



Dishabituation to the mirror in domestic dogs: a pilot study

A. Ogi^{*1}, V. Naef², S. Bacchi¹, A. Gazzano¹

¹Department of Veterinary Science – University of Pisa, Pisa, Italy.

²Neurobiology and Molecular Medicine, IRCCS Stella Maris, Pisa, Italy.

Abstract: It is well-known that domestic dogs have not passed the mirror self-recognition test. Therefore, to investigate the self-awareness of this species, different kind of test is needed. The role of habituation/dishabituation process and the possible predilection in using olfaction are the two main “hidden” variables in designing cognitive studies in dogs. Therefore, the aim of this study was to assess the influence of dishabituation and olfaction in a combined stimuli behavioral test. Nine dogs were tested in two different settings: the glass setting (GS) and the mirror setting (MS), during the GS dogs were facing a glass and during the MS they were facing a mirror. Each setting was divided into two phases of 3 minutes: one in the presence of a second dog behind the glass (GS+) or the mirror (MS+), and one in the absence of the second dog behind the glass (GS-) or the mirror (MS-). The difference between MS- and GS+ relative duration of the glass/mirror-oriented gaze was statically significant ($p=0.012$). This combined multimodal approach could help to clarify the role of habituation/dishabituation process in testing self-recognition in dogs..

Key Words: Dog; mirror; habituation; dishabituation; self-recognition; olfaction.

* Corresponding Author: asahi.ogi@vet.unipi.it

Introduction

The scientific literature on dog behavior is primarily focused on two main fields: on the one hand, many studies were carried out on social (Mariti et al., 2020) and non-social (Ogi et al., 2017) cognition (Bensky et al., 2013) on the other hand lot of research was performed on the physiological bases of emotions, investigating at specific roles of specific biomarkers, like cortisol (Ogi et al., 2020), serotonin (Gazzano et al., 2019), and oxytocin (Ogi et al., 2021). On the contrary, little is known about self-recognition and self-awareness in this species.

Since Gallup conducted his initial study on chimpanzees in the seventies (Gallup, 1970), the mark test has been used in a binary framework in order to confer, or not confer, the self-awareness ability to different species (Baragli et al., 2017; Plotnik et al., 2006; Reiss et al., 2001). The animals were exposed to a mirror for a period of habituation, after which a mark was placed in a portion of a body not directly visible to the animals. The species that tried to remove the mark were classified as species able to recognize themselves and, to some degree, species capable of self-awareness.

However, when recently a cleaner wrasse (*Labroides dimidiatus*) passed the test (Kohda et al., 2019), the debate on validity of the mark test in determining self-awareness has reopened.

Defining the self-awareness starting by a definition of human self-awareness with a top-down approach was previously questioned by de Waal & Ferrari (de Waal & Ferrari, 2010), and the study on the cleaner fish has generated a greater distrust in this anthropocentric and binary view (de Waal, 2019).

Materials and methods

The study was conducted in two contiguous rooms separated by a door. Each room is provided with an independent access. The door between the two rooms was replaced by a modified door, which could accommodate a glass or a mirror of the same dimensions. Nine privately owned dogs habituate to their image in the mirror, 6 spayed females and 3 intact males (mean \pm standard deviation age = $5 \pm 2,77$ years), were tested in two different settings: the glass setting (GS) and the mirror setting (MS) - depending on the material installed on the modified door. Each setting was divided into two phases of 3 minutes. During each phase, a slow feeder bowl was placed near the glass/mirror. In the first phase (phase A) the tested dog ate food in the presence of its owner only, in front of the glass (GS-) or mirror (MS-). In the second phase (phase B) the tested dog ate food in the presence of another dog situated across the glass (GS+) or mirror (MS+) (Figure 1). The dog recruited for testing the behavioral response of the nine dogs was a 5-year-old, crossbreed, spayed female, unknown to the tested dogs. During the tests, the owners remained with their dogs without interacting with them. All four phases were randomly administered to the dogs.

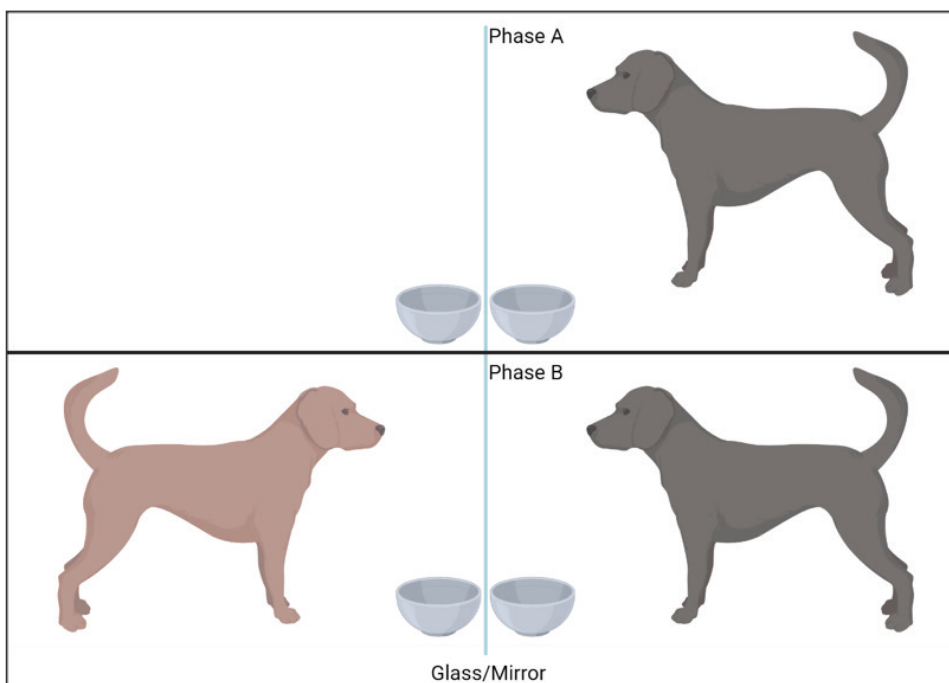


Figure 1. The two phases of the test. Phase A: tested dog alone. Phase B: tested dog in the presence of another dog. The two phases have been repeated in identical manner in the two different settings: glass setting (GS) and mirror setting (MS). Created with BioRender.com.

The behavior of the tested dogs was video recorded with two JVC Everio Disk Camcorder (JVC® GZ-MG 130E). One camera was positioned on a 150-cm-tall tripod located laterally to the tested dog, and the other was positioned frontally to the tested dog during the GS, and posteriorly to the tested dog during the MS. Each 3-min video was analyzed through a continuous sampling method by an expert, observing the gaze orientation of the tested dogs during all four phases (MS-, MS+, GS-, GS+). The relative duration of the glass/mirror-oriented gaze was determined to conduct a comparative assessment between the four phases. The statistical analysis was performed using GraphPad Prims 7.0 software. The significance between the four phases was determined by non-parametric Wilcoxon signed rank test ($p \leq 0.05$).

Results

The difference between MS- and GS+ relative duration of the glass/mirror-oriented gaze was statically significant ($p=0.012$).

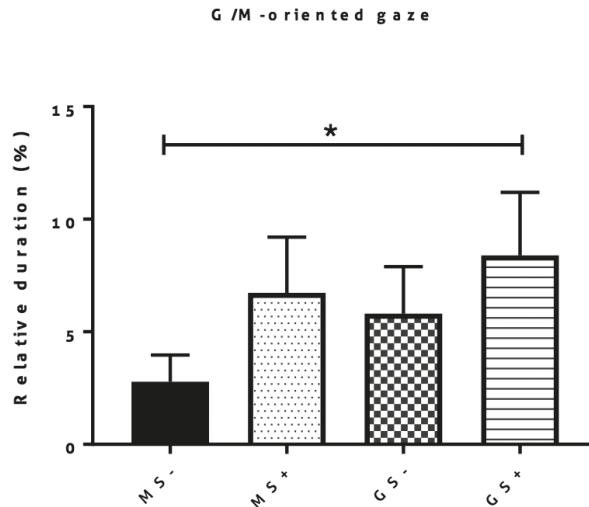


Figure 2. Glass or Mirror (G/M)-oriented gaze in Mirror Setting without the second dog (MS-), Mirror Setting with the second dog (MS+), Glass Setting without the second dog (GS-), Glass Setting with the second dog (GS+). The values are expressed as mean \pm standard error of the mean (SEM). * $p \leq 0.05$.

Discussion

The slow feeder bowl was placed near the glass/mirror in order to guide the subjects near the modified door between the two rooms and to elicit a possessive behavior. The possession-related distress was supposed to lead the tested dogs to perceive the reflected image in the mirror – or the other dog – as a possible threat.

Considering the orientation gaze as a measure of the interest/apprehension toward the stimulus, the main finding of this study highlights the low interest of the tested dogs in staring their reflection during MS- phase versus the high interest in staring the second dog in the GS+ phase.

Even though no significant differences between the other phases were found, the time spent by dogs gazing the mirror in the presence of the second dog (MS+) was slightly higher than the time spent by dogs gazing the glass in the absence of the second dog (GS-). This data could partially confirm that the sight is not the primary sense in dogs (Gazit, 2003). Moreover, our results support the hypothesis that the olfaction is crucial in cognitive task (Bräuer, 2020; 2021) and corroborate the urge of considering the impact of all the senses, olfaction in particular, in testing this species.

Dogs involved in this study were habituated to their reflected image, in fact, during the MS-phase they were little interested in their own reflection by itself. However, the perception of a second dog behind the mirror has increased the mirror-oriented gaze more than the glass-oriented gaze without the second dog (GS-). Even so, the behavior expressed during MS- phase could be an indicator of “partial” self-recognition in dogs or, at least, an indication that dogs realize that their reflection is no stranger.

The relative duration of the mirror-oriented gaze during the MS+ phase could be an indicator of a dishabituation process because the behavioral response was partially recovered and the interest towards the mirror was higher than the interest towards the glass during the GS- phase. Com-

binning the odor of another dog with the reflected image of the tested dog converts the familiar stimulus into an unfamiliar one, as suggested by Gallup & Anderson (Gallup & Anderson, 2018) in interpreting the findings of Horowitz in the “olfactory mirror” test (Horowitz, 2018).

As suggested by Gallup and colleagues (Gallup & Anderson, 2018), we do not think that if a dog can recognize itself both in olfactory and visual task, it necessarily means that dogs “has an ensemble of separate sensory self-concepts” (Gallup & Anderson, 2018). Moreover, we do not think that a separate sensory approach could answer to the questions about self-awareness in dogs, and possibly not even a combined multimodal approach like the present one.

Having said that, this study could help to clarify the role of habituation/dishabituation in designing cognitive studies in dogs and, more important, the possible predilection of dogs in considering olfactory stimuli compared to visual ones.

References

- Baragli P., Demuru E., Scopa C., Palagi E. Are horses capable of mirror self-recognition? A pilot study. *PLoS One* 2017, 12, e0176717, doi:10.1371/journal.pone.0176717.
- Bensky M.K., Gosling S.D., Sinn D.L. *The World from a Dog's Point of View*. In *Advances in the Study of Behavior*; Elsevier Inc., 2013; Vol. 45, pp. 209-406 ISBN 9780124071865.
- Bräuer J., Blasi D. Dogs display owner-specific expectations based on olfaction. *Sci. Rep.* 11: 3291; 2021; doi:10.1038/s41598-021-82952-4.
- Bräuer J., Hanus D., Pika S., Gray R. Uomini, N. Old and New Approaches to Animal Cognition: There Is Not “One Cognition.” *J. Intell.* 8: 28; 2020; doi:10.3390/jintelligence8030028.
- de Waal F.B.M., Ferrari P.F. Towards a bottom-up perspective on animal and human cognition. *Trends Cogn. Sci.* 14: 201–207; 2010; doi:10.1016/j.tics.2010.03.003.
- de Waal F.B.M. Fish, mirrors, and a gradualist perspective on self-awareness. *PLOS Biol* 17. 2019; e3000112, doi:10.1371/journal.pbio.3000112.
- Gallup G.G. Chimpanzees: Self-Recognition. *Science*, 167: 86-87; 1970; doi:10.1126/science.167.3914.86.
- Gallup G.G. & Anderson J.R. The “olfactory mirror” and other recent attempts to demonstrate self-recognition in non-primate species. *Behav. Processes* 148: 16-19; 2018; doi:10.1016/j.beproc.2017.12.010.
- Gazit I., Terkel J. Domination of olfaction over vision in explosives detection by dogs. *Appl. Anim. Behav. Sci.*, 82: 65-73; 2003; doi:10.1016/S0168-1591(03)00051-0.
- Gazzano A., Ogi A., Macchioni F., Gatta D., Preziuso G., Baragli P., Curadi M.C., Giuliotti L., Sergi V., Casini L. Blood serotonin concentrations in phobic dogs fed a dissociated carbohydrate-based diet: A pilot study. *Dog Behav.* 5; 2019; doi:10.4454/db.v5i2.103.
- Horowitz A. Smelling themselves: Dogs investigate their own odours longer when modified in an “olfactory mirror” test. *Behav. Processes* 143: 17-24; 2017; doi:10.1016/j.beproc.2017.08.001.
- Kohda M., Hotta T., Takeyama T., Awata S., Tanaka H., Asai J., Jordan A.L. If a fish can pass the mark test, what are the implications for consciousness and self-awareness testing in animals? *PLOS Biol.* 17; 2019; e3000021, doi:10.1371/journal.pbio.3000021.
- Mariti C., Lenzini L., Carlone B., Zilocchi M., Ogi A., Gazzano A. Does attachment to man already exist in 2 months old normally raised dog puppies? A pilot study. *Dog Behav.* 6: 1-11; 2020; doi:10.4454/db.v6i1.96.
- Ogi A., Fortunato D. Influence of the familiarity with the handler on the dog's paw preference. *Dog Behav.* 3: 13-18; 2017; doi:10.4454/db.V3i1.52.
- Ogi A., Mariti C., Baragli P., Sergi V., Gazzano A. Effects of Stroking on Salivary Oxytocin and Cortisol in Guide Dogs: Preliminary Results. *Animals* 10: 708; 2020; doi:10.3390/ani10040708.
- Ogi A., Mariti C., Pirrone F., Baragli P., Gazzano A. The Influence of Oxytocin on Maternal Care in Lactating Dogs. *Animals* 11: 1130; 2021; doi:10.3390/ani11041130.
- Plotnik J.M., de Waal F.B.M., Reiss D. Self-recognition in an Asian elephant. *Proc. Natl. Acad. Sci.* 103: 17053-17057; 2006; doi:10.1073/pnas.0608062103.
- Reiss D., Marino L. Mirror self-recognition in the bottlenose dolphin: A case of cognitive convergence. *Proc. Natl. Acad. Sci.* 98: 5937-5942; 2001; doi:10.1073/pnas.101086398.

Disabituazione allo specchio nel cane: uno studio pilota

A. Ogi¹, V. Naef², S. Bacci¹, A. Gazzano¹¹ *Department of Veterinary Science – University of Pisa, Pisa, Italy.*² *Neurobiology and Molecular Medicine, IRCCS Stella Maris, Pisa, Italy.**Sintesi*

È largamente risaputo che il cane domestico non ha superato il test di auto-riconoscimento allo specchio. Pertanto, per indagare l'autoconsapevolezza di questa specie, si sono resi necessari diversi tipi di test. Il ruolo del processo di abitudine/disabituazione e la possibile predilezione per l'uso dell'olfatto sono le due principali variabili "nascoste" nella progettazione degli studi cognitivi nel cane. Per questo motivo, lo scopo di questo studio è stato valutare l'influenza della disabituazione e dell'olfatto in un test comportamentale con stimoli combinati. Sono stati testati nove cani in due diversi setting: il setting con il vetro (GS) e il setting con lo specchio (MS), durante il GS i cani sono stati posti di fronte a un vetro e durante l'MS di fronte a uno specchio. Ogni setting è stato suddiviso in due fasi da 3 minuti ciascuna: una in presenza di un secondo cane dietro il vetro (GS+) o dietro lo specchio (MS+), e una in assenza del secondo cane dietro il vetro (GS-) o dietro lo specchio (MS-). La differenza tra MS- e GS+ della durata relativa del tempo di fissazione del vetro/specchio è risultata staticamente significativa ($p = 0,012$). Questo approccio combinato e multimodale potrebbe aiutare a chiarire il ruolo del processo di assuefazione/disabituazione nel testare l'auto-riconoscimento nei cani.

