Are the neural circuits controlling the temporal structure of spontaneous actions involved several different behaviors?

Christian Rohrsen, Sathish K Raja, Björn Brembs

University of Regensburg, Institute of Zoology - Neurogenetics, Universitätsstrasse 31, 93040 Regensburg, Germany
chiser_89@hotmail.com http://lab.brembs.net

1. Introduction

Variability is an adaptive and ubiquitous feature of all our behaviors, which is actively regulated according to task demands. Behavioral variability enables us under complex circumstances, individuals will generate different output. In humans, at rest, the so-called default network (DMN) is activated, presenting characteristics, random-like activity fluctuations, characterizing, among others, the different states in which we are awake. This is why we think that the neural network of the DMN in humans and the DMN in the brain is in a state of diffuse activity. Therefore, research into the mechanisms of the brain's random-like activity and apparent brain activity in the DMN will provide important insights into understanding the role of the DMN in many neurological diseases. The goal is to identify and characterize the neural generators of this spontaneity in the fly and the effects of spontaneity on behavior. To this end, we use both a wing beat analyzer to record the spontaneous turning maneuvers of tethered flying Drosophila and a “joystick” to record spontaneous fly movements. This way, we can study and compare spontaneous behavioral variability in two completely different paradigms.

Acknowledgment: to Constantino Antonio García Martínez for the assistance in the analysis of the data obtained from the Joystick.

2. Apparatus

(a) Wing beat analyzer

(b) Joystick

(c) manifesto

3. Results

3.1. Screening for linearity fly turning behavior

Fig. 1. Nonlinear behavior of the DMN in the fly is most strongly affected when comparing the nonlinear correlation (c) to the linear correlation (a) and to the total correlation (b). Inactivation of both of them together reduces significantly the nonlinear signature (c).

3.3. Testing for memory with shuffled data

Fig. 2. The nonlinear signature of the DMN in the fly is most strongly affected when comparing the nonlinear correlation (c) to the linear correlation (a) and to the total correlation (b). Inactivation of both of them together reduces significantly the nonlinear signature (c).

Analysis

The turning procedure (nonlinearly related and strongly synchronized data) was used for the nonlinear prediction for the wing beat analyzer. The flies create a series of turning maneuvers from which the turning maneuver of the fly can be partially predicted in the vicinity of the linear motion. This motion, on the other hand, is then considering the nonlinear signature of the fly turning behavior.

4. Summary

In the wing beat analyzers we found a set of neurons that seem to be crucial for the temporal structure of spontaneous turning behavior. We have started to compare and contrast these results with another orthogonal turning behavior. In addition, we applied different analysis algorithms as a way to test the integrity of the data. The flies were then compared to each other, and the results were in agreement with the neural network of the DMN and the fly turns are nonlinearly related and strongly synchronized data. The flies create a series of turning maneuvers from which the turning maneuver of the fly can be partially predicted in the vicinity of the linear motion. This motion, on the other hand, is then considering the nonlinear signature of the fly turning behavior.

Acknowledgments: to Constantino Antonio García Martínez for the analysis of the data obtained from the Joystick.

Presented at the annual meeting of the Society for Neuroscience in Chicago, October, 2015