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Конференция посвящена обсуждению познавательных процессов, их биологической и социальной детерминированности, моделированию когнитивных функций в системах искусственного интеллекта, разработке философских и методологических аспектов когнитивной науки. Программа конференции включает серию специализированных воркшопов, посвященных таким актуальным темам, как возрастные особенности когнитивного развития, ментальные ресурсы разного уровня, движения глаз при чтении и мультимодальная коммуникация. Публикуемые материалы представляют собой тезисы пленарных лекций, устных и стендовых докладов, а также выступлений на воркшопах. В электронном виде эти материалы представлены на сайте конференции (cogconf.ru), а также на сайте Межрегиональной общественной организации «Ассоциация когнитивных исследований» (МАКИ, www.cogsci.ru).

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THE TRAINING PROCEDURE INFLUENCES THE FORMED EXPERIENCE STRUCTURE AS REFLECTED IN THE ACTIVITY OF THE RAT RETROSPLENIAL CORTICAL NEURONS SPECIFICALLY ACTIVE DURING OPERANT SKILL PERFORMANCE [1]

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It has been shown previously that firing of task-specific neurons during food-acquisition behavior depended on the order in which individual acts had been formed in the training history (Gorkin and Shevchenko, 1996). In a more recent study (Svarnik et al., 2013) it was suggested that specific activities could be acquired in the course of training by activation of immediately early genes of these neurons. The authors found that an increase in c-Fos expression in the rat retrosplenial cortex after the second task acquisition was related to the way the animals learned the first task: rats that learned the first task in one stage had more c-Fos positive neurons than animals that acquired it in five stages. It was proposed also that "five stages" rats had reactivated their previous experience to a higher degree reducing the possibility of further reorganizations during new learning, unlike rats with one-stage learning of the first task (Svarnik et al., 2013). The present study was aimed at the verification of this assumption by comparing activity of the rats retrosplenial neurons specialized in relation to the instrumental food-acquisition behavior learned either in one or in four steps.

Methods. Male Long-Evans rats (n=8, 7-15 months) were trained to perform self-paced food-acquisition behavior of pressing a pedal to get food from the feeder on the one side of the experimental chamber (task 1) and then, to perform analogous behaviour on the opposite side of the cage (task 2). One group of rats learned the first task in one step, during a single session of training ("1 stage" group, n=4), and the other group acquired the same first task in the course of four daily sessions through step-by-step shaping procedure ("4 stages" group, n=4). "4 stages" group was successively rewarded for approaching a feeder (1), turning away from a feeder (2), approaching a pedal (3), and finally, pressing the pedal (4). After all rats acquired the first skill, the pedal and feeder on the first, familiar side of the cage were inactivated, and the animals were allowed to learn a similar instrumental task at the opposite side of the chamber (task2) in a one session. Single unit activity was recorded in retrosplenial disgranular cortex by glass micropipets (impedance 2-4 Mom at

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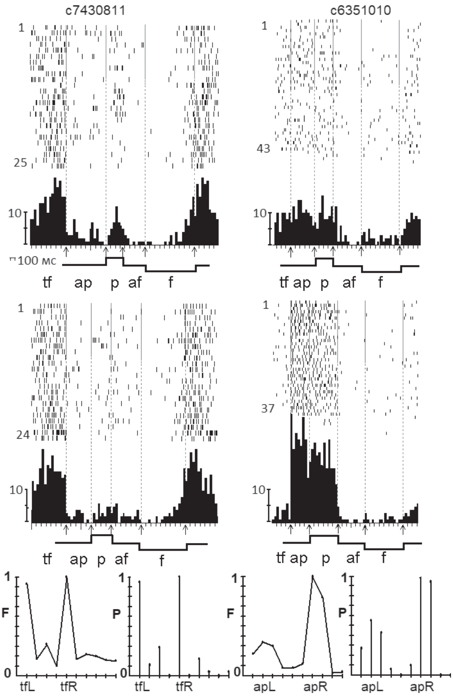
1 kHz) driven by micromanipulator. Each food-acquisition cycle was divided into 5 behavioral acts that corresponded to stages of training in the “4 stages” group of rats with addition of the specific act of lowering the head into the feeder. Task-related neuronal activations were identified if the mean frequency in specific behavioural act or group of acts was 1,5 times more than the mean frequency in all acts during the recording session. The neurons specialized in relation to the behavioural acts learned in the experimental cage (N-neurons) should have specific activations in 100% of trials.

Results. There were no significant differences between the groups of rats in the overall performance of two tasks measured by the number of unsuccessful (unrewarded) cycles (Mann-Whitney, Z=-0,3, p=0,68) and the mean duration of a cycle on each of the two sides of the cage (Z=1, p=0,34). From 399 neurons recorded in the retrosplenial cortex in both groups of rats, 80 cells had stable specific activations (N-neurons) during the performance of the new learned behavior (22% (n=40) in “1-stage” group and 18% (n=40) – in “4 stages” group). There was no difference in the percentage of N-neurons that had selective activations during the performance of task 2 in the both group of rats (Fisher exact, p=0,2). But we found significantly larger proportion of N-neurons specialized in relation to approaching and pressing the first pedal (in the order of training) (Fisher exact, p=0,04) in “4-stages” group of rats. These data reproduced our previous finding where we compared patterns of specialization of the rats’ retrosplenial neurons after learning only the first pedal-pressing task that had been formed in one or in four steps. Animals from “4 stages” group had more task-related neurons than animals which learned the same task in one step (Alexandrov et al., 2018). However, rats with “1 stage” learning had in turn more neurons specialized in relation to two analogous (“twin”) acts (Fisher exact, p=0,07), i.e. for example, pressing two pedals or approaching two feeders on the opposite sides of the cage (see Figure). In addition, “1 stage” rats had the less proportion of N-neurons specifically active in different acts of the task 1 comparing to task 2” N-neurons (Fisher exact, p=0,028 (one-tailed)). On the contrary, there were significantly more N-neurons with selective activations intTask 1 as compared to “task 2” cells (Fisher exact, p=0,03 (one-tailed)) in the “4 stages” group.

Figure. **A** and **B**. Spike raster plots (top) and perievent cumulative histograms (bottom) of the two sample units recorded during cyclic instrumental behavior on the left (**A**) and the right (**B**) side of the cage (50 ms bins, 1 scale division=100 ms). Left column, N-neuron that was selectively active during turning away from the feeder on the left and right sides of the cage. Right column, N-neuron that was specifically activated during approaching and pressing the right pedal. Trial number is shown at the left of each raster. The bottom panel shows behavioral markers (up-deflection for pedal-pressing and



down-deflection for lowering the head into the feeder). Perievent windows (within the grey vertical lines) display middle half of median perievent time between the prior and next events, averaged across trials: tf, turning away from the feeder; ap, approaching the pedal; p, pressing the pedal; af, approaching the feeder; f, lowering the head into the feeder. **C**. ordinate: F – normalized mean frequency (in relation to maximal) and P – probability of activation in 10 behavioral acts mentioned above beginning from acts "tf" on the left side (abscissa).

Summary. We found the dynamic relation between the proportion of task-specific neurons in the rats' retrosplenal cortex and the number of reorganizations of the previously formed experience during re-learning of the following task: animals that acquired the first task in one step had less ratio of neurons specialized in relation to approaching and pressing the first pedal, but more neurons with specific activations in the second task as compared to rats with four-stages learning of the first task. Also, it seems likely that similarity of learning procedure in addition to the common behavioural structure of two tasks, could be reflected in the activity of neurons specialized in relation to analogous (symmetrical) acts in both skills.

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