1   Running title: Avoidance distance test in goats and cows

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7   **Avoidance distance test in goats: a comparison with its application in cows**

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1   **Abstract**

2   The present study investigates the feasibility in goats of an avoidance distance (AD) behaviour test

3   set up for cattle, and compares the results in the two species to assess the suitability of the test for

4   on-farm welfare evaluation in goat farms.

5   The tests were performed on 324 lactating cows (170 in small farms and 154 in large farms) and

6   271 lactating goats (108 in small farms and 163 in large farms), housed in free stall farms (12 dairy

7   cattle and 17 dairy goat farms) in the Province of Sondrio, Northern Italy, following a protocol

8   validated for dairy cows in the Welfare Quality® project.

9   After the assessors were adequately trained, this test was relatively easy to perform and no major

10   difficulties were faced in either species. Goats exhibited a higher level of confidence with humans,

11   as showed by lower AD (goats: 68.60 ± 4.98 cm; cows: 71.36 ± 4.37 cm; $p<0.10$) and higher

12   frequency of contacts (AD=0) (goats: 45.8%; cows: 31.2%; $p<0.001$).

13   Farm size significantly affected AD values (lower in small farms) and frequency of contacts (higher

14   in small farms) in goats, but not in cows. This was probably due to the less marked management

15   difference between large and small farms of cattle than those of goats.

16   The AD test seems feasible in goats; however, the experimenter contacted nearly half of the goats.

17   To improve the sensitivity, a further level - represented by the possibility of gently stroking the

18   goat's head after the contact - may be included in the test in addition to contact.

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20   **Key words:** Human-animal relationship, dairy cattle, goats, welfare, behaviour.

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1   Introduction

2   Many published studies provide proof of the major effect of stockmanship on animal production

3   (Hemsworth, 2003) and welfare (de Passillé and Rushen, 2005). Veal calves and dairy cows

4   handled with additional positive human contact show fewer stress responses to handling than

5   controls (Lensink et al.,2000; Waiblinger et al., 2002), whereas cattle fearing humans show acute

6   and chronic stress signs as well as reduced productivity (Rushen et al., 1999, Breuer et al., 2003).

7   The effect of the quality of human-animal relationship on productive traits and welfare has been

8   scarcely investigated in goats. In dairy goats, Jackson and Hackett (2007) found no positive effect

9   of gentling on milk fat and protein concentration; however, a significant increase of body weight

10   (indirectly assumed by heart girth measurements) was observed by the same authors in response to

11   a short gentling treatment. Lyons (1989) recorded lower levels of milk ejection impairment (lower

12   residual milk volumes) in human-reared than in dam-reared goats. Besides having positive effects

13   on production, a better human-animal relationship (for example in response to gentling treatments)

14   can positively affect goats' reactions to handling and makes the animals less fearful, thus

15   facilitating husbandry operations (Boivin and Bradstaad, 1996). The way that animals are handled,

16   as well as the frequency of human-animal interactions, influence the nature of the human-animal

17   relationship on farm and can be reflected in the behavioural responses of animals to humans during

18   specific tests (Hemsworth et al., 2000; Boivin et al., 2003; Waiblinger et al., 2006). Behaviour tests

19   that measure animals' reactions to humans enable us to gain information about their level of fear

20   determined by the quality and frequency of the previous human-animal interactions. For example,

21   cattle show more intense fear responses to humans in larger farms with higher levels of

22   mechanization, due to the lower frequency of contacts with the stockperson (Mattiello et al., 2009).

23   Human-animal behaviour tests are important parameters to include in on-farm welfare assessment

24   schemes and can be classed into three large categories: reactions to a stationary human, reactions to

25   a moving human and responses to actual handling (Waiblinger et al., 2006). The avoidance distance

26   test measures the distance at which an animal withdraws from an approaching human; its validity as

1 a welfare indicator has been verified in dairy cows by correlating the flight distances to stockmen

2 behaviour and to other human-animal tests. It has been proven that the different variables were

3 conceptually related and that the repeatability and the inter-observer reliability of the avoidance

4 distance test were satisfactory (Windschnurer et al., 2009a).

5 In dairy goats, an attempt to measure human-animal relationship was experimented by Lyons

6 (1989) using a stationary human, a moving human and a pursuing human test. The response of the

7 animals was measured only in terms of time (latency to proximity, time in proximity and latency to

8 contact); no avoidance distance was recorded in these tests. Jackson and Hackett (2007) also

9 measured human-animal relationship in adult dairy goats using a latency to approach test. Lyons

10 and Price (1987) recorded the time in contact with an unknown experimenter in a test pen as a

11 measure of avoidance behaviour to humans. Some measure of human-goat distance was taken by

12 Lyons et al. (1988) in a test arena. Most of these measurements require movement of the animals

13 from their home pen. Therefore they cannot be included in on-farm welfare evaluation schemes.

14 However, this sort of evaluation is being requested more often, in view of future certification

15 requirements which are presently raising the attention of the European Agricultural Policy

16 (European Commission, 2009).

17 In order to obtain useful information for the evaluation of human-animal relationship on goat farms

18 in the frame of an on-farm welfare evaluation scheme, the present study investigates the feasibility

19 in goats of an avoidance distance behaviour test set up for cattle, and compares the results from the

20 two species.

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22 **Material and methods**

23 The study was carried out in 12 dairy cattle and 15 dairy goat free stall farms located in the

24 Province of Sondrio, Northern Italy. Goat breeds were Saanen, Camosciata, Frisa and Bionda

25 dell'Adamello; cattle breeds were Brown Swiss, Bruna and Italian Holstein Friesian. The number of

26 breeding females in these farms ranged from 9 to 194 (mean ± s.e. = 67.0 ± 15.2) in goat farms and

from 30 to 200 in cattle farms (mean ± s.e. = 69.1 ± 14.5). Depending on farm size, the farms were classed as small (up to 50 breeding females) or large (more than 50 breeding females) (Table 1). In goat farms, manual interventions are still quite frequent: manure removal is done manually in 3/4 and milking in 1/3 of small farms. However, both interventions are mechanical in large goat farms. In cattle farms, regardless of their size, both manure removal and milking are mechanical.

Sample size depended on herd size and, in any case, the proportion of tested animals was never lower than 40% (Welfare Quality®, 2009). Avoidance distance (AD) tests to an unknown person were performed on 324 lactating cows and 271 lactating goats (once for each animal), following a protocol validated for dairy cows in the Welfare Quality® project (Windschnurer et al., 2009b). The observer (who had been previously specifically trained) entered the home pen and stood in front of the animal at a distance of 3 m, established a reciprocal visual contact with the animal, then started to move slowly towards the animal at a speed of one step/s, 60 cm/step and the arm lifted with an inclination of 45°, the hand palm directed downwards, without looking into the animal's eyes, but looking at the muzzle. When the animal showed the first avoidance reaction (moving backwards, turning or shaking its head), the observer recorded the AD as the distance from his hand and the muzzle of the animal, with a definition of 10 cm. This distance was estimated by sight; the accuracy of the estimates had been previously assessed during the training period. If the animal could be touched by the observer AD was 0, and this was defined as "contact".

Data were submitted to Kolmogorov-Smirnov test to verify the normality of the distribution. The effect of species (cows *vs* goats) and of farm size (small *vs* large) were investigated by means of non parametric analysis of variance (Kruskal Wallis test) for AD mean comparisons and by Chi square test for the comparison of frequency distribution of contacts.

Results and discussion

Training was essential in order to carry out the tests properly, assess distances and recognize possible confounding factors as disturbance by other animals or specific motivational states that

1   could affect the animals' reactivity. The test was relatively easy to perform and no major difficulties

2   were faced in either species.

3   AD data did not satisfy the assumptions of a normal distribution (mean ± s.e.=70.10 ± 3.29 cm,

4   min=0 cm, max=300 cm, interquartile range=120 cm, skewness=0.862, kurtosis=-0.613;

5   Kolmogorov-Smirnov test: df=595, $p < 0.001$), therefore they were submitted to non-parametric

6   analysis of variance. AD was lower in goats (n=271, mean ± s.e.=68.60 ± 4.98 cm) than in cows

7   (n=324, mean ± s.e.=71.36 ± 4.37 cm) and this difference approached statistical significance

8   (Kruskal-Wallis Chisq=2.87, df=1, p<0.10). The maximum AD recorded in cows was 300 cm,

9   while in goats it was only 200 cm. The frequency of contacts was significantly higher in goats (124

10   out of 271, 45.8%) than in cows (101 out of 324, 31.2%) (Pearson Chisq=13.35, df=1, p<0.001).

11   This suggests that goats have a higher level of confidence with humans. Goats are generally

12   described as a curious and highly reactive species, which often tends to exhibit exploratory

13   behaviour (Kilgour and Dalton, 1984; Houpt, 2005). This may be one of the factors explaining the

14   lower AD and higher frequency of contacts recorded in this species. Furthermore, in goat farms the

15   management practices are often based on manual procedures (e.g. for manure removal and

16   sometimes also for milking), and this may have positively affected goats' level of confidence and

17   lead to a lower level of fear in animals more accustomed to human contact. This is supported by the

18   fact that significant differences depending on farm size were found in goats, but not in cows (Table

19   2; Fig. 1). Consistent with these results, the percentage of contacts was affected by farm size only in

20   goats (70.4% of contacts in small farms *vs* 29.4% of contacts in large farms; Pearson Chisq=43.83,

21   df=1, p<0.001), while no difference was recorded in cows (32.4% of contacts in small farms *vs*

22   29.9% of contacts in large farms; n.s.). This might be due to the fact that the level of mechanization

23   in cattle farms is always high, even in small farms. Therefore, management differences between

24   large and small farms in cattle are less marked than in goats, and this might explain the lack of

25   significant differences in our cattle farms. It has to be remarked that, under different circumstances

26   (with more marked differences related to the level of mechanization), significant AD differences

were found in cattle depending on the type of management and on farm size (Mattiello et al., 2009). Our results in goats are further supported by earlier research reporting shorter avoidance distances in goats that were reared in small old farms than in large modern farms (Mattiello et al., 2008), in response to different farm size and level of mechanization. Frequent manipulation of the goats during daily activities seems to play a major role in reducing fear responses towards humans.

Conclusions

The AD test seems feasible in goats and was able to detect differences depending on farm size and, consequently, on management practices. Compared to cows, goats seemed generally more confident with man, and physical contact between the animals and the observer was more frequent than in cows. The starting distance for performing AD test in goats might therefore be reduced to 2 m, instead of the 3 m defined for cattle. Furthermore, as nearly half of the goats got in contact with the experimenter, in order to improve the test sensitivity a further level − which might be termed as "acceptance" - may be included in the test in addition to contact. The test would then include three levels: avoidance (ranging from 10 to 200 cm), contact (followed by immediate withdrawal) and acceptance (after the contact, the animal accepts gently stroking of the head).

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1 **Figure caption**

2 Figure 1. Box plots showing the distribution of avoidance distance (AD) in small and large farms of

3 goats and cows. The figure reports the median, the 25th and 75th percentiles, and the minimum and

4 maximum observed values that are not statistically outlying. Extreme values (points at a greater

5 distance from the median than 3 times the inter-quartile range) are also highlighted in the figure

6 with an asterisk (*).

7 Figure 1 title: Avoidance distance.