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Do Great Grey Owls Comprehend Means–end Relationships?

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Cognitive abilities of the Great Grey Owl (*Strix nebulosa*) were tested with a means–end problem. Owls were presented the single baited string task and the string discrimination task. Our results suggest that owls failed to comprehend the physics underlying the object relationships involved in the tasks presented.

A common way to assess animal's comprehension of means–end paradigm is to offer them tasks which could be solved promptly and without previous learning. In order to assess this capacity the so-called string-pulling paradigm is widely used, in which an animal has to get the remote bait to which a string is attached.

An ability to solve string-pulling tasks has been studied in various bird species: corvids (Bagozkaya, Smirnova, & Zorina, 2010a and b; Heinrich, 1995; Heinrich & Bugnyar, 2005; Taylor, Medina, Holzhaider, Hearne, & Hunt, 2010;), large parrots (Auersperg et al., 2009; Huber & Gajon, 2006; Pepperberg, 2004; Schuck-Paim, Borsari, & Ottoni, 2009; Werdenich & Huber, 2006;), small parrots (Dücker & Rensch, 1977; Funk, 2002; Krasheninnikova & Ralf, 2010), small passerines: paridsand finches (Vince, 1956, 1958, 1961), goldfinches and siskins (Seibt & Wickler, 2006 etc. In general it is possible to conclude that large-brained bird species, such as big parrots and crows, are presumably able to comprehend the cause-effect relationship between string and bait in the respective tasks (Heinrich, 1995; Pepperberg, 2004; Schuck-Paim, et al., 2009; Werdenich & Huber, 2006).

Owls are characterized by a high level of brain complexity, their Portman's index being 14.37 (Portman, 1947). Judging by Portman's index owls appears to be the members of the same group of large brained birds which includes both big parrots and crows (Portman's index of crows is 15.3; Portman, 1947). One may suggest that owls' capacity to solve cognitive tests could be comparable to those in the large brained birds, whose highly developed cognitive abilities are proven by numerous experiments (Bagozkaya et al., 2010b; Emery & Clayton, 2004; Heinrich 1995; Heinrich &Bugnyar 2005; Huber & Gajon 2006; Pepperberg, 2004; Schuck-Paim et al., 2009; Taylor et al., 2010; Werdenich & Huber 2006). In contrast to crows and large parrots, owls have never been investigated in cognitive studies.

In the present work we investigated the way owls face a new problem. We used a single baited string task and a string discrimination task that have successfully been used in previous studies to test means–end comprehension. Our goal was to determine whether owls were able to solve these tasks and whether such ability was based on real understanding of the cause–effect relationships between string and bait.

Method

Subjects

Twelve owls (*Strix nebulosa*) at least 3 years old were used as subjects. Our experiments were carried out at "Vitasphera" Rare Bird of Prey farm, Moscow Province, Russia. The birds' daily ration consisted of six or seven

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(depending on season) one-day chicken carcass plus vitamins. Food deprivation was not used, but during experiments chickens were used as a bait only. All birds were experimentally naïve. Each bird was labeled with nontoxic paint.

Apparatus

Owls were tested in a large group aviary (6x6x6 m) and individual aviaries (6x6x3 m). Each aviary was equipped with a perch. An experimental box consisted of three nontransparent sides and a slanting glass as a top. This box was attached to the aviary wall 1.3 m above the floor (Figure 1).

Figure 1. An experimental box.

Procedure

The experimenter attached the bait to the distal end of the string and put it into the box (Figure 1). The bait consisted of a one-day chicken carcass. After placing the baited string (or strings) into the box the experimenter left from the place immediately. He returned regularly (once in an hour) to check the baited string and to placed a new one, if the bait had been eaten. The birds' performance was registered by video recorder (Panasonic SDR-H280 video camera). The testing was conducted daily in the late afternoon (5 to 12 p.m.).

The single baited string task. The single baited string task tested the ability of owls to pull the baited string from experimental box (Figure 2a). This experiment was performed in order to choose (from the group of 12 owls) those birds that were able to solve this task.

Twelve owls (1S – 12S) living together in the large group aviary were offered the single baited string task (Figure 2a). Each bird which performed the task successfully was moved into individual aviary. Staying in the individual aviary bird could not see other birds. The single baited string task was presented five times to each subject individually.

The string discrimination task. The string discrimination task tested whether birds were able to comprehend the cause-effect relationship between string and bait (i.e., the physical connection of string and bait). Two strings and two baits were used in each trial (Figure 2b). One of the baits was attached to the end of the longer string (43 cm). The short string (36 cm) did not reach bait for 7 cm (Figure 2b). The positions of these strings of two types alternated (left-right) quasi-randomly. If the bird performed successfully the single baited string task, it was offered string discrimination task for 15 times.

The current study met the bioethical requirements of Directive 86EC. The experimental protocol was approved by Bioethical Committee of Moscow State University.

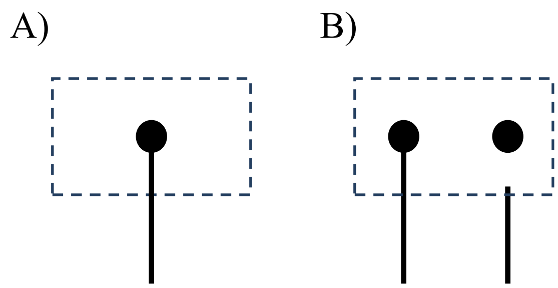

Figure 2. Displacement of strings and baits in the single baited string task (**A**) and the string discrimination task (**B**).

Results

All owls were slow in their choices: the number of trials completed by a single bird per day varied from 2 to 3 (maximum 4), with the average one choice attempt per 1.5 hr.

The single baited string task. Six (1S – 6S) out of 12 owls (1S – 12S) living together in the group aviary pulled the baited string from the box.

Five owls (1S – 5S) pulled the baited string in the 5 successive trials after moving them into the individual aviaries. Only one owl (6S) did not approach the experimental box when it was tested isolated from group mates.

The string discrimination task. The performance of four owls (1S and 3S – 5S) stayed at the chance level throughout the 15 trials (binomial test: $p > 0.05$, Table 1). Only one bird (2S) chose the more long baited string significantly more often than the empty short one (binomial test: $p \leq 0.0176$, Table 1).

Table 1
The number of correct choices per 15 consecutive trials in the string discrimination task

Subjects	The number of correct choices
1S	10
2S	12*
3S	10
4S	7
5S	9

*$p \leq 0.05$.

Discussion

The data presented demonstrate that owls (*Strix nebulosa*) do not comprehend the function of the strings and the physical causality involved, i.e., the physical connection between string and bait.

All subjects except one did not solve the string discrimination task (Figure 2b). This single bird (2S) chosed the longer baited string significantly more often than short empty one. Nevertheless, we think that the success of this subject was gained via the usage of the very simple rule. Our observations showed that while solving the string discrimination task, this bird always reached the bait in a special manner – trying to pinch the string the closer possible to the bait per se (fixing the distal part of the string which is close to the bait). As one of the strings (the shorter one) in this test was not attached to the bait, its distal end was 7 cm apart from the bait. And this bird pinched the string with the bait approximately at this place. So, when bird had to choose between two strings, it preferred the string a portion of which really existed at this point, i.e., the longer baited string. Blue-fronted amazons (Schuck-Paim et al., 2009) failed to solve similar task. However, hooded crows successfully solved it (Bagozkaya et al., 2010b). Lear's macaws and hyacinth macaws were able to visually identify the absence of a physical connection between the string and the bait. These birds chose the baited string in 6 of 7 trials (binomial test: $p = 0.054$; Schuck-Paim et al., 2009).

In owls (*Strix nebulosa*) intra-specific differences in solving tasks were demonstrated. For example, only six owls out of twelve were able to solve the single baited string task. Intra-specific differences in solving this task were shown in small passerine bird species (Seibt & Wickler, 2006; Vince, 1956, 1958) and ravens (Heinrich, 1995). There was also considerable variation in the techniques which owls used to pull the strings: they took the string by the beak or by the paw by either its distal or proximal ends, and sometimes by the middle of the string; one bird pulled the string in the attempt to fly away with the string in the paw. Kea parrots, hooded crows and spectactacle parrotlets have shown no less flexibility while being tested in the similar tasks (Bagozkaya et al., 2010; Krasheninnikova & Wanker, 2010; Werdenich & Huber, 2006).

It has been known that birds with a high level of brain complexity demonstrate a higher level of cognitive abilities (Emery & Clayton, 2004; Krushinskii, 1986; Pepperberg, 1999). A relatively high score of Portman's index for owl brain made it possible to suggest that the Great Grey Owl species would solve the cognitive tests at the level of corvids and parrots. However, the first results presented in this paper indicate that it is not the case - owls could not comprehend the physics underlying the object relationships involved in the tasks used. And this is unlike ravens, grey parrots, keas, macaws and hooded crows, which were able to comprehend the cause-effect relationship between string and bait (Bagozkaya et al. 2010; Heinrich, 1995; Pepperberg, 2004; Schuck-Paim et al., 2009; Werdenich & Huber, 2006).

Needless to say, our data provided only the brief outline on the problem cognitive abilities level in this avian group which met low attention of researchers. The data obtained indicate the strong need for a further study in this field.

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