



Peer Community In Animal Science

Gazing behaviour as a tool to study goat cognition

Isabelle Veissier based on peer reviews by **Richard Bon** and 1 anonymous reviewer

Jana Deutsch, Steve Lebing, Anja Eggert, Christian Nawroth (2024) Goats who stare at video screens – assessing behavioural responses of goats towards images of familiar and unfamiliar con- and heterospecifics. OSF, ver. 4, peer-reviewed and recommended by Peer Community in Animal Science. <https://doi.org/10.31219/osf.io/d4nzk>

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Many cognitive studies use paradigms based on active decision-making, that require that animals are motivated to participate and interested in the reward (e.g. Rivas-Blanco et al., 2023). By contrast, looking time paradigms, in which the visual attention of an animal to a stimulus is measured, requires little training and little action from the subject, and can be used without reinforcement (e.g. Wilson et al., 2023).

In this methodological paper, Jana Deutsch and her collaborators investigated the possibility of using a looking time paradigm to study perception and cognition in goats. The advantage of such a paradigm would be that it requires little training and can be used with no reinforcement. Goats were observed in front of two video screens presenting pictures of goats (familiar or not), of humans (familiar or not), or remaining white. The authors hypothesised that goats would pay more attention to pictures than to a white screen, would pay more attention to goats than to humans, and would discriminate familiar vs. unfamiliar beings. The goats had received previous positive contacts with the familiar humans. The goats were extensively habituated to the experimental set-up so that stress did not interfere in responses to testing. The stimuli were presented on the screens in a pseudorandomized and counterbalanced order.

As hypothesised, goats looked longer at screen with pictures, and longer when the picture was that of another goat (familiar or not) than of a human being. Goats however did not seem to discriminate between familiar and unfamiliar being, or were equally motivated by the two types of beings. Ear postures were also recorded but did not show a relation with looking time and were not related to the type of picture shown on screens. Therefore, the authors argue that looking time but not ear posture is considered appropriate to test discrimination abilities or preferences in goats. More studies are needed to check if goats can differentiate familiar vs. unfamiliar beings.

The experimental design is sound. The statistical analyses are rigorous and very relevant. The paper is clearly written.

I recommend the manuscript for publication for its originality and its quality; In addition, the paper bring findings – that looking time is an adequate paradigm in goats to analyse how they pay attention to stimuli – that have potential impacts on further studies in animal cognition.

References:

Deutsch, J., Lebing, S., Eggert, A., Nawroth, C. (2024). Goats who stare at video screens – assessing behavioural responses of goats towards images of familiar and unfamiliar con- and heterospecifics. OSF, ver.4 peer-reviewed and recommended by Peer Community In Animal Science.

<https://doi.org/10.31219/osf.io/d4nzk>

Rivas-Blanco, D., Monteiro, T., Virányi, Z., Range, F. (2024). Going back to “basics”: Harlow’s learning set task with wolves and dogs. *Learning & Behavior*. <https://doi.org/10.3758/s13420-024-00631-6>

Wilson, V. A. D., Bethell, E. J., Nawroth, C. (2023). The use of gaze to study cognition: limitations, solutions, and applications to animal welfare. *Frontiers in Psychology*, 14:1147278.

<https://doi.org/10.3389/fpsyg.2023.1147278>

Reviews

Evaluation round #2

DOI or URL of the preprint: <https://doi.org/10.31219/osf.io/d4nzk>

Version of the preprint: 3

Authors’ reply, 30 July 2024

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Decision by Isabelle Veissier, posted 08 June 2024, validated 13 June 2024

Moderate revisions

Dear authors,

I thank you for providing a revising version of your manuscript and explaining changes in an accompanying letter.

I thank you for shortening the introduction and discussion and for making them more to the point, and for addressing the reviewers’ comments. There are still some points that need to be considered.

Answers to Reviewer 1

You provide answers in the response letter but did not necessarily change the manuscript. It is important to address reviewers’ comments also in the manuscript, namely:

- justification of female should also be in manuscript
- The explanation on previous positive human contacts that you provided to Rev 1 (“*feeding them with dry pasta, if possible touching and petting them) on a regular basis (once a day, five days per week) ’*”) should be in text
- The fact that you already observed that goats differentiate geometrical stimuli could be added in discussion, maybe in § from L 465
- Potential interference due to social relationship: to be added in discussion

Answers to Reviewer 2

Again some answers are provided only in the letter. Please add information in the manuscript. Below are the points in your letter that should also be mentioned in manuscript:

- *Screen height: 'Subjects standing in front of the apparatus were considered to look approximately at the centre of the screens'*
 - *The start of the data collection was adjusted individually for each session based on the behaviour of each subject. When the goat entered the testing area, approached the apparatus and was standing relatively calmly in front of it, the session was started. Sometimes, individual subjects first explored the testing area before approaching the apparatus which led to a delay in starting the session.*
 - *As at least one motivational trial alternated with a test trial, the four stimuli of one session were presented with a break between stimuli presentation of at least 10 seconds.*
 - *Coding the videos frame-by-frame enabled us to put the single frames into the course of ear movements. Using similar coding criteria for ear positions in a follow-up study had very high inter-observer agreement, further supporting the feasibility of our ethogram using a frontal camera.*
- > please provide figures on reliability (from that previous experiment)

Additional points

L452: replace 'they' by 'goats'

L460 and 461: use the same verb tense (could not and were' or cannot and are' (if you want to make a general statement)

L536 – 537: your hypothesis is only on goats since you have not tested other species → replace non-human animal (in this case goats)' by 'goats'

Author contribution: SL contributed only to data curation and investigation. It is essential that author contribute to the writing of the paper and agree with its content.

Evaluation round #1

DOI or URL of the preprint: <https://doi.org/10.31219/osf.io/d4nzk>

Version of the preprint: 1

Authors' reply, 28 May 2024

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Decision by **Isabelle Veissier**, posted 25 January 2024, validated 25 January 2024

Moderate revisions

Dear authors,

Your manuscript is well written and brings results interesting to the scientific community. The manuscript needs however revisions, especially in its introduction and discussion/conclusion. Based on the comments from reviewers and my own reading of the manuscript, I recommend that :

- The introduction is shortened (4 pages at present whereas introductions are often no longer than 2 pages) and more focused.
 - o The problem you want to address is stated in the second sentence of the introduction. However, you do not detail the different biases that are encountered with current paradigms and so it is not easy for the

reader to understand why the looking-time paradigms allows to eliminate these biases. This should be the core of the introduction.

- o The rest of the introduction can be easily reduced.
- o The objective of the study should be more clearly stated: is your objective to know if goats can discriminate between images of human vs conspecific and between images of familiar vs. non familiar being OR to know if a looking time paradigm allows studying socio-cognitive capacities in goats (and you use images of human vs conspecific and between images of familiar vs. non familiar to check this)?
- o You better justify the use of human faces
 - The discussion is shortened (6 pages at present which is quite a lot) and focused on answers you provide to the initial problem identified,
- o Answers might be that goats pay attention to images on a screen (at last looking varies) , they react differently to conspecific vs human faces (so such differences in behaviour are promising for researches on discrimination or ...), essentially looking time varies (so this seems a good variable to use in further studies using such paradigms), nevertheless there might be differences in perception that cannot be seen in looking time because it is the same for familiar vs unfamiliar images.
- o The precise reasons why goats don't behave differently in front of conspecific vs human faces or why they behave the same in front of familiar vs unfamiliar faces seems to me secondary.
- o I am not convinced by the structure of the discussion with headings, especially because they are organised as some grouping of results and not as answers to your objectives
 - You refine the description of methods
 - You address all specific comments from reviewers

Minor comment from my side:

L54: replace "while" by 'whereas' if you want to stress the opposition

I invite you to revise your manuscript according to the reviewers and my comments. Please make clear in the manuscript what you change (e.g. highlighting changes in yellow) and provide me with an accompanying letter where you indicate how you have addressed each comments and where (provide line numbers).

Regards

Reviewed by anonymous reviewer 1, 08 January 2024

This paper explores how goats discriminate between images of familiar and unfamiliar conspecifics and heterospecifics using a looking time paradigm in a goat-adapted apparatus. The paper is very well written and I enjoyed reading it. While the results deviate from findings in other species, the authors are cautious, considering diverse alternative explanations and acknowledging methodological limitations, offering valuable insights for future goat cognition research. I have some minor comments that I would like the authors to develop:

Methods:

- L193: Is there a specific rationale for exclusively focusing on females and this particular breed?
- L197: Could prior participation in other experiments have impacted the presented results?
- L282: Could you provide more details on human-goat interactions' qualitative and quantitative aspects?

Was this interaction sufficient for goats to be familiar with the experimenters, and was it limited to the experimental period?

Results:

- L426 and 436: Besides human/goat faces, could any other stimuli (a black dot, another species' face) yield similar results when compared to a white screen?

Discussion:

- L511: More details on how familiar humans and goats interacted are needed; see previous comments.
- L577: What about the social relationships of the tested animals with stimuli goats on the screen. Do you think a more in-depth study of their relationships could enhance understanding of their looking time?
- L703-704: I do not think this is correct, since you have some biases and uncontrolled parameters in your experiment that may have hindered a complete test of the concept.

Reviewed by **Richard Bon**, 23 January 2024

General comments

The term stimuli is too vague to introduce a precise theoretical framework. You use two-dimensional visual stimuli, i.e. non modified images of living organisms, from conspecifics and human faces. Human is not any ordinary heterospecific species: I mean that you don't consider human as a predator species? I suppose that a vast literature has been devoted to the fact that domestic animals have a long history with human species across domestication. That human is a familiar species of goats. You could have used another heterospecific species, such as a related capridae, a phylogenetically distant species, a predator... So why using human faces?

Indeed the introduction does not clearly posit the theoretical challenge(s). Your hypotheses (and predictions) are largely inspired by several studies investigating these questions using domestic and non-domestic animals.

Another concern regarding your results is the lack of data regarding the look of the empty screen. Thus, it is not easy to assess whether the faces are highly attractive, i.e. do goats spent much more time looking at the non-empty screen than at the empty one. What would have obtained if the goat were submitted to two empty screens?

The discussion is too long.

Comments regarding the text

L. At which height above the floor were the screen and the cameras recording frontally the goats positioned? I found the information in fig. 2. When looking at the horizon, at which height the gaze of goats hit the screens?

L. 313: when did you decide to start the data collection from the entrance in the testing area? Data collection: Did the goat always face/look towards one of the screen after eating the food reward. Did you respect a time delay between the presentation of images within a same test trial?

L. 228 : the term "back" wall is misleading: it is in the wall separating the two screens.

Video coding: how many did different persons code the video?

L. 334: what was the frequency of video frame acquisition?

L. 339: it is unclear what is " a head movement directed towards a screen": could you use the line joining the middle of the snout and cutting the segment joining the two eyes to decide objectively whether a goat was looking a screen; for instance it seems difficult to score that variable when the gaze is oriented in the middle of the two screens? See also l. 346

L 343: did you draw this line manually on each of the frames

L 346: unclear what is the wall containing the apparatus

L. 349: I discover that goats were climbing... what does this mean?

L. 350: how could you determine the snout was above the eyes' level because it is possible only using a camera positioned laterally

L. 352-353: what is the bottom wall: I do not understand this sentence

L. 378: coding ear position is the most contentious coding work: did you estimate the concordance index in this case. I do not understand how you could detect the 4 positions using only a frontal camera...

L385: why did you use first a non-parametric test and then a linear mixed-effect model (supposed to be more complete)? I am unclear whether the fact that familiar vs non-familiar images (paired in every sessions) effect was incorporated in the model...

L. 393: it is the total looking duration over 10-sec

The legend of figure 2.

Results

Fig 7 cannot be read. Why didn't you use the same representation as in fig 6?

Preference for S+ vs S-: is there an effect of trial session on the FL?

Difference session 4 vs session: did you compare looking duration during session 1 and session 5. Your difference session 4 vs session may represent an habituation and dishabituation effect...

Discussion

L. It is unclear for me

L. 477: "assessing attention and arousal" was not one of your objectives. Also how could you measure both of these variables?

L. 491-496: are these results a surprise? If you had presented a tree (instead of a goat/human) or even a predator vs an empty screen, what would have you expected?

L. 510: what do you mean by predisposition? In addition to your proposition, you could also discuss the case where goats never in contact with humans would have been confronted to a human face...

L. 526: It is difficult to interpret your results as an avoidance: the total duration of looking towards human face is not nil. To what extent the fixation of human faces is different from the empty screen.

L. 538: you cannot conclude that the difference of time looking a human image (session 4) and a goat image (session 5) represent/is an habituation-deshabituation mechanism. You have the data but you do not exploit them. Thus you may only suggest that the data could correspond to habituation-deshabituation. Because you pretend using a counterbalanced methods, did you observe the same thing with animals first presented to goat images and after human images.

Effect of stimulus familiarity: your methodology does not allow to test whether the goats discriminate familiar vs non-familiar faces. For instance, if you present simultaneously the two kinds of images, perhaps should you find different results.