Title
Observational Learning in a Glaucous-winged Gull Natural Colony

Journal
International Journal of Comparative Psychology, 24(2)

ISSN
0889-3675

Authors
Obozova, T. A.
Smirnova, A. A.
Zorina, Z. A.

Publication Date
2011

DOI
10.46867/ijcp.2011.24.02.02

International Journal of Comparative Psychology, 2011, 24, 226-234.

Observational Learning in a Glaucous-winged Gull Natural Colony

T. A. Obozova, A. A. Smirnova and Z. A. Zorina
Lomonosov Moscow State University, Russia

The ability of the Glaucous-winged Gull (*Larus glaucescens*) to observationally learn has been investigated in their natural habitat, in a gull's colony located on Toporkov Island (Comandorsky State Nature Reserve, Far East, Russia). The experiment was carried out in the gull's breeding period, when each bird's pair in the colony occupies and protects vigilantly their small nesting sites surrounded by those of neighboring pairs. The gulls chosen to be demonstrators were trained to solve two different tasks both of which were not part of the species' behavioral repertoire. The first task was obtaining a bait placed by an experimenter into an opaque box within the bird's visual field; the second one was choosing a red box from a set of four identically-looking boxes differing only in color. In contrast to the demonstrator gulls, which needed considerably training, most observers (the gulls nesting side-by-side with the demonstrators) performed the same tasks correctly in the first trial. Thus, gulls have proven to be capable of successful learning to solve simple choice tasks by observing what their conspecifics are doing. Observational learning can be a way to distribute individual experience among the gulls in a colony. The ability to observationally learn quickly may be one of the factors underlying a higher adaptive potential of these birds.

Social learning, as a way to modify animal behavior and acquire absolutely new skills by observing activities performed by conspecifics seems to be a form of learning universally used among animals. It has been found for representatives of different animal taxa including even invertebrates (Fiorito & Scotto, 1992; Reznikova, 2004, 2007). It is no surprise because the ability to socially learn expands the range of species' adaptability, allowing the species to adapt more successfully to constantly varying environmental conditions. There are experimental proofs at hand that animals can use social learning as an efficient strategy, for instance, to access new foods (Daly, Rauschenberger, & Behrends, 1982; Sherry & Galef, 1984, 1990) or new sources of habitual foods (Alcock, 1969; Lara, Gonzalez, & Hudson, 2009), to master new techniques of obtaining food (Palameta & Lefebvre, 1985; Tomasello, Davis-Dasilva, Camak, & Bard, 1987), as well as to naturalize in new habitats, especially for nesting (Sarin & Dukas, 2009; Seppanen & Forsman, 2007).

Most investigations on the ability of animals to observationally learn have been carried out in laboratory conditions. They involve, as a rule, training demonstrator animals to perform some manipulations with an object, while their conspecifics (the observers) are watching them, followed by testing the latter to find out if (and how) they have acquired the skills gained by demonstrators. It was in laboratory experiments that the most important conclusions on the mechanisms

This work was supported by a RFFI grant (#10-04-00891-a). We would like to thank Dr. Yu. Artukhin from the Kamchatka Branch of Pacific Institute of Geography FED RAS (Petropavlovsk-Kamchatsky), Dr. L. Zelenskaya and employers of the Commander Island Nature Reserve for their constant help. We are also very grateful to Dr. V. Skvortsov, who took part in discussing some important issues and helped us in writing the paper. Correspondence concerning this article should be addressed to Tatyana Obozova, Department of Higher Nervous Activity, Lomonosov Moscow State University, 119899, Vorob'evy gory, 1 – 12, Moscow, Russia (obozovat@mail.ru).

and strategy of social learning were made (Sherry & Galef, 1984, 1990). The number of investigations carried out on animals in their natural habitats is by far less. Still, only field investigations can really prove the existence of this pattern of behavior in nature and clarify its role and significance for a species.

Needless to say, interpreting results of field experiments is difficult. Thus, the acquisition of new skill is sometimes hardly distinguishable from the realization of some inherited behavior program (Madden, 2008; Reznikova, 2004, 2007). Therefore, experimental conditions should be controlled as accurately as possible, and the tasks offered should be not part of the behavioral repertoire that the species demonstrates in nature.

Most of the previously investigated bird species have been found to be able to differentiate patterns of social learning (Dawson & Foss, 1965; Fawcett, Skinner, & Goldsmith, 2002; Fritz & Kortschal, 1999; Campbel, Heyes, & Goldsmith, 1999; Huber, Rechberger, & Toborsky, 2001; White, Gros–Louis, King, Papakhian, & West, 2007). Even the representatives of those bird families where brain complexity is low (pigeons and chickens) display some imitation abilities (Kaiser, Zentall, & Galef, 1997), that is, to exactly repeat demonstrator's actions, which is considered (Thorndike, 1911; Whiten & Ham, 1992) as one of the most complicated forms of social learning. Birds are able to learn by observing not only their conspecifics but also other bird species (Lefebvre & Bouchard, 2003; Seppanen & Forsman, 2007). As Templeton, Kamil, and Balda (1999) and Lefebvre, Palameta, and Hatch (1996) have stated, the level of sociality is an important factor influencing the ability of species to observationally learn: social birds benefit from observing conspecifics, whereas non-socials do not.

In the present work, we have estimated the ability of the Glaucous-winged Gull to observationally learn in their natural colony. Although we could not find any data on cognitive abilities and brain complexity of gulls, their Portmann's index (ratio of forebrain weight for a given species divided by the brainstem weight of Galliforme of equivalent body weight: Portmann, 1947), 4.93 suggest a rather low brain complexity, like that in pigeons and chickens. In nature, gulls behave very flexibly, which allows them to adapt quickly to changing environment conditions (Trapp, 1979; Zelenskaya, 2008).

Our experiment was carried out on Toporkov Island where the big colony of the Glaucous-winged Gull had been found. In this protected territory, the gulls are reconciled with presence of humans even at the nests. In breeding period, each bird pair in the colony occupies and vigilantly protects their small nesting sites. The dominating one in a pair is always the male: it is the first one to obtain a bait. That allowed us to work with individually recognized birds. The nesting sites of neighboring pairs closely adjoined to each other suggest an assumption that the neighbors may observe each other's behavior.

To find out whether the gulls are able to observationally learn in a colony, we chose two tasks that were, first, easy enough to be learned and, second, could only be learned by observing conspecifics but not performed by unfolding an inherited behavior program. It had been shown earlier that gulls as well as other birds with a low level brain complexity (Krushinsky, 1990; Lazareva, 2001) do not understand that an object gone from their field of vision had not disappeared absolutely, so they would not search it. This was the base of our first experiment where the gulls were trained to obtain a bait being put into an opaque box before their eyes. In the second experiment, demonstrators were trained to choose a red box out of four identically-looking boxes differing only by color.

Experiment 1: Training to Obtain a Hidden Bait

Method

Subjects

Twenty males of the Glaucous-winged Gull were used as subjects. Judging by plumage coloring, they were adult birds no younger than 5 years (Yudin & Firsova, 2002).

The experiments were carried out in 2008–2009 in a gull colony on Toporkov Island (a small island in Kommandorsky archipelago) during the breeding period, from early June to the end of July.

The identification of each bird pair involved in the experiment was possible thanks to their adherence to their own nesting sites. Males could be distinguished from the females by their behavior while given food (males always dominate over females). The accuracy of the site-based identification was improved by labeling birds with nontoxic paints.

Training the Demonstrators

Six experimental sites were plotted in the gull breeding colony, in such a way that the birds nesting in different sites could not watch each other. This was possible thanks to natural obstacles, like those created by microrelief or the bends of the coastal line.

Each site included a nesting site of a demonstrator surrounded by 2–6 observer sites. Before the experiment began, the borders of nesting sites had been marked by drawing color labels in the places where territorial demonstrations occurred. A wooden support (h = 40 cm, d = 30 cm) was placed in the each nesting site.

To train demonstrators to obtain a bait, the experimenter placed the bait (sliced fish) before the bird's eyes into an opaque box (20 X 20 X 20 cm, no lid) standing onto the support. While on the ground, the bird could not see the content of the box. If the gull did not show any interest to the hidden bait, the experimenter repeated the demonstration another way hanging the bait over the box edge so that it could be visible for the bird; in this case, the bait was always eaten.

The next trials went on in the same way until the gull started to obtain the bait (by pecking the box off the support to reach it) and did it five times in a row without additional demonstrations. It had been shown earlier that, gulls that had successfully obtained a bail at least once made then no mistake any longer. The only reason for the next four trials after the first correct one was to give the observers a chance to see the action repeatedly.

Testing the Observers

As soon as the demonstrators obtained the bait successfully five times in a row, the observers were offered the same task. The observers that obtained a hidden bait in the very first trial (marked with "+" in Table 1) were not tested any longer. If an observer did not show any interest to the hidden bait in the first trial, the experimenter trained it to solve this task. The numbers of trials needed for observers to make the first correct performance are represented by figures in Table 1.

Figure 1. Experiment site with demonstrator's (red) and observer's (white, yellow, blue) nesting sites. Dots 1 to 22 are gull nests.

Results

Table 1
The results of training demonstrators and testing observers for all the six experimental sites, with a single demonstrator accompanied by two (sites 2 and 3) to six (site 1) observers in each site.

Experimental sites	site 1	site 2	site 3	site 4	site 5	site 6
Training the demonstrators: the number of trials needed for each of six demonstrators to obtain the bait	15	27	31	35	41	1
Testing the observers: additional number of trials needed to obtain bait. Plus signs (+) indicate that the observers obtained a bait in the first trial.	25 + 3 + + +	3 3	3 3	+ 3 + +	not tested	not tested

The 15, 27, 31, 35 and 41 trials were necessary for the demonstrators from experimental sites (1–5) scattered over the colony, to successfully obtain the bait hidden in the boxes. Yet another demonstrator (experimental site 6) performed the task correctly at once, without training (Table 1).

It should be noted that some observers from experimental sites 5 and 6 were not tested for different reasons. Those from experimental site 5 turned out too shy, while the observers from site 6 had, in fact, seen no training process since their demonstrator had performed the task correctly without training.

Seven of 14 observers obtained the bait in the first trial, without any training (four observers from site 1 and three observers from site 4: Table 1). The other seven observers obtained the bait after a remarkably short training: six of them – in the third trial (one observer from the site 1, two observers from the site 2, two from the site 3, and three observers from the site 4). Only one observer from the site 1 needed to be trained as long as with demonstrators 25 trails: Table 1). The average of trial numbers needed for observers to solve their task was substantially different from that for demonstrators (Mann–Whitney test; $Z = 3.01$, $p = 0.003$).

Experiment 2: Training to Differentiate Between Colors

Method

Subjects

Six adult males of the Glaucous-winged Gull were used as subjects. They were not absolutely unlearned since they had received some training related to the below task but not exactly the same (choosing between boxes different in size, not in color).

Training the Demonstrators

Two experimental sites were plotted at a significant distance from each other in the gull breeding colony. Each site included a nesting site of a demonstrator with two nearby observer sites. Before the experiment began, the borders of nesting sites had been marked with color labels as in Experiment 1.

To train demonstrators for choosing a red box among several boxes differing only by color, four identical supports (h = 40 cm, d = 30 cm) were placed in the nesting site of the demonstrators (20cm were between each other). A plastic box (7 X 7 X 7cm) was installed onto each of four supports. All the technical details of the procedure, including the route the experimenter would approach the birds and the order in which the boxes would be set, were the same every time, however the position (relative to a certain support) of differently colored boxes was varied quasi-randomly. Each gull was trained to choose the reinforced red box to reach the criteria (5 correct choices successively, binomial test, $p < 0.0001$).

Testing the Observers

As soon as the demonstrators had reached the criteria, the same task was offered to the observers. The bait was placed in each of four boxes to avoid training during the test and exclude smell as a possible tip. It was the first choice result only that we recorded (Table 2).

Results

Table 2
The results of training demonstrators and testing observers for two experimental sites, one demonstrator accompanied by two observers in each site.

Experimental sites	site 1	site 2
Training the demonstrators: the number of trials needed for demonstrators to reach the criteria	12	15
Testing the observers: plus signs (+) indicates the observers that obtained a hidden bait in the first trial; minus signs (–) indicates the observers that failed in the first trial.	+ +	+ –

The 12 and 15 trials were necessary for the demonstrators to reach the criteria. In contrast to them, 3 of 4 observers performed the task correctly without any training (Table 2): they choose the red box in the first trial (binomial test, $p < 0.01$).

Discussion

Our data provided the first notion on the cognitive abilities of gulls never studied before in this context. It has been shown that the gulls are able to observationally learn. Furthermore, we have revealed an ability of gulls to object permanence and solving tasks implying color discrimination.

The fact that five of six demonstrators did not try to look for a hidden bait in the first experiment confirms our unpublished data that the Glaucous-winged Gull is not able to form a representation of a fully hidden object (Piagetian stage 4; Piaget, 1952). Before the experiment described in this paper was stated, we had tested a number of gulls in the same colony on whether they are capable of comprehending that bait gone out of sight had not completely disappeared (Piagetian stage 4; Piaget, 1952). Twelve adult males (none of which were later tested for observational learning in the current study) had been found not to try to obtain a bait (a piece of fish) placed before their eyes in their nesting sites and then covered with a non-transparent paperboard cone (h = 25 cm, d = 20 cm). However, faced with a transparent cone, the same gulls would always topple the cone over to get the bait. Birds with low brain complexity (with Portmann's index of approximately 4: pigeons, chickens, quails and guinea: Portmann, 1947) behave alike in analogical experiments (Krushinsky, 1990; Lazareva, 2001). On the contrary, birds with large brain complexity (whose Portmann's index is about 16, like in crows and parrots: Portmann, 1947) easily perform similar tasks (Emery, 2006; Krushinsky, 1990; Lazareva, 2001; Pepperberg & Funk, 1990; Pepperberg & Kozak, 1986; Pollok, Prior, & Gunturkun, 2000).

Demonstrator gulls can be successfully taught to differentiate stimuli by color in 12 or 15 trails. It is interesting that these numbers did not exceed those needed for them to learn quite simple food-obtaining skills (getting bait from a box).

Testing observers showed that almost all the gulls involved in both experiments (except a single individual in Experiment 1: a gull from site 1) performed both tasks without training. The 13 of 14 observers obtained the hidden bait in either first or third trials, where demonstrators needed 15-41 trials to learn the baits' location. Three of four observers chose a red box among four boxes differing by colors in the first trials, while the demonstrators needed 12 or 15 trials to do that. Therefore, gulls can learn these tasks by observing their conspecifics.

Thus, we have proven that colonial gulls, whose life assumes close neighborhood between individuals in a colony during breeding period, are capable of learning by observing their conspecific neighbors. The fact that in the Glaucous-winged Gull colony individual experience can be distributed among the other gulls, favors the "information-centres" hypothesis about sharing information on feeding sites between individuals in bird assemblages, such as communal roosts and breeding colonies (Ward & Zahavi, 1973).

It is quite possible that the ability of gulls to quickly learn by observing activities performed by their conspecifics lies behind the remarkable behavioral flexibility they display in nature. A well-known feature shared by most representatives of the Laridae family, including the Glaucous-winged Gull, it is manifested in using any accessible types of food, e.g. picking up carrions and placentas in the fur seals breeding-grounds, feeding on dead fish in salmon spawning areas, eating ripened berries, collecting food garbage in dumps and fur farms, following fishing vessels to make use of fishery waste etc. (Zelenskaya, 2003, 2008). Gulls are also known as predators and kleptoparasites attacking other (mostly smaller) birds (terns, puffins and guillemots) in air or eating the eggs of their conspecifics and guillemots or taking away the cached fishes. Gulls also successfully use various types of habitats including anthropogenic ones; they can breed and bring up their chicks in the city environment (Trapp, 1979; Zelenskaya, 2003, 2008). It is, very likely, observing couples nesting successfully in unusual places (such as house roofs) that allows other individuals to join the "pioneers." According to our observations, some gulls of the Kommandorsky population also breed their chicks not on the slopes in Toporkov and Ariy Kamen Islands but on the house roofs in Nikol'skoe village (Bering Island), where they are safe from pets and can feed on food garbage and sops people discard: this roof-nesting population is growing bigger every year. Therefore, a higher adaptive potential may in certain birds be a direct result of their more developed ability to assimilate their conspecifics' experience, which, in turn, helps them spread wider and make themselves at home wherever possible.

References

Alcock, J. (1969). Observational learning in three species of birds. *Ibis, 111,* 308–321.

Campbel, F. M., Heyes, C. M., & Goldsmith, A. R. (1999). Stimulus learning and response learning by observation in the European starling, in a two–object/two–action test. *Animal Behaviour, 58*, 151–158.

Daly, M., Rauschenberger, J., & Behrends, P. (1982). Food-aversion learning in kangaroo rats: A specialist-generalist comparison. *Animal Learning and Behavior*, *10*, 314–320.

Dawson, B. V., & Foss, B. M. (1965). Observational learning in budgerigars. *Animal Behavior, 13,* 470–474.

Emery, N. J. (2006). Cognitive ornithology: The evolution of avian intelligence. *Philosophical Transactions of the Royal Society B, 361*, 23–43.

Fawcett, T. W., Skinner, A. M. J., & Goldsmith, A. R. (2002). A test of imitative learning in starlings using a two-action method with an enhanced ghost control. *Animal Behaviour*, *64*, 547–556.

Fiorito, G., & Scotto, P. (1992) Observational learning in *Octopus vulgaris*. *Science, 256,* 545–547.

Fritz, J., & Kortschal, K. (1999). Social learning in common ravens, *Corvus corax*. *Animal Behaviour, 57,* 785–793.

Huber, L., Rechberger, S., & Taborsky, M. (2001). Social learning affects object exploration and manipulation in keas. *Animal Behaviour, 62,* 945–954.

Kaiser, D. H., Zentall, T. R., & Galef, B. G., Jr. (1997). Can imitation in pigeons be explained by local enhancement together with trial–and–error learning? *Psychological Science, 8,* 459–460.

Krushinsky, L. V. (1990). *Experimental studies of elementary reasoning: Evolutionary, physiological and genetic aspects of behavior.* New Delhi, India: National Library of Medicine.

Lara, C., Gonzalez, J., & Hudson R. (2009). Observational learning in the white-eared hummingbird (*Hylocharis leucotis*): Experimental evidence. *Ethology*, *115*, 872–878.

Lazareva, O. F. (2001). *Transitive inference and object permanence in young and adult birds.* (Doctoral dissertation). The Lomonosov Moscow State University, Moscow.

Lefebvre, L., & Bouchard J. (2003). Social learning about food in birds. In D. M. Fragaszy & S. Perry (Eds.), *The biology of traditions: Models and evidence* (pp. 94–126). Cambridge, UK: Cambridge University Press.

Lefebvre, L., Palameta, B., & Hatch, K. K. (1996). Is group-living associated with social learning? A comparative test of a gregarious and a territorial columbid. *Behaviour, 133,* 241–261.

Madden, J. R. (2008). Do bowerbirds exhibit cultures? *Animal Cognition, 11,* 1–12.

Palameta, B., & Lefebvre, L. (1985). The social transmission of a foodfinding technique in pigeons: What is learned? *Animal Behaviour, 33,* 892–896.

Pepperberg, I .M., & Funk, M. S. (1990).Object permanence in four species of psittacine birds: An African grey parrot (*Psittacus erithacus*), an Illiger macaw (*Ara maracana*), a parakeet (*Melopsittacus undulates*) and a cockatiel (*Nymphus hollandicus*). *Animal Learning and Behavior, 18,* 97–108.

Pepperberg, I. M., & Kozak, F. A. (1986). Object permanence in the African grey parrot (*Psittacus erithacus*). *Animal Learning and Behavior, 14,* 322–330.

Piaget, J. (1952). *The origins of intelligence in children.* New York: International Universities Press.

Pollok, B., Prior, H., & Gunturkun, O. (2000). Development of object permanence in foodstoring magpies (*Pica pica*). *Journal of Comparative Psychology, 114,* 148–157.

Portmann, A. (1947). Etudes sur la cerebralisation chez les oiseaux. *Alauda*, *14,* 2–20.

Reznikova, Zh. (2004). Social learning in animals: Comparative analysis of different forms and levels. *Journal of General Biology*, *65,* 136–152.

Reznikova, Zh. (2007). *Animal intelligence: From individual to social cognition.* Cambridge, UK: Cambridge University Press.

Sarin, S., & Dukas, R. (2009). Social learning about egg-laying substrates in fruitflies. *Proceedings of the Royal Society: Biological Science*, *276*, 4323–4328.

Seppanen, J. T., & Forsman, J. T. (2007). Interspecific social learning: Novel preference can be acquired from a competing species. *Current Biology, 17,* 1248–1252.

Sherry, D. F., & Galef, B. G. (1984). Cultural transmission without imitation: Milk bottle opening by birds. *Animal Behaviour, 32,* 937–938.

Sherry, D. F., & Galef, B. G. (1990). Social learning without imitation: More about milk bottle opening by birds. *Animal Behaviour, 40,* 987–989.

Templeton, J. J., Kamil, A. C., & Balda, R. P. (1999). Sociality and social learning in two species of corvids: The pinyon jay (*Gymnorhinus cyanocephalus*) and Clark's nutcracker (*Nucifraga columbiana*). *Journal of Comparative Psychology, 113,* 450–455.

Tomasello, M., Davis-Dasilva, M., Camak, L., & Bard, K. (1987). Observational learning of tool-use by young chimpanzees. *Human Evolution*, *2*, 175–183.

Thorndike, E. L. (1911). *Animal intelligence.* NY: Macmillan.

Trapp, J. L. (1979). Variation in summer diet of Glaucous-winged Gulls in the western Aleutian Islands: An ecological interpretation. *Wilson Bulletin, 91,* 412–419.

Ward, P., & Zahavi, A. (1973). The importance of certain assemblages of birds as "information – centres" for food finding. *Ibis, 115,* 517–534.

White, D. J., Gros–Louis, J., King, A. P., Papakhian, M. A., & West, M. J. (2007). Constructing culture in cowbirds (*Molothrus ater*). *Journal of Comparative Psychology, 121,* 113–122.

Whiten, A., & Ham, R. (1992). On the nature and evolution of imitation in the animal kingdom: Reappraisal of a century of research. *Advances in the Study of Behavior, 22,* 239–283.

Yudin, K. A., & Firsova, L. V. (2002). *Fauna of Russia and neighbouring countries. Charadriiformes Volume 2, Issue 2. Part 1: Skuas of the family Stercorariidae and gulls of the subfamily Laridae* St. Petersburg, Russia: Nauka.

Zelenskaya, L. A. (2003). Foraging strategy of the commander Islands Glaucouse-winged Gulls (*Larus glaucescens*) population. *Russian Journal of Zoology, 82,* 694–707.

Zelenskaya, L. A. (2008). Changes of the diet in breeding Glaucous-winged Gulls, *Larus glaucescens,* on the Commander Island. *The Biology and Conservation of the Birds of Kamchatka, 8*, 26–37.