

Interspecific social skills in a highly socialized Aguará Guazú (maned wolf, *Chrysocyon brachyurus*). A pilot-subject study

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The maned wolf or Aguará Guazú (*Chrysocyon brachyurus*), is the largest canid of South America and shares with the grey wolf (*Canis lupus*) a common wolf-like ancestor. They are solitary and avoid individuals of the same or different species, even in captivity. There is little data on the behavior of this species, even though it is in danger of extinction and conservation strategies are being developed. The aim of this work is to assess the behavior of a maned wolf raised by humans on interspecific social and cognitive tasks – sociability toward a familiar person and toward a stranger, gazing at the human face to ask for food, and following human cues to locate hidden food. The results show numerous social behaviors and the ability to learn to use human cues to solve problems. We discuss the importance of intensive socialization at early stages on the development of canids.

Keywords: Maned wolf. Early learning. Sociability. Communication.

Habilidades sociales interespecíficas en un Aguará Guazú (*Chrysocyon brachyurus*) altamente socializado. Estudio de sujeto único

El Aguará Guazú (*Chrysocyon brachyurus*) es el cánido más grande de Sudamérica y comparte con el lobo (*Canis lupus*) un ancestro común. Es solitario e incluso en cautiverio evita a otros individuos de la misma u otra especie. Son escasos los datos sobre el comportamiento de esta especie, aun cuando se encuentra en peligro de extinción y se están desarrollando estrategias para su conservación. El objetivo del trabajo es evaluar un Aguará Guazú criado por humanos en tareas socio-cognitivas interespecíficas: la sociabilidad hacia una persona familiar y hacia un desconocido, la mirada a la cara humana para solicitar comida y el seguimiento de claves humanas para encontrar alimento oculto. Los resultados muestran altos niveles de sociabilidad así como la capacidad de aprender a usar claves humanas para resolver problemas. Se discute la importancia de la socialización intensiva en periodos tempranos del desarrollo en cánidos.

Palabras claves: Aguará Guazú. Aprendizaje temprano. Sociabilidad. Comunicación.

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Introduction

The maned wolf *Chrysocyon brachyurus* (Canidae, Carnivora) is the largest canid of South America and shares a common ancestor with the grey wolf *Canis lupus* (Wayne *et al.*, 1987). It is a solitary species. They are omnivorous, but take only small-medium size preys (i.e. rodents and birds) or fruits, and do not hunt together. However, males and females stay close during the breeding season, and in some cases they were observed travelling and resting together (Dietz, 1981). Female enter oestrus once per year, for around five days, and the peak of the breeding season is from April to June (Rodden *et al.*, 2004).

Considering that they are solitary and prefer tall grasslands (Rodden *et al.*, 2004), it is difficult to observe their behavior and there is scarce information about their socio-cognitive abilities in the wild. In addition, in captivity they usually avoid people and are intolerant of conspecifics (Brady and Ditton, 1979). In hand reared pups fear toward humans appears around days 27-35 (Fletchall *et al.*, 1995).

Many previous studies showed that socialization in the early age is vital for the relationship between wolves (*Canis lupus lupus*) and humans (Klinghammer and Goodman, 1987). Highly socialized wolves have remarkable communicative skills in the interaction with humans (e.g. Udell *et al.*, 2010; Bentosela *et al.*, 2016). These abilities can be related to the fact that wolves are highly social, live in packs and hunt together (Mech and Boitani, 2004). It is possible that these characteristics enhance their interspecific social skills.

This phenomenon has also been studied among foxes. For example, Pedersen *et al.* (2002) found that early handling of blue fox cubs (*Alopex lagopus*) decreased their fear responses toward humans in several behavioral tests.

This is a pilot-subject study that aims to evaluate the social skills of one maned wolf which was raised by humans from less than one month of age. Specifically, we assessed: 1) the levels of sociability towards both a familiar and an unfamiliar human during a sociability test; 2) gazing behavior towards the human face when food is visible but out of reach, and 3) the ability to follow proximal and distal pointing gestures to find hidden food.

Material and Methods

Subject

The subject was a female of one year old maned wolf (*Chrysocyon brachyurus*). It arrived to “Granja La Esmeralda” Experimental Zoological Station in Santa Fe Province, Argentina, when it was 25 days old. It was reared in permanent contact with the staff. At approximately six months of age, it was transferred to an individual enclosure where she currently lives. It received social daily visits from the staff during the first months after moving in. All the evaluations were carried out inside the subject’s enclosure.

Habituation procedure

Three months before the assessment, a female experimenter visited the subject twice a week, and interacted with it for 30 min on average (range of interactions times: 20 to 60 min. per visit). During these interactions, the experimenter played with the subject with sticks and balls, pet it and speak softly to it. In addition, she would give to her some food at random (cheese, sausage and liver) but she did not specifically reinforce the social interaction. This experimenter served as a familiar person during the studies.

Subject was evaluated in three tests (*Sociability test*, with a familiar and a stranger experimenter; *Gazing at the human face*; and *Object choice task*) on three different days, see below.

I. Sociability test

The test consisted of two phases of three minutes with no interval. Only the experimenter and the animal were present in the enclosure. The test was carried out in exactly the same way both when experimenter was a familiar person or a stranger. The first phase was passive: the experimenter provided social reinforcement through petting and soft talking during two-three sec. only if the subject approached her at a distance of less than 50 cm. When the subject started to make physical contact again, the experimenter responded in the same

way. If it did not approach, the experimenter remained stationary until the three min. finished. Immediately after this phase, an active phase (3 min.) began in which the approach was facilitated through calls, positive words, sounds, soft clapping, etc. The experimenter could talk, pet, and play with the subject (see Figure 1A).

We measured the time the animal spent near and in contact with the experimenter in each phase. Additionally, we registered the appearance of greeting and following behaviors when the experimenter entered the enclosure.

II. Gazing at the human face

The objective of this test was to evaluate whether subject was capable of learning to use its gaze as a communicative



Figure 1. Experimental set of sociability test (A), gazing at the human face task (B) and object choice task using proximal (C) and distal pointing (D).

response to a person (see Figure 1B). The procedure comprised four phases:

1. Baseline (BL): the experimenter sat with the bowl on her lap and gave to the subject five pieces of food at random intervals. Then called the subject by its name and gave it the last piece of liver. At this point, she started making eye contact with the subject for two min. without giving any more food. After a one min. interval, the second phase took place.

2. Acquisition: the subject had to gaze at the face to get a piece of food. During the first two-three min. gaze training trials, instigation was used, consisting of placing food at one side of the experimenter's eye line. If the subject gazed at her face, the reward was immediately given and instigation was repeated. After these two trials, three (3 min.) training trials without instigation were conducted.

3. Extinction: no food was provided regardless of the animal's responses. One to three min. extinction trial was conducted.

4. Re-acquisition: to control possible satiety or fatigue effects, a three min. recovery trial was performed where the response was again reinforced. The interval between trials and phases was of one min. The cumulative duration of the gaze (s) was calculated in each trial for each phase, as well as the time spent in close proximity (less than 75 cm) to the experimenter.

III. Object choice task

The goal of this test was to evaluate whether the subject was able to follow human cues to find hidden food. The procedure consisted of an object choice task in which there were two bowls, one of them contained food, and the animal had to find the food following a human cue. In order to control odor cues both bowls were spread with a piece of liver. One experimenter

was inside the enclosure and the other, who pointed the bowls, was outside the cage.

The procedure included two cues of increasing degree of difficulty: proximal pointing (Figure 1C) and distal pointing (Figure 1D). Six pre-training trials were conducted where the experimenter placed a piece of liver in one of two bowls in full view of the subject. When the subject approached the container, the experimenter provided the reinforcement giving the food with her hand through the fence. After pre-training, ten proximal pointing trials were conducted (the distance between the experimenter's index and the bowl was 10 cm). If the correct bowl was picked, then the experimenter rewarded it with a piece of food through the fence.

At the end of this phase, two control trials were performed. The objective was to assess if there were inadvertent cues that guided the subject's responses. During these trials, the experimenter did not emit any cue. If the subject chose the correct bowl, it received reinforcement, otherwise it did not.

After control trials, ten distal pointing trials were performed. In this case, the experimenter stood between the containers so that the distance between her index and the bowl was greater than 50 cm. The rest was similar to the proximal pointing phase.

Finally, six control trials similar to the above were carried out. The number of correct, incorrect, and non-choice responses was recorded for each phase (proximal and distal pointing and control).

Ethical note

This work fulfills ethical standards for animal care and has been approved by the Institutional Committee on Care and Use of Experimental Animals (CICUAL) at the Institute for Medical Research IDIM – CONICET, Resolution N° 036-16.

Results

I. Sociability test

The subject spent 100% of the time in close proximity and 97.8% of the time in contact with the familiar experimenter in the passive phase. During the active phase it spent 96.6% and 88% of the time in close proximity and in contact, respectively (see Figure 2). In addition, it showed greeting and following behaviors like licking, muzzling and ears down when the experimenter entered the enclosure. This suggests that the subject showed social responses toward the familiar person along most of the test, which may indicate that the human was a powerful reinforcement for her.

In the case of the unfamiliar experimenter, the subject spent 77.3% of the time in close proximity and 64.8% in contact with experimenter in the passive phase. In the active phase, this time dropped to 23.4% and 3.1%, respectively (Figure 2). Although the percentage with the unfamiliar person was lower, it spent more than

half of the duration of the trial interacting with the stranger, which again suggests the occurrence of interspecific social responses. Greeting and following responses were also observed when the person entered the enclosure.

It is interesting to note that a preliminary test was conducted to assess sociability in the adjacent enclosure inhabited by two Aguará Guazú, and neither of them approached the experimenter nor even became visible during the one-hour evaluation period.

II. Gazing at the human face

Figure 3 shows the percentage of time spent gazing (a) and staying in proximity (b) to the experimenter. These data indicate that the subject was capable of learning a communicative gazing response to access the reinforcement, and that it was flexible to changes in reinforcement contingencies.

III. Object choice task

The subject performed successfully using both human cues. Its performance

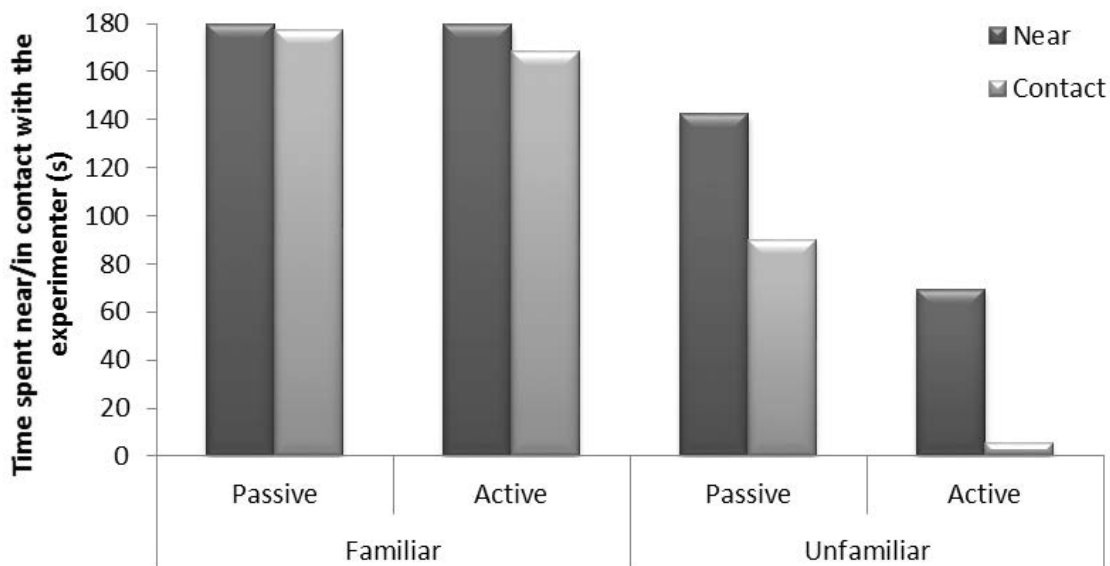


Figure 2. Time (s) spent near (less than 75 cm, gray bar) and in contact (white bar) with the familiar and unfamiliar person during the passive and active phase in the sociability test.

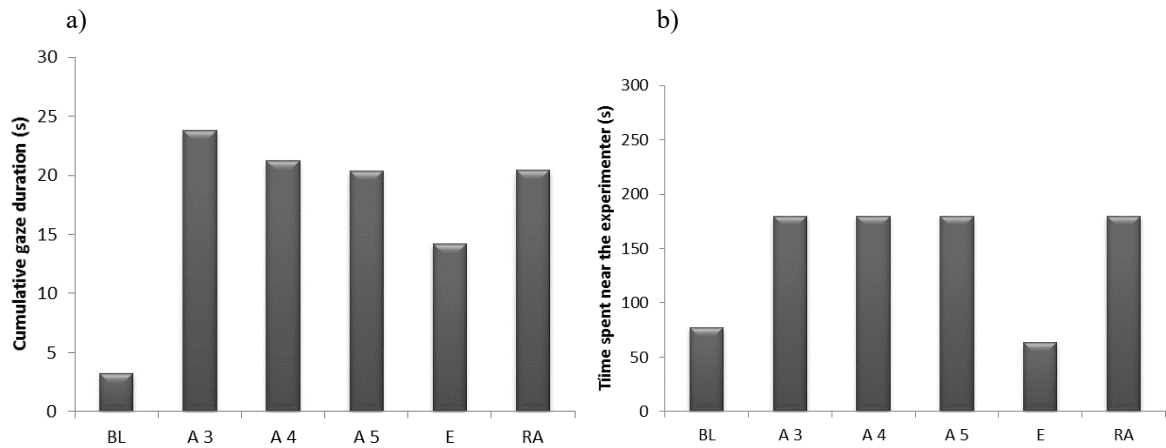


Figure 3. a) Cumulative time (s) of each trial of gazing at the human face when food is visible but out of reach. BL: baseline, A: acquisition, E: extinction, RA: re-acquisition. b) Cumulative time (s) of each trial that the subject spent near the person (less than 75 cm) during gazing at the human face task.

was above chance in both, proximal pointing (binomial test, $p=0.009$; correct choice 90%) and distal pointing (binomial test, $p=0.0009$; correct choice 100%). On the other hand, she performed at random in control trials (binomial test, $p=0.218$; correct choice 65.5%).

Discussion

In our study we have demonstrated that an Aguará Guazú, reared by humans from an early stage, is capable of developing complex social responses toward humans. These skills included approaching and looking for contact both with a familiar and an unfamiliar person, gazing at the human face asking for food and following human cues in order to find a hidden reward.

As observed in socialized wolves (Bentosela *et al.*, 2016), social responses were more intense towards the familiar person, which suggests the existence of a previous bond between them. It should be noted that this bond was established over a relatively short period of time (nearly three months of interaction). This is similar to what was observed in shelter dogs which

showed attachment behaviors towards a human after brief positive interactions, even as adults (Gácsi *et al.*, 2001).

It is important to bear in mind that the subject's socialization was intense and from an early stage of development. This could have helped not only to create bonds with humans but also to increase the probability of learning to interact with them and also establish new relationships along her lifetime. These opportunities to learn are also related to the fact that the subject, like socialized wolves, depended on people to access most of the valuable resources. Therefore, individuals were social tools (Leavens *et al.*, 2005), the means to an end, so that the motivation to learn to interact must have been undoubtedly high.

Regarding to the second task, gazing at the human face when food was inaccessible was flexible to changes in reinforcement contingencies. It increased during acquisition, decreased in extinction, and augmented again in re-acquisition. Such changes occurred fast, with little training time, and were accompanied by closeness to the person providing the food. These results are very similar to those obtained with

pet dogs (Bentosela *et al.*, 2008) and with Pampa foxes (Barrera *et al.*, 2012), and would suggest that the Aguará Guazú uses this communicative response in a flexible way while interacting with people. This is particularly striking as it was traditionally thought that the gazing response was exclusively used by dogs in uncertain situations or when reinforcement was not available (Miklósi *et al.*, 2003).

Finally, with regard to the following of pointing cues, evidence indicates that numerous species in captivity are capable of following them to find hidden food. Probably the hand-food association established from an early stage in life facilitates this type of learning (Udell *et al.*, 2010).

A significant limitation to our work is the fixed order of the tasks that might generate a learning effect on the performance. However, as it was a unique case, this variable could not be controlled. The only defined criterion was that the sociability test should be conducted first so as to obtain a spontaneous response from the animal, before it could relate the experimenters with food or with an evaluation situation.

At this point it should be noted that this is a single-subject study and as a consequence, it is not possible to know if these results can be replicated in other individuals or this is an exception. However, and considering the lack of information available regarding this species, this is a first step which opens an important issue regarding social behaviors in the Aguará Guazú for future investigations.

Despite being a single-subject study, this work provides two important contributions. First, it offers information on the repertoire of interspecific social and communicative responses of an under-researched species which, according to the Red Book of Mammals, is in danger of extinction (Díaz and Ojeda, 2000; Ojeda *et al.*, 2012). Knowing how the bond between the Aguará

Guazú and humans develops, expands or decreases is critical for handling these individuals. Second, it suggests that early experience is critical for the development of human bonds in this species. In this sense, this species is particularly interesting given its solitary habits and avoidance behaviors toward humans during captivity and in the wild. These behavioral characteristics are different from wolves' social habits. This discrepancy highlights the importance of the present results showing a great flexibility of social responses in this Aguará Guazú.

From an applied perspective, these data are particularly relevant especially considering that it is a species in danger of extinction (Ojeda *et al.*, 2012), and show that it is possible to form a bond with this species. It must be remarked that if the objective is to reinsert them in natural environments, this type of rearing could be unfavorable to the survival of the animals and they would need to be subjected to a program to gradually extinguish their positive behaviors toward humans and increase their avoidance. Instead, if there are no possibilities of reintegration and the animal has to remain in captivity, these results show that interaction with humans could be a valuable source of social enrichment.

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Bibliography

- BARRERA, G., JAKOVCEVIC, A., MUSTACA, A. and BENTOSELA, M. Learning and Interspecific Communicative Responses in Pampas Foxes (*Lycalopex gymnocercus*). **Behavioural Processes** 89: 44–51, 2012.
- BENTOSELA, M., BARRERA, G., JAKOVCEVIC, A., ELGIER, A. M. and MUSTACA, A. E. Effects of reinforcement, reinforcer omission and extinction on a communicative response in domestic dogs (*Canis familiaris*). **Behavioural Processes** 78: 464–469, 2008.
- BENTOSELA, M., WYNNE, C., D'ORAZIO, M., ELGIER, A. and UDELL, M. Sociability and gazing toward humans in dogs and wolves: simple behaviors with broad implications. **Journal of the Experimental Analysis of Behavior** 105: 68–75, 2016. (doi: 10.1002/jeab.191)
- BRADY, C. A. and DITTON, M. K. Management and Breeding of Maned Wolves at the National Zoological Park, Washington: International Zoo Yearbook 19: 171–176, 1979.
- DÍAZ, G. B. and OJEDA, R. A. Libro Rojo Mamíferos Amenazados de la Argentina. Mendoza: Sociedad Argentina para el Estudio de los Mamíferos, p.106, 2000.
- DIETZ, J. M. Ecology and Social Organization of the Maned Wolf (*Chrysocyon brachxurus*). Doctoral dissertation, Michigan State University, East Lansing, Michigan, 1981.
- FLETCHALL, N. B., RODDEN, M. and TAYLOR, S. Maned Wolf Husbandry Manual. Maned Wolf. SSP. p.76, 1995.
- GÁCSI, M., TOPÁL, J., MIKLÓSI, A., DÓKA, A. and CSÁNYI, V. Attachment Behavior of adult dogs (*Canis Familiaris*) living at rescue centers: Forming new bonds. **Journal of Comparative Psychology** 115: 423–431, 2001.
- KLINGHAMMER, E. and GOODMAN, P. Socialization and management of wolves in captivity. In H. Frank (Ed.), Man and wolf: advances, issues and problems in captive wolf research. Springer, Amsterdam, 1987.
- LEAVENS, D. A., RUSSELL, J. L. and HOPKINS, W. D. Intentionality as measured in the persistence and elaboration of communication by chimpanzees (*Pan troglodytes*). **Child Development** 76: 291–306, 2005.
- MECH, D. L. and BOITANI, L. Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. In SILLERO-ZUBIRI, C.; HOFFMANN, M.; MACDONALD, D. W. IUCN/SSC Canid Specialist Group. Gland, Switzerland and Cambridge, UK. x + 430 p., 2004.
- MIKLÓSI, A., KUBINYI, E., TOPÁL, J., GÁCSI, M., VIRÁNYI, Z. and CSÁNYI, V. A. Simple reason for a big difference: Wolves do not look back at humans but dogs do. **Current Biology** 13 (9): 763–766, 2003.
- OJEDA, R. A., CHILLO, V. and DIAZ, I. G. B. Libro Rojo de mamíferos de la Argentina. Sociedad Argentina para el estudio de los mamíferos (SAREM), 2012.
- PEDERSEN, V., MOELLER, N. H. and JEPPESEN, L. L. Behavioural and physiological effects of post-weaning handling and access to shelters in farmed blue foxes (*Alopex lagopus*). **Applied Animal Behaviour Science** 77: 139–154, 2002.
- RODDEN, M., RODRIGUES, F. and BESTELMEYER, S. Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. In SILLERO-ZUBIRI, C.; HOFFMANN, M.; MACDONALD, D. W. IUCN/SSC Canid Specialist Group. Gland, Switzerland and Cambridge, UK. x + 430 p., 2004.

UDELL, M. A. R., DOREY, N. R. and WYNNE, C. D. L. What did domestication do to dogs? A new account of dogs' sensitivity to human actions. **Biological Reviews** 85: 327–345, 2010.

WAYNE, R. K., NASH, W. G. and O'BRIEN, S. J. Chromosomal evolution of the Canidae. 1. Species with high diploid numbers. **Cytogenetics and Cell Genetics** 44: 123–133, 1987.