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Short report

Do African grey parrots (*Psittacus erithacus*) know what a human experimenter does and does not see?

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ABSTRACT

Perspective-taking is a cognitive ability that can be useful to access information during social interactions. This ability is extensively exploited in humans, and some evidence of it has been found in other mammals and some bird species. Perspective-taking requires individuals to be sensitive to the attentional state of others. In this experiment, three hand-reared grey parrots were tested on their ability to adapt their behaviours according to the perception of a human handler. Two different screens placed on a table separating the human side from the parrot's side were used: one transparent and one opaque. In the Control condition food was put behind each screen, whereas in the Test condition 'forbidden' objects (attractive for the bird but normally not accessible) were placed behind each screen. Birds were expected to choose at random between the two screens in the Control condition but to prefer the opaque one in the Test condition in order to avoid being scolded and chased away. In the Control condition, birds chose at random, whereas the older parrot chose the opaque screen significantly more in the Test condition. The latency for the decision was longer in the Test condition compared to Control, and when choosing the Transparent screen compared to the Opaque.

1. Introduction

Theory of mind is a set of specific cognitive abilities which involves the attribution of mental states to others, such as perspective taking, intentions, desires, or beliefs (Premack and Woodruff, 1978). One important skill contributing to theory of mind is probably the ability to evaluate whether an individual can see or hear something (perception attribution). Recent studies conducted in several different species have shown that individuals are able to take acoustic cues into account in a competitive foraging task and consider how auditory information could change a competitor's knowledge state. Indeed, chimpanzees (Melis et al., 2006 but see Bräuer et al., 2008), rhesus macaques (Santos et al., 2006), Western scrub-jays (Stulp et al., 2009) or even dogs (Kundey et al., 2010) have been found to prefer to retrieve or cache food from a silent vs. noisy container when a competitor was not watching. Sensitivity to the visual attentional state of others has been found in non-human primates (great apes: Liebal et al., 2004; capuchins: Hattori et al., 2007, 2010), dogs (Call et al., 2003; Virányi et al., 2004), and more recently horses (Proops and McComb, 2010). In these experiments, subjects beg (or approach) an experimenter who is looking at them for food more often than one who cannot see them. In corvids, scientists found that they were able to attribute perception (Bugnyar et al., 2004) and to take into account the knowledge state of a competitor (Dally et al., 2006; Bugnyar, 2010). Perspective-taking could be useful for deceptive behaviours. In chimpanzees (Hare et al., 2000, 2001) and capuchins (Hare et al., 2003), individuals were tested with their conspecifics in a task in which they had to retrieve food in front of a dominant subject. Only chimpanzees showed a clear preference for the source of food hidden to the dominant (compared to the visible one). Similar results were obtained with goats: subordinates' preferences depended on whether they were the target of aggression from the dominant animal during the experiment. Subjects who were targeted with aggression preferred the hidden piece of food to the visible one (Kaminski et al., 2005). Dogs also preferred to bring back a toy that a human was able to see when asking for an object (Kaminski et al., 2009), thus taking into account the perception of the experimenter.

It seems to us of evident interest to look also at species distantly related to humans, and more specifically at bird species known for their complex cognitive abilities (corvids and psittacids: Emery and Clayton, 2003; Emery, 2004). Indeed, these bird species fit most of the criteria of the Relationship Intelligence Hypothesis (Emery et al., 2007; Shultz and Dunbar, 2010). This hypothesis suggests that individuals who have to manage complex social interactions with specific partners need more brain power (Dunbar, 1998). Psittacids have a social life with complex population dynamics, large relative brain size, a long infancy and lifetime, and most are monogamous (Emery et al., 2007). The ability to be sensitive to the attentional

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states of others, or even to attribute perspectives to partners, could improve cooperative actions or maximize individual fitness during competitive events.

Corvids are able to respond to human-given cues such as gaze (von Bayern and Emery, 2009). They prefer to re-cache their food if watched during the caching (Bugnyar and Kotrschal, 2002; de Kort et al., 2006). In a recent experiment, three hand-reared African grey parrots were able to use human-given cues (Giret et al., 2009). All the birds used a proximal pointing cue spontaneously or after a short period of training, and one of the three grey parrots quickly learned to use a proximal gaze cue. The same birds were tested on their ability to attribute intentions to an experimenter: we observed that all the birds adapted their responses according to the human's intentions, biting the wire mesh when the human was unable to give them food and displaying frustration (frustration calls, beak scraping) and opening their beak when the latter was unwilling to do so (Péron et al., 2010).

Parrots kept in captivity are known for their tendency to destroy objects. Do parrots rely on any human cues in order to make their decision (when and what to steal and destroy), knowing that if their owner sees them they would be chased? Like most parrots kept as pets, our birds were hand-reared and had daily interactions with us, which might facilitate the distinction between different human attentional states. We tested the birds in two different conditions: (1) a Control condition in which food was provided and (2) a Test condition in which usually 'forbidden' objects were accessible. 'Forbidden' objects were items in the human environment that birds were not allowed to interact with, such as a rubber and pens. Birds were attracted by these objects and tried to steal them, but when they did so they were scolded by a human. In each condition the items were placed on the table behind two different screens, one opaque and one transparent, and the experimenter stood on the other side looking in the direction of the bird. Parrots were expected to choose at random in the control situation and to prefer the opaque screen in the Test condition to avoid being scolded.

2. Materials and methods

2.1. Subjects

Three hand-reared grey parrots (chosen because they accepted to stay separated from the rest of the group for a while) were tested: two males (Iris, twelve years old, and Doudou, three years old) and one female, Rubis (eight years old), all siblings. They lived as pets in the dwelling of a human family with their parents and two other siblings. They were housed in a room (19 m^2) furnished with several toys and maintained at about 23 °C with 14 h/10 h light-dark cycle. They were fed with water and seeds *ad libitum*, received fresh fruits and vegetables every day, and often came and ate with humans at lunchtime. All of the tested birds had the same propensity to interact with objects but their experience facing this situation (trying to steal objects or food) varied according to their age. In daily life, the birds quite often tried to steal objects, and were scolded if they were seen. Usually, birds were chased, threatening them with rapid hand movements, using objects (such as feather duster) or not and also shouting at them.

2.2. Procedure

Birds were tested individually in an adjacent room (20 m^2) between 10:30 a.m. and 12:00 p.m. The experimental setup consisted of two screens (25 cm × 40 cm), one opaque and one transparent, separated by a piece of cardboard (20 cm × 40 cm) and placed on a table (1 m × 1.30 m). Screens were placed so as to separate two different areas: the experimenter's position and the bird testing area. The cardboard was used so that birds could not move from one side to the other once they were behind a screen. With the opaque screen, the experimenter could see the bird's approach but not the food (or object) retrieval. Birds were not food-deprived, and were familiarized, but not trained with the device: they were free to explore the table (with the screens on it) during the day before the beginning of the study. We alternated the side of the screens between sessions. The food or the objects were placed on the table out of sight of the birds. The experimenter sat on the other side, alternating his gaze between the proximal edge of the table and the location of the food items or 'forbidden' objects for 5–10 s. The parrot was placed at the end of the table and the trial lasted for 120 s, during which he was allowed to approach the food or the objects. Then, at the end of the trial, the tested bird was removed from the table. Inter-trial intervals lasted between 1 and 5 min, during which the positions of the screens and the conditions were switched (food vs. object) out of sight of the tested bird and before he was brought back to the table. We conducted 20 trials in each condition, four trials per condition per day during five consecutive days, alternating across the conditions during a session.

2.3. Control condition

Food (grapes and seeds) was placed behind each screen, and we expected the parrots to choose the place where they would eat the food at random, as eating this food was not forbidden.

2.4. Test condition

Attractive objects (tape, pens, rubbers, elastics, empty blister strips, etc.) that the parrots were not usually allowed to touch but that they often stole and destroyed when an opportunity arised, were placed behind each screen. Two new identical objects were used for each trial. In the case of choosing the object placed behind the transparent screen or once having it in the beak (after choosing the item placed behind the opaque screen for instance) the bird was chased (if the experimenter was watching in the mean time).

2.5. Coding and statistical analysis

During the trials we recorded the choice and the latency of each bird. We ran binomial tests in order to compare the birds's choices according to condition: we used a two-tailed analysis for the Control condition, as birds were expected to choose at random between the two screens, and a one-tailed analysis for the Test condition, as they were expected to prefer the opaque screen. We assessed bird motivation by comparing the latency time before their choice in both situations. To do so we used generalized linear mixed model (GLMM; by Laplace approximation; Number of obs: 120, groups: Ind, 3) as implemented in the lmer function of the Stats Package lme4 for R Software Version 2.10.0 for Mac OS X. We analysed the whole data set with a Poisson distribution. Latency was taken as the dependent variable, and we tested for the influences of (1) situation (Control vs. Test) and (2) choice (Opaque vs. Transparent). We also tested (3) the interaction between situation and choice on the latency time. The random term in our model took into account the individuals.

3. Results

In the Test condition, but not the Control condition, Iris chose the opaque screen significantly more often than the transparent one (binomial test; $N = 20$, $k = 5$, $P = 0.015$; Control condition: $N = 20$, $k = 7$, $P = 0.147$). The same result was found at the group level (for the group $N = 60$, $k = 21$, $P = 0.007$), with no difference in the Control condition ($N = 60$, $k = 24$, $P = 0.063$).