Behavioural Processes 89 (2012) 44–51

Contents lists available at SciVerse ScienceDirect

Behavioural Processes

journal homepage: www.elsevier.com/locate/behavproc

Learning interspecific communicative responses in Pampas foxes (*Lycalopex gymnocercus*)

Gabriela Barrera, Adriana Jakovcevic, Alba Mustaca, Mariana Bentosela*

Laboratorio de Psicología Experimental y Aplicada (PSEA), Instituto de Investigaciones Médicas (CONICET-UBA), Combatientes de Malvinas 3150, 1426 Buenos Aires, Argentina

ARTICLE INFO

Article history:
Received 12 July 2011
Received in revised form 13 October 2011
Accepted 21 October 2011

Keywords:
Canids
Interespecific communication
Learning
Pampas's foxes

ABSTRACT

Domestic dogs show remarkable communicative abilities in their interaction with people. These skills maybe explained by the interaction between the domestication process and learning experiences during ontogeny. Studies carried out on other species of canids, which have not been domesticated are relevant to this topic. The purpose of this article is to study the effect of instrumental learning on captive Pampas foxes' (*Lycalopex gymnocercus*) communicative responses to humans. Seven foxes were tested in a conflict situation involving food within sight but out of their reach. In these situations dogs typically gaze at the human face to ask for food. In Study 1, there was an increase in gaze duration as a consequence of reinforcement and a decrease during extinction, when animals did not receive any more food. In Study 2, all of the four foxes tested successfully followed proximal pointing gesture to find hidden food. When a distal pointing cue was given, three out of four followed it in the first session and one in the second session. These results are consistent with those previously found in dogs, and suggest that learning experiences allow the development of communicative skills, even in not domesticated canid species.

1. Introduction

Communication between animals occurs when an observer can detect predictable changes in the behavior of one of them (the reactor), in response to certain signals from the sender (Wilson, 1975). This definition, unlike traditional approaches that emphasized the transmission of information, highlights the influence on the receiver's behavior (Rendall et al., 2009). From an evolutionary point of view, selection favors senders whose signals affect the behavior of receivers to the sender's advantage (Carazo and Font, 2010). In this sense, the psychology of learning adds to this definition the role of reinforcement for one or both participants (Skinner, 1953). A successful communication is crucial for social species, as it allows to predict others actions and adjust their own behavior leading to a synchronization effect (Csányi, 2000). From this point of view, many interactions can be defined as communicative acts but they do not necessarily imply intention on the part of the members involved (Leavens and Hopkins, 1999).

A typical experimental situation where communicative responses are observed involves tasty food is in sight but out of the animal's reach and the only way to get it is through the interaction with a person. As Leavens et al. (2005) state, in these situations people become social tools that allow access to certain goals.

Domestic dogs proved to be successful in this kind of communicative interactions with humans. The evidence suggests that they are able to produce and comprehend signals in cooperative contexts with people (Hare and Tomasello, 2005). Among the most studied responses are the tendency to gaze at the human face in situations of uncertainty or conflict (e.g., Gaunet, 2008; Miklósi et al., 2003) and to follow human cues (e.g., pointing, body position) to find hidden food (e.g., Soproni et al., 2001). Gaze behavior is crucial to establish communication in social species. For example, it helps animals to find relevant stimulus such as food and predators (Tomasello et al., 1998; Emery, 2000). Human-directed gaze and the alternation between the receiver and the target object are considered referential responses in attention-getting behaviors (Gómez, 2007). It also provides information about the individual's emotional state (e.g., Emery, 2000). Similarly, human pointing is considered an essential element in the non-verbal referential communication (e.g., Leavens et al., 2005).

Dogs' successful performance in communicative tasks with humans is evident even at early stages of development (e.g., Riedel et al., 2008) and it is better than that of other species such as primates (e.g., Itakura et al., 1999). These capabilities were interpreted as the result of the intense process of domestication (e.g., Hare et al., 2010) undergone by dogs 14,000–16,000 years ago (Pang et al., 2009; Vila et al., 1999), and would be relatively independent from ontogenetic experiences (e.g., Bräuer et al., 2006; Miklósi, 2009). However, recent studies showed that instrumental learning is involved in the mechanisms of dog–human communication.

* Corresponding author.
E-mail address: marianabentosela@gmail.com (M. Bentosela).

0376-6357/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.beproc.2011.10.013

Dogs increased their gaze duration towards the human face and their pointing following behavior when these responses led to a food reward. Also, a decrease in this behavior was observed during processes of extinction and omission, when they were no longer reinforced (Bentosela et al., 2008; Elgier et al., 2009).

Similarly, Marshall-Pescini et al. (2008) showed that untrained dogs gazed more often at their owners in an unsolvable task than highly trained dogs, which spent more time interacting with the baited apparatus. On the other hand, longer duration of gazing was observed in sport trained dogs in which the gaze towards humans is specially reinforced. For example, Marshall-Pescini et al. (2009) found that Agility trained dogs gazed at their owners significantly more than both pet dogs and Search & Rescue trained dogs. Moreover, Bentosela et al. (2008) found that Schutzhund trained dogs gazed more at the human face during a walk than untrained dogs. In addition, McKinley and Sambrook (2000) founded that trained gundogs were more successful than pet dogs in a human pointing following task. In summary, the evidence indicates that prior learning experiences modulate communicative responses.

Furthermore, shelter dogs, characterized by having low levels of social interaction with people, showed faster extinction of the gaze at the human face (Barrera et al., 2011) and a slower learning of subtle communicative responses, such as the distal pointing gesture (index finger more than 50 cm from the target) than pet dogs (Udell et al., 2008, 2010a).

These data support the "Two Stage Hypothesis" (Udell and Wynne, 2010) that states that the domestication process is not sufficient to explain these abilities, and therefore, interaction with humans during ontogeny is also necessary. These experiences must occur during the sensitive period of socialization and throughout the animal's life. Considering this debate, comparative studies with other species of canids, genetically related to dogs but that did not undergo the process of domestication, are of great importance.

Fox is a common name for many species of carnivorous mammals belonging to the Canidae family. Foxes are a canid species less closely related to domestic dogs than wolves (Lindblad-Toh et al., 2005; Lucherini et al., 2004). To our knowledge the only antecedent in the literature of interspecific communication in foxes is Hare et al.'s study which evaluated silver foxes (*Vulpes vulpes*). Hare et al. (2005) showed that silver foxes of 2–3 months of age were able to follow the proximal pointing gesture accompanied by gazing towards the target, but were less successful than a group of similar age foxes selected for their docility over 45 generations. However, this species has not been tested for their comprehension of other cues such as proximal pointing without gaze or distal pointing or for responses involving gaze in a communicative context with humans.

In the present studies we evaluate another fox species, the Pampas fox (*Lycalopex gymnocercus*), which is one of the six species in the genus *Lycalopex*. It occurs in Bolivia, Paraguay, Uruguay, Argentina and Brazil. It prefers open habitats but also occurs in areas of Pampas grassland. Pampas foxes are generalist, adaptable and opportunistic predators. They may form monogamous pairs. These pairs are frequently observed from mating until pups leave the natal den. However, they hunt and spend most of their time alone (Lucherini and Luengos Vidal, 2008; Lucherini et al., 2004).

Our first objective was to assess the effect of learning in the development of a communicative response in adult Pampas foxes with low human socialization. To achieve this aim we evaluated the effect of reinforcement and extinction on the communicative behavior of gazing to the human face when there is food in sight but out of reach, using a procedure similar to dogs' studies (Bentosela et al., 2008; Jakovcevic et al., 2010). Foxes had to learn that if they gazed to the human face, the person changed her behavior offering the reward to them.

Gaze response was scarcely assessed in the comparative studies with other canid species. The most important study is Miklósi et al. (2003). After training the dogs to pull a rope to open a box and obtain food, the animals were exposed to an unsolvable trial in which the box was blocked. In this situation dogs looked more quickly and for longer to the owner's face than socialized wolves. However in this study there was no attempt to train the gaze response. Also in this study it was not possible to rule out certain alternative explanations of the between-species difference. For example, wolves may be more impulsive than domestic dogs, and therefore take longer to inhibit the actions directed to the device or maybe are more resistant to extinction of learned responses. The behaviors directed to the device would be incompatible with the possibility to respond to other environmental stimuli including people. Because of that, it would have been interesting to test both groups in the same unsolvable task but when they are alone, without any human presence and evaluate if species differences are observed.

Our second objective was to evaluate the comprehension of human communicative cues. With this purpose we evaluated foxes' following of proximal and distal pointing in an object choice task.

These studies highlight the role of learning experiences upon the development of interspecific communicative skills in a new canid species that have not been assessed yet. Also they contribute to the debate about the origin of these abilities in dogs.

2. Study 1

The purpose of this study is to evaluate the acquisition, extinction and re-acquisition of the gaze towards the human face to ask for food in Pampas foxes. To achieve this aim, animals were exposed to a conflict situation involving food in sight but out of their reach. During acquisition, an experimenter placed herself beside the food source and reinforced with a piece of food the subject every time it gazed at her face. In the extinction phase, the experimenter did not deliver the food anymore and during re-acquisition she reinforced the fox's gaze again. In each of these three phases, the gaze response is associated with a specific result (presence–absence–presence of food). As a consequence, a change in its duration would be expected to be closely connected to these outcomes. The experimental situation is similar to that used with domestic dogs in previous studies in which they modified their gaze duration depending on the reinforcement contingencies they received (see Bentosela et al., 2008; Jakovcevic et al., 2010). If we found that the foxes' gaze response is modified by these changes in consequences (as was observed with dogs), it can be assumed that instrumental learning is involved in the mechanisms of human–canid interspecific communication.

Since the animals showed fear responses to the proximity of people, including caregivers, it was necessary to modify the protocol used with dogs in order to facilitate foxes' learning performance. Modifications included a longer familiarization period, where proximity to people was reinforced, a longer duration of the acquisition phase and an instigation procedure at the beginning of this phase. These strategies were selected based on the principles of learning and behavior modification.

2.1. Method

2.1.1. Subjects

Subjects were seven adult Pampas foxes (*L. gymnocercus*; five males and two females) housed in social groups in two (8 m × 6 m) outdoor enclosures at the Experimental Zoological Station "Granja La Esmeralda" of Santa Fe, Argentina, tested with the permission of the Station's veterinarians. Enclosures were delimited by a 40 cm high brick wall and by a 2 m high wire mesh. Inside, there was a 2 m × 2 m concrete kennel. In each enclosure there were four and five foxes, respectively. Two of them could not be tested due to