National Tsing Hua University, Center for Brain Science

Education

2007-2013: National Tsing Hua University, Institute of Biotechnology, PhD

2005-2007: National Tsing Hua University, Institute of Biotechnology, Master

2001-2005: National Tsing Hua University, Department of Life Sciences, Bachelor

Abstract

Not all experiences learned or experienced can be stored in the brain as long-term memories. The formation of long-term memory requires repetitive learning and protein synthesis. Our research focuses on understanding the proteins and nerve cells involved in long-term memory formation. To explore this topic, I took several approaches: First, I screened brain nerve cells to identify neurons that require protein synthesis for long-term memory formation. Second, I looked for proteins and signaling pathways in these neurons

that contribute to long-term memory formation. Finally, we studied the states and synaptic outputs of these neurons during the process of long-term memory formation. The ultimate goal is to fully understand how the brain encodes and decodes long-term memory. This will be accomplished by testing how memory-related proteins regulate neurons and affect memory formation. Studying the neural and protein molecular mechanisms of long-term memory formation, including inhibition, enhancement, and storage, as well as the yin-yang and qian-kun modulations in the brain, could help the brain select the memories it needs to store. If these mechanisms are understood, we have the opportunity to manipulate (enhance or inhibit) memory formation.

Research Method

The model animal we used is the fruit fly, and by studying the basic functioning of the fruit fly's microbrain, we can understand the principle of memory formation in the human brain. Fruit flies are innately sensitive to smell and can produce aversive memories by learning to associate odors with electric shocks. This is similar to the associative classical restraint learning discovered by Russian psychologist Ivan Pavlov, i.e., experiments in which puppies salivate at the sound of a bell. In the experiment, we used a device called a T-type memory trainer to make the fruit flies smell two different odors. When given the first odor (Odor 1), they were given an electric shock, while when given the second odor (Odor 2), they were not given an electric shock. When the fruit flies were asked to choose between the two odors, most of them would run to the second door because they remembered the previous experience. Through a single session of training, fruit flies can develop different types of memory, including short-term memory (STM), medium-term memory (MTM), and anti-stupor memory (ARM). After ten repetitive training sessions with intermittent breaks (as in a 10-minute break in the middle of a class), they can produce long-term memory (LTM), remembering more than a week's worth of time. However, if they are trained in an intensive sequence ten times without breaks, they will not be able to develop LTM. Long-term memory requires protein synthesis, which was inhibited by feeding the fruit fly protein synthesis inhibitor cycloheximide (CXM) (Tully et. al. 1994).

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經歷

2024~now: 國立中山大學 助理教授
2024: 國立成功大學 博士後研究員
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2017-2020：科技部助理研究學者
2018-迄今：國立清華大學 系統神經生物研究所 兼任助理教授
2017：訪問學者 Visiting Scientist, Dart NeuroScience company, USA
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學歷

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研究內容

並非所有學習或經歷的經驗都能在腦中儲存成為長期記憶。長期記憶的形成需要反覆的學習和蛋白質的合成。我的研究重點在於了解參與長期記憶形成的蛋白質與神經細胞。為了探索這一複雜的課題，我採取了幾種方法：

首先，篩選大腦神經細胞，以識別在長期記憶形成中需要蛋白質合成的神經元。其次，尋找這些神經元中有助於長期記憶形成的蛋白質和信號通路。最後，研究這些大腦神經元在長期記憶形成過程中的狀態和突觸輸出。最終目標是全面了解大腦如何編碼和解碼長期記憶。

透過測試與記憶相關的蛋白質如何調控神經細胞並影響記憶的形成。研究長期記憶形成的神經和蛋白分子機制，包括抑制、增強和儲存，如同大腦中有陰陽乾坤調控，這是否可以幫助大腦選擇儲存所需的記憶。如果能理解這些機制，我們就有機會操控(增進或抑制)記憶的形成。

誠摯歡迎您加入這個研究行列
如《腦筋急轉彎》劇情中的冒險故事一樣，一同探索大腦記憶形成的奧秘。

研究方法

我們使用的模式動物是果蠅，透過研究果蠅微小腦的基礎運作方式，來理解人類大腦記憶形成的原理。果蠅先天對嗅覺特別敏感，可以通過學習將氣味與電擊聯想在一起，產生厭惡記憶，這一點與俄國心理學家巴甫洛夫（Ivan Pavlov）發現的聯想式古典制約學習相似，即小狗聽到鈴鐺聲會流口水的實驗。在實驗中，我們使用一種稱為T型記憶訓練機的裝置，讓果蠅分別聞兩種氣味。給第一種氣味（Odor 1）時對它們進行電擊，而給第二種氣味（Odor 2）時不進行電擊。接

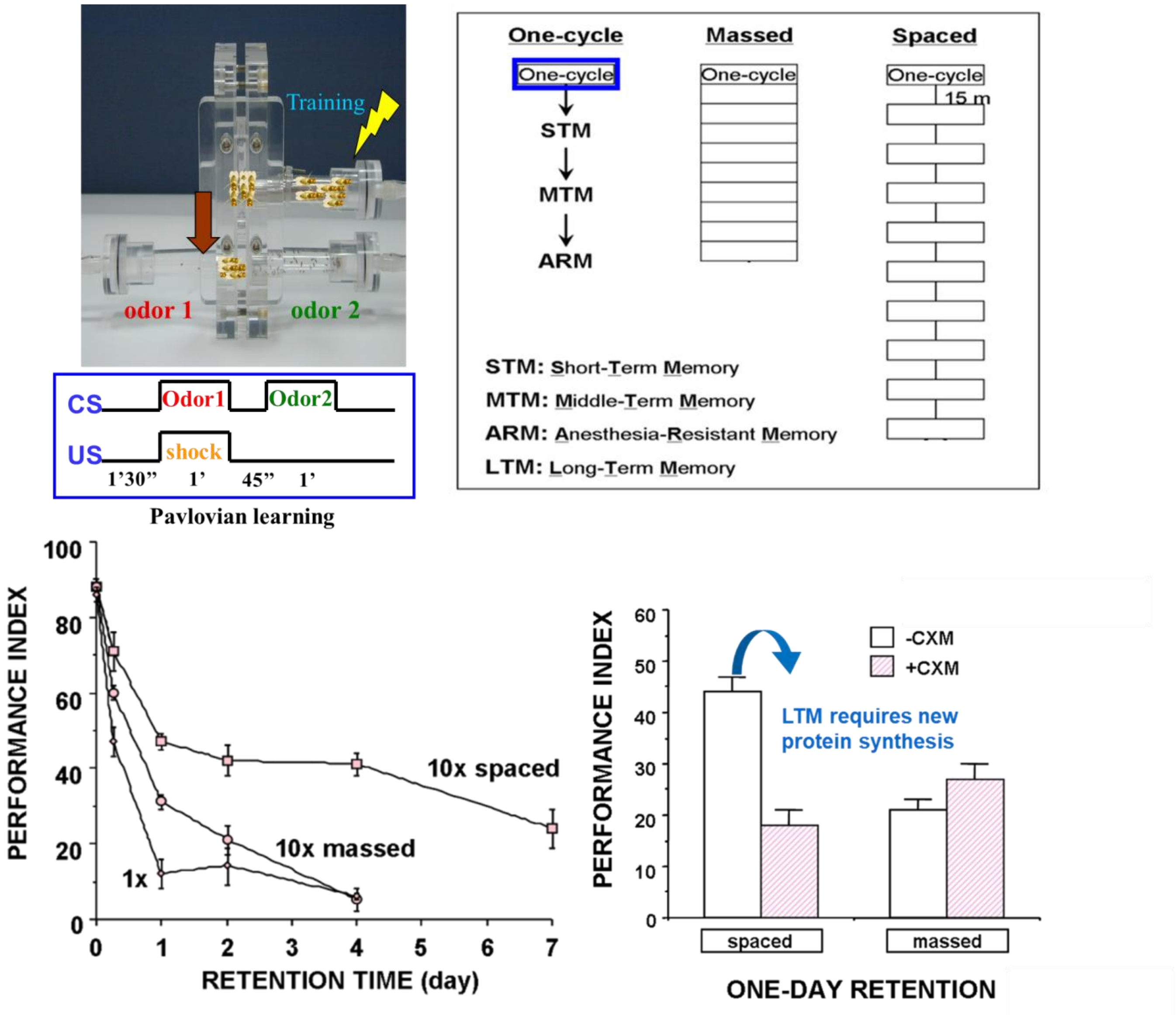
著讓這些果蠅選擇兩種氣味，它們大多會跑向第二種氣味，因為它們記得之前學習過的經驗。通過這樣的一次訓練，果蠅可以產生短暫的記憶，包括短期記憶（STM）、中期記憶（MTM）與抗昏迷記憶（ARM）。如果經過十次重複的訓練，並在中間有間隔休息（如同上課中間休息十分鐘），它們就可以產生長期記憶（LTM），記住超過一週的時間。但如果是經過密集式連續訓練十次，中間不休息，它們則無法形成長期記憶。而長期記憶需要蛋白質合成，在餵食果蠅蛋白質合成抑制劑cycloheximide（CXM）後，會抑制長期記憶的形成 (Tully et. al. 1994)。

相關介紹:

過目不忘！揭開大腦記憶的秘密 | 熱血科學家的長話短說

破解長期記憶之謎！第三彈！ | 熱血科學家的長話短說

果蠅學習訓練與記憶測試機 Training Flies in a T-Maze



期刊論文

(*: co-first author #: correspondence; IF: impact factor, JCR Science Edition)

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2. Lin, H.W.*, **Chen, C.C.*#**, Jhang, R.-Y., Chen, L.Y., de Belle, J.S., Tully, T., and Chiang, A.S. (2022). CREBB repression of protein synthesis in mushroom body gates long-term memory formation in *Drosophila*. Proc Natl Acad Sci USA *119* (50), e2211308119. (IF: 12.291)

3. Lin, H.W.*, **Chen, C.C.***, de Belle, J.S., Tully, T., and Chiang, A.S. (2021). CREBA and CREBB in two identified neurons gate long-term memory formation in *Drosophila*. Proc Natl Acad Sci USA 118, e2100624118. (IF: 12.291)

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5. **Chen, C.C.#**, Lin, H.W., Feng, K.L., Jhang, R.Y., Chen, L., de Belle, J.S., Tully, T., Chiang, A.S. (2021). CREB repressor in mushroom body enhances *Drosophila* LTM formation. bioRxiv, doi: https://doi.org/10.1101/2021.06.10.447902

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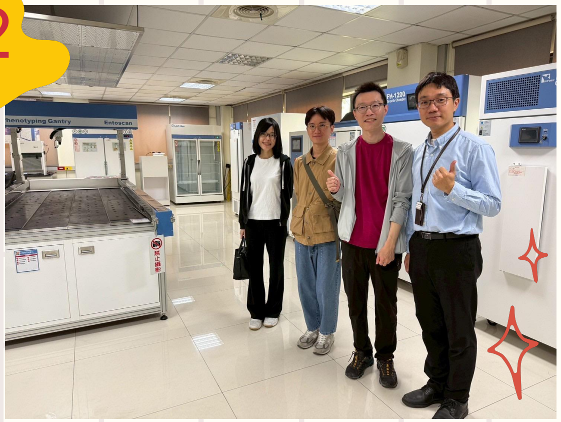

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