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RATS MAY TAKE INTO ACCOUNT THEIR OWN BODY WEIGHT

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In animals, the awareness of own body is expressed in their ability to take into account various parameters of their bodies in the relationship with the environmental objects. Currently, one of the areas of these studies is the ability of animals to perceive their bodies as a physical obstacle to solve a problem. We studied the ability of brown rats to consider their own body weight. To solve the experimental problem, the rats were supposed to receive the bait by crossing one of three bridges located above the floor. The bridges could be installed in a fixed or unfixed position. In the second case, when the rat tried to cross the bridge, it fell. Accordingly, the rat needed to correlate its body weight with the strength of the support. We found that 14 out of 41 tested rats could solve this problem. During the experiment, these rodents demonstrated characteristic “trying movements”, during which, we believe, they correlated their own weight with the reliability of the bridge.

Keywords: brown rats, self-awareness, body-awareness, weight, body weight awareness, mirror self-recognition.

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Восприятие собственного тела, применительно к животным, выражается в их способности принимать в расчет различные параметры собственного тела в их связи с объектами внешней среды. В настоящее время одним из направлений исследований является изучение способности животных воспринимать свое тело в качестве физического препятствия для решения задачи. Мы изучали способность серых крыс учитывать вес собственного тела. Для решения экспериментальной задачи крысам необходимо было получать приманку, проходя по одному из трех мостиков, расположенных над полом. Мостики могли быть установлены в закрепленную или незакрепленную позицию. Во втором случае, когда крыса пыталась пройти по мостику, она падала. Соответственно, крысе было необходимо соотносить вес своего тела с прочностью опоры. Было установлено, что 14 из 41 испытуемых крыс могут решить данную задачу. В ходе эксперимента эти грызуны демонстрировали характерные «пробующие движения», в ходе которых, как мы полагаем, они соотносили собственный вес с характеристиками внешних объектов. Таким образом, нами была продемонстрирована способность крыс учитывать вес собственного тела.

Ключевые слова: серые крысы, вес, self-awareness, body-awareness, самоузнавание в зеркале, body weight awareness.

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Introduction

The study of the evolutionary prerequisites of self-awareness is one of the main directions of modern comparative psychology and cognitive ethology, based on a combination of several methodological approaches [6]. Currently, the point of view is being developed, according to which self-consciousness is a multi-modular phenomenon, and each module has its independent phylogenetic trajectory. Frans de Waal believes that self-awareness, both in phylo- and ontogeny, is formed gradually, bottom-up, step by step [5].

There are three main approaches to the search for traits of self-awareness in animals: 1) studying the ability of self-recognition in the mirror [6]; 2) the ability of animals to distinguish their own odor (“olfactory mirror”) [7; 8]; 3) studying the ability to perceive one’s body as a physical obstacle to solving a problem (“body-awareness”) [4; 10; 11].

The fact that a subject has an idea of the physical properties of its body may be evidenced by the ability to spontaneously (without additional training) solve problems for which these properties need to be taken into account. Currently, two variants of such tasks are used in the studies. One is used to assess the ability of children, elephants and dogs to operate with the idea that their body has weight and to understand that body weight can be an obstacle to the performance in an experimental task [3; 4; 11]. The second one allows the researcher to assess the subject's ability to operate with the idea of the size of own body, i.e. to correlate it with the size and shape of the opening through which the subject must pass [3; 10].

The advantage of this approach is that, theoretically, it may be applied to representatives of many different species. However, when using it, the problem common to other methods of studying animal cognition arises, i.e. how to discriminate between operating with representations and rapid learning to solve an experimental task. Below we consider some currently available research in the ability of animals and humans to take into account their own weight ("body weight awareness") [3; 4; 11].

In a study of early development of body awareness in children Brownell, Zerwas and Ramani [3] used two versions of a body-as-an-obstacle task. A child standing on a blanket was encouraged to push a stroller attached to a blanket. In order to fulfil the task, the child had to get off the blanket (an attempt to push the stroller without leaving the blanket was regarded as an erroneous action). In another test, a child sat on a mat and listened to a short story. When the story ended, the experimenter asked the child to pass the mat over to him. Children's attempts to pull the mat out from under themselves without first getting up and moving their bodies out of the way were counted as errors. The children aged 18 months coped with both variants of the tasks only after one, and more often several, erroneous actions. At the age of 22-26 months, the number of erroneous actions decreased significantly, and some children solved these problems on the first try. These results suggest that the idea of the properties of one's body (namely, that it has weight) is just beginning to form during the second year of life.

Working with elephants, Dale and Plotnik [4] preliminarily trained the animals to pick up a stick and give it to the experimenter. Then the elephants made 48 test trials and two types of control tests (also 48 trials each). At the beginning of each trial, the elephant was brought onto a mat. In test trials, a stick was tied to the mat. The experimenter stood at such a distance from the mat that, for the elephant, it was only possible to pass the stick over to him by getting off the mat. Control tests, in which the stick was not tied to the mat, made it possible to find out whether the elephants left the mat only in the situation when it was necessary to solve the problem. The two types of control tests differed only in that in one of them the experimenter pulled on a rope tied to the mat, creating a tension on the fabric under the elephant's feet. One group of animals was first presented with all 48 test trials, and then the control ones. With the other two groups, the experiment started with one or another control trial. Comparison of the results of both all 48 trials of each type and the first 12 showed that elephants significantly more often left the mat when it was necessary in test trials. Four elephants from different groups did not make a single error during the first 12 trials. The other four made only one mistake during the first 12 trials. Two animals from the group that made test trials first never left the mat in subsequent control tests. These results indicate that the correct action in the test trials was not formed as a result of training.

A similar technique was used by Lenkei et al. [10] to assess body awareness in 54 dogs. In this work, the third type of control test was additionally used, in which the stick was tied to a hook fixed in the ground next to the mat, which did not create "foot discomfort" as when attached to the mat. To reduce the effect of training, each dog was presented with 4 conditions of each type (4 test and 12 control), alternating them in a quasi-random order. In the test trials, less than 15%

of the animals remained on the mat. Dogs reliably faster left the mat in the test trials than in all three types of controls. They left the mat reliably slower in the tests when the stick was tied to the hook, and more often they did this by releasing the stick, while in the test tests they more often left the mat without releasing the stick. In those control tests in which the experimenter pulled on the rope tied to the mat, the dogs stayed on it significantly more often than in the test trials, which indicates that the sensation of tissue tension under the legs is not enough for the dog to get off the mat. Overall, these results indicate that dogs understand the structure of this task and have an idea that their body has weight.

In the current study we assessed the ability of gray rats to take into account their own body weight as an obstacle to solving the experimental problem. Rats are common models for studying cognitive processes [2; 12]. They have an explicit spatial memory and can navigate the terrain using external signs [14]. Rats can learn the rules for solving a problem. For example, in a study by Murphy, Mondragon and Murphy [13], the ability of rats to navigate oriented by a sequence of visual cues was demonstrated. However, these rodents have never participated in experiments aimed at studying their ability to take into account their own body weight. Previously, we conducted a study that demonstrated the ability of rats to take into account their body size [1; 11]. Due to the specificity of the animals, we could not organize the experimental task in the same way as it had been done in the studies on children, elephants and dogs [3; 4; 11]. So, we have developed an original method for studying the ability of rats to take into account their own body weight.

Materials and Methods

Subjects: 41 male rats *Rattus norvegicus,* naive individuals aged 2 to 6 months. During the experiment, the animals were kept in individual cages.

The experimental setup was a glass box without a ceiling (area 1000x950, height 500 mm). Inside the box, on its opposite sides, parallel to the bottom plane at a height of 300 mm there were two shelves that occupied the entire width of the box and each had a length of 320 mm. The shelves were connected by three bridges (50 mm wide each) arranged parallel to each other. Two bridges were located along the edges at 200 mm distance from the wall of the box, the third was in the center at a 200 mm distance of from each of the side bridges. The bridges were attached to and balanced on a single metal rod located exactly in the center of their length. Due to this, the bridges could be fixed in different positions (Fig. 1).

Loose condition: the bridges, when balanced, were parallel to the bottom, connecting both shelves. A light pressure on one of the edges of the bridge made it move vertically.

Fixed condition: the bridges were additionally attached to the shelves with latches (from the bottom), so that pressing them did not entail their displacement.

The experiment included of two series: introductory and experimental. At the beginning of each test, the rat was placed in the center of one of the shelves inside the experimental setup (hereinafter, shelf No. 1). In the center of the opposite shelf (hereinafter — shelf No. 2) there was a bait (cheese). The test was considered completed either after the rat, having passed over one of the bridges to shelf No. 2, reached the bait, or when the rat fell from the bridge, which was in an unsecured position, or if the rat did not attempt to pass along any bridge. All trials were carried out sequentially with each animal. The interval between the trials was 5 min.

The introductory series consisted of 27 trials. All bridges were in a fixed position. Objectives of the series: to form in rats the skill of reaching the bait, to reveal whether individual preferences of a certain bridge for the transition to shelf no. 2 are formed in rats.

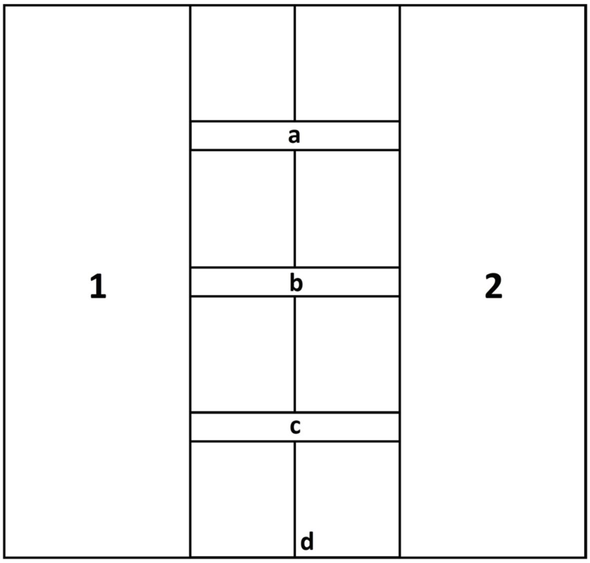

Fig. 1. Experimental setup (top view): 1 — shelf No. 1; 2 — shelf No. 2; a, b, c — bridges; d — fixation rod

The experimental series consisted of a maximum of 36 trials. In each trial, only one of the three bridges was in a fixed position; the location of this bridge varied quasi-randomly: firstly, the fixed bridge had to be 12 times in each position (left, center, or right), and secondly, the same bridge could not remain in the fixed position for more than two sequential trials by one individual. The task of the series was to form the skill of choice adequate for passing the bridge. The series continued either until the rats reached the learning criterion, i.e. a sequence of 9 successful passes without falling (p = 0.001, binomial test), or was terminated after 36 trials.

During the experiment, the following dependent variables were registered.

— The number of successful passes over the fixed bridge from shelf No. 1 to shelf No. 2 (in the introductory series).

— The number of attempts to cross the bridge (in the experimental series) — such an attempt could be successful if the rat passed the fixed bridge, or unsuccessful if the rat fell

— The number of falls from unsecured bridges (in the experimental series).

— The number of “trying movements” (in the experimental series). By trying movements, we understood the behavior of a rat in which it, placing its four paws on shelf No. 1, stretched its muzzle in the direction of the bridge. Then the rat pressed the bridge of one of its front paws. The animal performed several such presses for about 5—10 seconds, after which it acted depending on the result. If the bridge was fixed, the rat crossed it to shelf No. 2. If the bridge was loose, such trying movements of the rat led to some displacement of the bridge under the pressure of the rat’s paw: the edge of the bridge dropped below the shelf level, after which it returned to the original position. Some rats demonstrated the described trying movements starting from the second trial in the experimental series.

Data analysis. In the introductory series, to determine the preference for the position of the bridge, the Pearson chi-square test was used, with the help of which the empirical distributions of the number of passes along the left, central and right bridges, obtained as a result of the experiment, were compared with a uniform distribution (the probability of passage along each bridge is 33.3%).

In the experimental series, we used the factorial analysis of variance ANOVA to identify the factors that influenced the choice of the bridge for the attempted passage. The following variables were used as predictors: condition (fixed / loose) and bridge position (left / central / right).

To identify the influence of trying movements on the number of falls, a linear regression analysis was carried out, with the number of trying movements as a predictor variable, and the number of falls as a dependent variable.

All mathematical calculations were performed in Statsoft Statistica (version 10.0.1011.0).

Results

Results of the introductory series. Each rat successfully reached the bait, going from shelf No. 1 to shelf No. 2, in each of the trials. All rats showed an individual preference for the central bridge (in total for 27 trials) — the χ^2 criterion (df = 2; p = 0.001). In total, the rats crossed the left bridge 146 times, the central one 780, and the right one 154 (χ^2 = 327.803; df = 2; p = 0.001).

According to the results of the experimental series, the rats were divided into 3 groups.

— The 1st group of rats, 14 individuals that have reached the training criterion. The rats allowed 2 to 5 falls (M = 3.07; SD = 1.07). In these group, trying movements appear after several falls, starting from the 2nd trial: before the attempt of passing over the bridge, the rats of this group carried out trying movements and then acted depending on the result.

— The 2nd group of rats, 8 individuals that did not reach the training criterion after 36 trials. The rats allowed 20 to 27 falls (M = 23.00; SD = 2.58). In these animals, 5 trying movements were identified.

— The 3rd group of rats, 19 individuals that made from 2 to 5 falls (S = 2.89; SD = 0.80) and then did not attempt to cross the bridge, remaining on shelf No. 1. After committed falls, in subsequent tests the rats placed on shelf No.1 either did not approach the bridges at all, or approached them, then made trial movements, but did not move further on.

The only predictor that influenced the attempt to cross the bridge in the 1st group of rats was bridge fixation: rats significantly more often attempted to cross the fixed bridge (N = 14; F (1, 78) = 290.278; p = 0.00001). The predictor of the bridge position (left / central / right) had no effect, as well as its interaction with the predictor of bridge position (Table 1, Fig. 2).

Table 1

Results of 14 rats of the 1st group: assessment of the influence of predictors on the number of attempts to pass the bridges, factorial ANOVA

Predictors	SS	sd	MS	F	p
Bridge loose/fixed	84,0000	1	84,0000	290,278	0,00001
Bridge position	0,5000	2	0,2500	0,864	0,425498
Bridge loose/fixed + Bridge position	0,9286	2	0,4643	1,604	0,207566

Summing up all tests of the experimental series, the rats of the 1st group allowed 43 falls and made 275 trying movements, the rats of the 2nd group allowed 161 falls and carried out 5 trying movements. Regression analysis shows a negative relation between the number of trying movements and the number of falls (R = 0.963; B = -1.008; p = 0.0001) (Fig. 3).

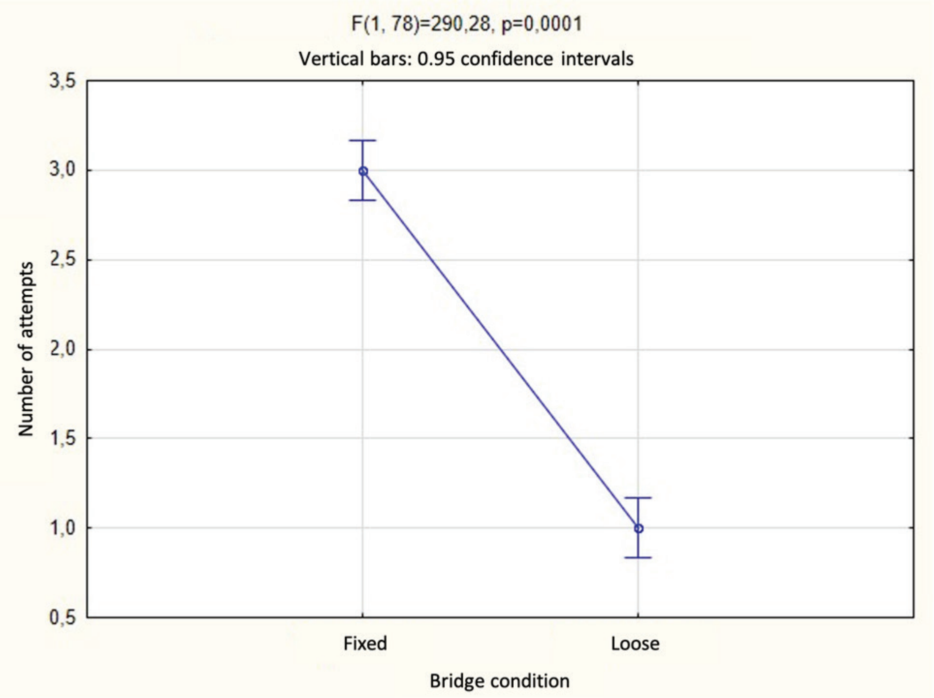

Fig. 2. Results of the 1st group (N = 14): influence of the bridge loose/fixed predictor on the number of attempts

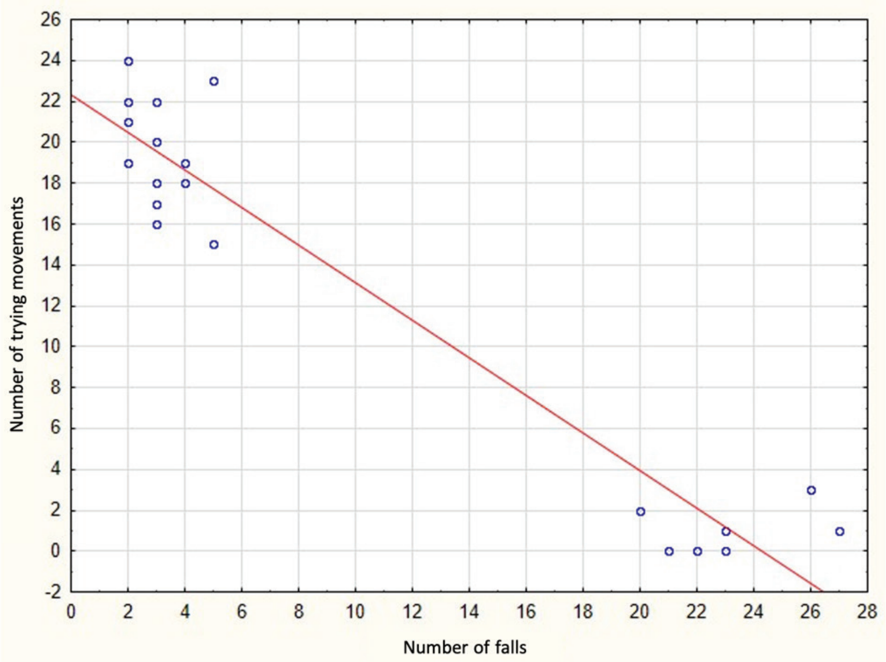

Fig. 3. Diagram of scattering of the number of trying movements and the number of falls during the experimental series in rats of the 1st group and the 2nd group (total N = 22)

Discussion

We suppose that, in the introductory series, the preference of all rats for the central bridge is explained by the fact that the shortest path to the bait runs along it. This factor is secondary; however, it was excluded by the quasi-random position of the fixed bridge in the second series. We explain the selection of the 3rd group of rats in the experimental series by the fact that, for these animals, falls were a strong stress, and therefore they did not dare to make further attempts to move along the bridges. This is probably due to the type of rat nervous system. Meanwhile, based on the results of 14 individuals from the first group, we can state that the gray rat is able to take into account its own body weight when interacting with environmental objects. We believe that it was during the revealed “trying movements” that the rats carried out a comparison of their own body weight with the strength of the support (fixed or loose bridge).

At the same time, as in the experiment with elephants [4], children [3] and dogs [11], for rats as well, their own body was at first an obstacle to solving the problem, but then they began to use it as a means for selecting a suitable bridge. The rats of the first group learned the rule: before passing on the bridge, it is necessary to test it for strength. It is important to note that this action was not carried out mechanically (as a procedural skill, just like pressing a button or pedal) as a rat assessed the will-be result of the trying movement and stepped on the bridge only if, after several clicks, the bridge did not succumb. We emphasize that, when pressed during search movements, the unsecured bridge did not collapse totally, but only dropped slightly, then returned to its original position. Accordingly, the rats inferred its strength based on these characteristics. The data obtained in this study are consistent with the previously established fact of the ability of gray rats to take into account the boundaries of their own body when passing through openings of various sizes [1].

Thus, our study demonstrated the possibility of experimental detection of the ability to take into account their own body weight in rats. To date, signs of the ability to take into account their own body weight have been found in children aged 22-26 months [3], elephants [4] and dogs [11]. The technique we used expands the set of tests that can be used to study the multidimensional phenomenon of perception of their own bodies by animals [5]. It can be applied to a wide range of species, which will make it possible to trace the development of this cognitive ability in phylogenesis.

References

1. Khvatov I.A., Sokolov A.Yu., Kharitonov A.N., Kulichenkova K.N. Body scheme in rats Rattus norvegicus. Eksperimental’naya psihologiya = Experimental Psychology (Russia), 2016. Vol. 9, no. 1, pp. 112—130. DOI:10.17759/exppsy.2016090109 (In Russ., abstr. in Engl.).
2. Barnes C.A. Memory deficits associated with senescence: a neurophysiological and behavioral study in the rat // Journ. Comp. Physiol. Psychol. 1979. Vol. 93. № 1. P. 74—104.
3. Brownell C.A., Zerwas, S., and Ramani, G.B. (2007). “So big”: the development of body self-awareness in toddlers. Child Dev. 78(5), 1426—1440. DOI: 10.1111/j.1467-8624.2007.01075.x
4. Dale R., and Plotnik J.M. (2017). Elephants know when their bodies are obstacles to success in a novel transfer task. Sci. Rep. 7, 46309. DOI: 10.1038/srep46309
5. De Waal F. B. M. (2019) Fish, mirrors, and a gradualist perspective on self-awareness. PLoS Biology, 17(2), e3000112. DOI:10.1371/journal.pbio.3000112
6. Gallup G.G., Jr., and Anderson J.R. (2020). Self-recognition in animals: Where do we stand 50 years later? Lessons from cleaner wrasse and other species. Psychology of Consciousness: Theory, Research, and Practice. 7(1), 46—58. DOI: 10.1037/cns0000206

7. Gatti R.C., Velichevskaya A., Gottesman B., Davis K. (2020) Grey wolf may show signs of self-awareness with the sniff test of self-recognition. Ethology Ecology & Evolution. 33(4), 444—467. https://DOI.org/10.1080/03949370.2020.1846628

8. Horowitz A. (2017) Smelling themselves: Dogs investigate their own odours longer when modified in an “olfactory mirror” test August. Behavioral Processes, 143, 17—24. DOI:10.1016/j.beproc.2017.08.001

9. Khvatov I.A., Sokolov A.Y., and Kharitonov A.N. (2019). Snakes Elaphe Radiata May Acquire Awareness of Their Body Limits When Trying to Hide in a Shelter. Behav. Sci. 9(7), 67. DOI: 10.3390/bs9070067

10. Lenkei R., Faragó T., Zsilák B., and Pongrácz P. (2020). That dog won’t fit: body size awareness in dogs. Anim. Cogn. 2020. 23(2), 337—350. DOI: 10.1007/s10071-019-01337-3

11. Lenkei R., Faragó T., Zsilák B., and Pongrácz P. (2021). Dogs (Canis familiaris) recognize their own body as a physical obstacle. Sci. Rep. 11(1), 2761. DOI: 10.1038/s41598-021-82309-x

12. Morris R. Developments of a water-maze procedure for studying spatial learning in the rat //Journal of neuroscience methods. 1984. Vol. 11. № 1. P. 47—60.

13. Murphy R.A., Mondragón E., Murphy V.A. (2008). Rule learning by rats // Science. Vol. 319(5871). P. 1849—51. DOI:10.1126/science.1151564. PMID 18369151. S2CID 591112

14. Treisman A.M., Gelade G. (1980). A feature-integration theory of attention // Cognitive Psychology. Vol. 12 (1). P. 97—136. DOI:10.1016/0010-0285(80)90005-5. PMID 7351125

Литература

1. *Хватов И.А., Соколов А.Ю., Харитонов А.Н., Куличенкова К.Н.* Схема собственного тела у грызунов (на примере крыс *Rattus norvegicus*) // Экспериментальная психология. 2016. Том 9. № 1. С. 112—130. DOI:10.17759/exppsy.2016090109

2. *Barnes C.A.* Memory deficits associated with senescence: a neurophysiological and behavioral study in the rat //Journ. Comp. Physiol. Psychol. 1979. Vol. 93. № 1. P. 74—104.

3. *Brownell C.A., Zerwas S., and Ramani G.B.* “So big”: the development of body self-awareness in toddlers // Child Dev. 2007. Vol. 78(5). P. 1426—1440. DOI: 10.1111/j.1467-8624.2007.01075.x

4. *Dale R., and Plotnik J.M.* Elephants know when their bodies are obstacles to success in a novel transfer task // Sci. Rep. 2017. Vol. 7. 46309. DOI: 10.1038/srep46309

5. *De Waal F.B.M.* Fish, mirrors, and a gradualist perspective on self-awareness // PLoS Biology. 2019. Vol. 17(2). e3000112. DOI:10.1371/journal.pbio.3000112

6. *Gallup G.G., Jr., Anderson J.R.* Self-recognition in animals: Where do we stand 50 years later? Lessons from cleaner wrasse and other species // Psychology of Consciousness: Theory, Research, and Practice. 2020. Vol. 7(1). P. 46—58. DOI: 10.1037/cns0000206

7. *Gatti R.C., Velichevskaya A., Gottesman B., Davis K.* Grey wolf may show signs of self-awareness with the sniff test of self-recognition // Ethology Ecology & Evolution. 2020. Vol. 33(4). P. 444—467. https://DOI.org/10.1080/03949370.2020.1846628

8. *Horowitz A.* Smelling themselves: Dogs investigate their own odours longer when modified in an “olfactory mirror” test August. Behavioural Processes. 2017. Vol. 143. P. 17—24. DOI:10.1016/j.beproc.2017.08.001

9. *Khvatov I.A., Sokolov A.Y., and Kharitonov A.N.* Snakes Elaphe Radiata May Acquire Awareness of Their Body Limits When Trying to Hide in a Shelter // Behav. Sci. 2019. Vol. 9(7). P. 67. DOI: 10.3390/bs9070067

10. *Lenkei R., Faragó T., Zsilák B., and Pongrácz P.* That dog won’t fit: body size awareness in dogs // Anim. Cogn. 2020. Vol. 23(2). P. 337—350. DOI: 10.1007/s10071-019-01337-3

11. *Lenkei R., Faragó T., Zsilák B., and Pongrácz P.* Dogs (Canis familiaris) recognize their own body as a physical obstacle // Sci. Rep. 2021. Vol. 11(1). 2761. DOI: 10.1038/s41598-021-82309-x

12. *Morris R.* Developments of a water-maze procedure for studying spatial learning in the rat // Journal of neuroscience methods. 1984. Vol. 11. № 1. P. 47—60.

13. *Murphy R.A., Mondragón E., Murphy V.A.* Rule learning by rats // Science. 2008. Vol. 319(5871). P. 1849—51. DOI:10.1126/science.1151564. PMID 18369151. S2CID 591112

14. *Treisman A.M., Gelade G.* A feature-integration theory of attention // Cognitive Psychology. 1980. Vol. 12(1). P. 97—136. DOI:10.1016/0010-0285(80)90005-5. PMID 7351125. S2CID 353246

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