T-patterns analysis differentiates between the open field behavioral strategies in two species of wild rodents

I.Yu. Zarayskaya and K.V. Anokhin
P.K. Anokhin Institute of Normal Physiology of RAMS, Moscow, Russia, irzar2003@mail.ru

Introduction

Detailed studies of rodent exploratory behavior demonstrated that they establish space structure of routes and places in a novel environment, including a home base and excursions from it and back to it [1]. It has been found that when a rat or a mouse is placed in a new environment (e.g. open field apparatus) it produces two main forms of activity: forward progression and lingering. Lingering episodes are involved in investigation of a particular location, while forward progression brings the animal from one location to the next [2]. Quantifying them separately allows to differentiate between exploratory behavior of different species and strains of rodents [3]. However, attempts to reveal various strategies of rodent exploratory behavior based only on algorithmic segmentation and subsequent classification of locomotor behavior into different motion modes run into difficulty of lacking information about successions of discrete behavioral acts from which the "forward progression" and "lingering" episodes consist of.

Used approach

The aim of the present study was to reveal a natural structure of rodent exploratory behavior in the open field test as consisting of hierarchically organized patterns of behavioral acts. Our approach to identification of discrete acts was based on the development of track segmentation algorithms [4] that permit to divide a behavioral continuum into the single behavioral episodes and to detect connection between them. In the present study we performed comparative analysis of exploratory behavior in two species of wild rodents: bank voles (*Clethrionomys glareolus*) and pygmy wood mice (*Sylvaemus uralensis)*. We studied their behavior in an open field apparatus (d=120 cm) in two 15-min test sessions separated by 24 hours. Video tracking was performed by "Easy Track" software developed in our lab [5]. The subsequent segmentation of behavioral continuum into single behavioral acts was performed by custom developed "Segment Analyzer" software [4]. In total we isolated 14 different behavioral categories: "running", "quiet", "sniffing", "stretching", "head turn", "body turn", "turn around", "head up", "rear support", "rear", "jump", "climbing", "digging" and "grooming". Obtained successions of discrete behavioral acts were then analyzed by the «Theme» software to reveal the structure of T-patterns [6].

Experimental data and further work

During both open field tests pygmy wood mice (*Sylvaemus uralensis*) displayed a broader spectrum of behavioral act categories as compared to the bank voles (*Clethrionomys glareolus*). However, analysis of behavior patterns revealed clear similarities between sequences of acts in the two species under both (first and second tests) conditions. Primarily it concerned "body turn-sniffing" and "turn around-sniffing" behavioral sequences. These patterns were involved in investigation of particular locations and therefore were labeled by us as "lingering" patterns, analogously to the category from the motion mode analysis experiments [3]. Patterns "body turn – quiet", "head turn - quiet", "turn around - quiet" reflected the resting behavior. These patterns were connected to home bases in both species. "Forward progression" episodes contained "lingering" acts in all cases. Such patterns as "running - rearing with support", "body turn -running" and "running-sniffing" were found in each studied animal.

Major differences between the two species were found in the "lingering" strategies, which were mostly connected to the investigation of particular locations. Patterns «body turn - digging», «body turn - rearing», «rearing with support - climbing», «rearing with support - digging», «sniffing - digging» were found only in pygmy wood mice, while «head turn – body turn», «head turn - sniffing» and «head turn – turn around» were present in bank voles only.

We conclude that proposed approach to analysis of open field behavior structure highlights peculiarities of exploratory behavior organization in the studied rodent species. In future we intend to test the hypothesis that the found T-patterns of open field behavior can be fixed actions programs of rodent exploratory behavior.

References

1. Eilam D, Golani I. (1989). Home base behavior of rats (*Ruttus norvegicus*) exploring a novel environment. *Behavioral Brain Reseach, I,* **34**:199-211.
2. Kafkafi, N., Mayo, C. L., Drai, D., Golani, D. & Elmer, G. I. (2001). Natural segmentation of the locomotor behavior of drug-induced rats in a photobeam cage. *Journal of Neuroscience Methods,* **109**, 111-121.
3. Drai, D. & Golani, I. (2001). SEE: a tool for the visualization and analysis of rodent exploratory behavior. *Neuroscience and Biobehavioral Reviews*, **25**, 409-426.
4. Cherepov A.B., Mukhina T.V., Anokhin K.V. (2005). Automatic segmentation of mouse behavior during video tracking in home cages. *Proceedings of Measuring Behavior 2005, 5th International Conference on Methods and Techniques in Behavioral Research*. Ed. by L. Noldus, F. Grieco, L. Loijens and P. Zimmerman. Wageningen: Noldus Information Technology. P. 403.
5. Anokhin K. and Mukhina T. (2005). Development of a neurocognitive interface for an animal video tracking system.; *Proceedings of Measuring Behavior 2005, 5th International Conference on Methods and Techniques in Behavioral Research*, Ed. by L. Noldus, F. Grieco, L. Loijens and P. Zimmerman. Wageningen: Noldus Information Technology.
6. Magnusson M.S. (1996). Hidden real-times patterns in intra- and interindividual behavior: Description and detection. *Eur. J. of Psychological Assessment* **12**, 112-123.