Temporal Expectation Signal in the Basal Forebrain Predicts Decision Speed

Ksenia Vlasov[1], Hachi Manzur[1], Alessandro Scaglione[1], Shih-Chieh Lin[1,2,3*]

[1]*National Institute on Aging, National Institutes of Health, Baltimore, MD, USA*
[2]*Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan*
[3]*Brain Research Center, National Yang-Ming University, Taipei, Taiwan*

The speed of decision making in response to a stimulus is determined not only by the motivational salience of the stimulus but also by internal expectations about when the stimulus will occur, the latter of which is referred to as temporal expectation. Previous studies have found that the influence of motivational salience on decision speed is mediated by the phasic bursting response of noncholinergic basal forebrain (BF) neurons. However, it remains unknown whether the influence of temporal expectation on decision speed is mediated by the same neuronal circuit. Here we show that the same BF neurons also encode temporal expectation and their neuronal activity predicts decision speed. In rats trained to perform simple reaction time (RT) tasks under different foreperiod distributions, stronger temporal expectations of stimulus onset were coupled with stronger inhibitions of BF neuronal activity during the pre-stimulus foreperiod. Moreover, the decrease of BF neuronal activity during the foreperiod was quantitatively coupled with a rebound excitation after stimulus onset. The rebound excitation occurred shortly after the initial phasic bursting response to stimulus onset, and its strength was coupled with faster RTs. Together, these results support the conclusion that noncholinergic BF neurons integrate both motivational salience and temporal expectation, and serve as a common gain control mechanism to regulate decision speed.

Keywords: basal forebrain, reaction time, noncholinergic, foreperiod effect, temporal expectaion

Email:shihchieh.lin@ym.edu.tw