

Neuronal Memory of Time Interval in Mice Visual Pathway

Qingpeng Yu¹, Nan Qin¹, Yupu Diao¹ and Jiayi Zhang^{1,#}

¹ *Institutes of Brain Sciences and State Key Laboratory of Medical Neurobiology, Fudan University, China*

Many living organisms have the ability to remember temporal information such as time interval. Previous studies from zebra fish, monkeys and rats demonstrate that neural circuits in the optic tectum, prefrontal cortex, and the thalamus have ramping activities that temporarily correlate with periods of external rhythmic stimuli (also named entrainment). However, it remains unknown what the origin of entrainment is and how it appears in visual cortex. Here we chose Thy1-ChR2-GFP mice to do whole cell recording *in vitro* in order to test whether entrainment phenomenon is derived from the retinal ganglion cells (RGCs). We also recorded the response of V1 to repetitive visual stimulation *in vivo* using microelectrodes. In the *in vitro* experiments, we did not observe entrainment phenomenon in any RGC. What's more, we did not observe the replay phenomenon, which has been observed in the *in vivo* experiments in V1. Thus, it seems that entrainment and replay may not originate from the retina, but from the visual pathway. In the *in vivo* experiments, periodic blue laser stimuli (period 10s, duration 1s), was presented to one eye of Thy1-ChR2 mice mildly anesthetized by isoflurane. A few cycles of rhythmic activity in V1 retained the interval, duration and even amplitude of previous periodic stimulation after periodic stimulation. Interestingly, we noticed an accidental discovery that the neural circuits seem to be able to 'replay' the 10s interval during stimulation of 20s intervals, right after 10s stimulations finished. There may be common neural mechanisms between the entrainment and replay phenomena, and it is quite possible that entrainment is the internal dynamics of replay.