Applied Animal Behaviour Science, 32 (1991) 45–54
Elsevier Science Publishers B.V., Amsterdam

Effects of differential handling on the behaviour of domestic ewes (*Ovis aries*)

J.M. Mateo[a,1], D.Q. Estep[a] and J.S. McCann[b]

[a]*Department of Psychology, University of Georgia, Athens, GA 30602, USA*
[b]*Department of Animal and Dairy Science, University of Georgia, Athens, GA 30602, USA*

(Accepted 22 March 1991)

ABSTRACT

Mateo, J.M., Estep, D.Q. and McCann, J.S., 1991. Effects of differential handling on the behaviour of domestic ewes (*Ovis aries*). *Appl. Anim. Behav. Sci.*, 32: 45–54.

Thirty-three Suffolk and Suffolk × Hampshire ewe lambs raised under two different management systems were subjected to one of three handling regimens for 3 weeks. One group of 11 animals was exposed daily to gentle handling, while a second group of 11 was exposed daily to forced human handling. A third group of 10 animals received no handling. The animals were tested prior to handling training, just after training, and 3 weeks after the last training period on four standardized tests designed to simulate typical management practices. These included a test of approachability to the handler, movement through a chute, halter-restraint in proximity to the handler and simulated shearing. Results showed significant effects for gentle handling and for the source of the sheep in measures of approachability, but no effects in the other tests. Thus brief gentle contacts with handlers can improve the approachability of sheep, but breed or prior experience can modulate these effects.

INTRODUCTION

It has long been acknowledged that certain management practices are aversive to farm animals. Many typical handling procedures used for sheep, such as dipping, shearing, or foot-trimming appear to be aversive. The animals quickly learn to avoid areas and people associated with such experiences. Hemsworth and Barnett (1987) stated that as fear responses serve to protect animals from aversive stimuli, behaviours such as avoidance and approach can be used as indices of aversion to a given situation. Fell and Shutt (1989) have tested the behavioural responses of sheep to the specific handler that had restrained it during surgery. These sheep maintained greater distances and dispersed less than control sheep who received similar handling but no

[1]Present address: Department of Psychology, Mason Hall, University of Michigan, Ann Arbor, MI 48109-1027, USA.

surgery. However, there was no difference between the groups when tested with no human present or with the handler who regularly fed them. The authors suggested that the reactions of sheep to humans are specific to their individual experiences with the handlers.

According to Hutson (1985), aversive treatment serves as a negative reinforcer for sheep moving through the handling system. He found that positive food reinforcement such as barley reduced the amount of labour needed to move sheep through a race system into a handling machine. Thus it appears that positive reinforcement can reduce the negative responses to some handling treatments.

Frequent and gentle handling can also reduce the stress accompanying isolation and restraint, and may even initiate approach behaviours. According to Kilgour (1987), habituation can attenuate the fear normally associated with novel situations. Farm animals tend to habituate to repeated management procedures and thus learn to accept the restraint involved with such handling. Grandin (1989) allowed sheep that had previously experienced both electro-immobilization and restraint in a squeeze tilt table to approach the table to be restrained again. After a time, the sheep voluntarily accepted the tilt table restraint, with some even lining up to re-enter the system. A rapid training of unruly horses has been accomplished through slow approaches and gentle strokes by trainers. Within a few hours, these horses were reportedly tame and approachable (Kilgour, 1987). Lynch and McCarthy (1967) found that petting a dog during shock administration resulted in a decrease in heart rate, rather than the usual tachycardia associated with shock. However, it is not known if these reactions generalized to other humans or persisted over time.

Hemsworth and his colleagues facilitated swine body growth and approach behaviours with pleasant or positive human behaviours such as squatting, allowing voluntary approach by the pigs, and stroking with bare hands. Pigs handled aversively (shocked), handled inconsistently, or who were approached directly by an erect human wearing gloves showed increased latencies to approach and increased corticosteroid levels (Gonyou et al., 1986; Hemsworth et al., 1986; Hemsworth et al., 1987).

Gentle human contact also has positive effects on sheep. For example, stroking the heads and necks of pregnant ewes while quietly talking to them led to a decrease in muscle tension and an inhibition of escape, butting, and stamping behaviours typical of untamed animals (Pearson and Mellor, 1976). Hargreaves and Hutson (1990) found that gentled sheep exhibited decreased flight distances and heart rates in the presence of humans. Gentled sheep also had increased latencies to approach treatment areas, which was interpreted as decreased fear of the individual people associated with the situation, rather than an increased aversion to the treatments.

Thus, it appears that slow, gentle tactile and verbal stimulation from hu-

mans can be positively reinforcing to farm animals and can be used to tame them and to develop positive social relationships. In fact, Hediger (1964) asserted that "friendship between animal and man ... can only be achieved by unforced, voluntary approach on the part of the animal, and not through the irresistible force of contact" (p. 165).

Whereas some authors such as Hediger and Hemsworth seem to believe that gentle, unforced handling of animals is most effective for developing positive relationships with humans and reducing fear, it is not clear that gentle handling is superior to forced handling or to no handling at all in the performance of sheep on typical human–animal management tasks. It is also not clear that any reduction of fear responses to humans as a result of handling will carry over to other tasks. It could be that gentling or forced restraint training only affects certain classes of interactions with humans and does not produce a generalized effect on human–animal interactions.

The objective of our study was to determine if gentle unforced handling was superior to forced restrained handling or to no handling at all in affecting the sheep performance on a battery of standardized tests simulating management practices. The tests included: (a) an approachability test, in which sheep were allowed to approach and contact the human trainer; (b) a chute test in which isolated sheep were allowed to traverse a curved chute; (c) a halter test in which sheep were haltered and tied briefly to a post; (d) a simulated shearing test in which the sheep were restrained and shears were moved over their bodies.

Sheep have excellent long-term memories, especially of aversive experiences (Belschner, 1962). Hutson has empirically shown that sheep can remember routes through stockyards for at least 6 weeks, and show memory of handling procedures for up to 1 year, even when not rewarded (Hutson, 1980, 1985). Given these memory abilities, we also sought to determine whether the differential effects of handling, if any, would be retained following a 3 week period of no handling. Thus, animals were given the battery of tests: (1) prior to the start of handling as a baseline; (2) immediately after handling; (3) 3 weeks after training ended.

ANIMALS, MATERIALS AND METHODS

Animals

Of the 33 sheep studied, 17 Suffolk ewe-lambs were obtained from the small farm flock at the University of Georgia (Source 1), and 16 Suffolk × Hampshire cross-bred ewe-lambs were loaned from a large commercial breeder in Watkinsville, GA (Source 2). Animals were approximately 6–7 months of age when testing and training began. Sheep of this age were chosen because of both their relative maturity and their availability from within the two flocks.

A 2×3×3 mixed design was employed, with the independent variables of source (Sources 1 and 2), handling condition (gentle, control, and restrained), and test session (pre-, post- and re-tests). Sheep from each source were randomly assigned to one of the three handling groups. One sheep was used as a decoy, and was maintained with the control group.

Each of the three handling groups was restricted to one of three paddocks of approximately one-half of an acre each throughout the duration of the study. The location of the study was novel to both groups of sheep. Animals were provided with daily grain rations, and had access to Bermuda-grass pastures and ad libitum water.

Handling

During handling sessions, each sheep remained in a 2.4 m×4.0 m pen for 5 min, during which time it received the appropriate handling treatment. The decoy ewe was penned adjacent to the handling area during all handling sessions. She maintained a consistent, quiet behaviour, which apparently transferred to the individual sheep during their initial exposures to the handling situation. Each sheep received one handling session per day, 7 days per week for three weeks. This 21-day handling period was selected on the basis of prior research on sheep gentling (Pearson and Mellor, 1976); in addition, the handling duration was considered to be of a practical length for producers interested in gentling their sheep.

Animals in the unhandled control condition (UH) were individually moved into the pen and left alone for 5 min.

Each sheep in the gently handled group (GH) was encouraged to approach the trainer, who, with outstretched hands, called softly to the ewe. Attempts were made to rub the shoulders and neck of the sheep if it approached. The time span until each sheep sniffed the trainer's outstretched hand and permitted contact was recorded. The trainer sat in the pen near the decoy sheep to facilitate approach.

Each animal in the restrained group (RH) received similar auditory and tactile stimulation from the trainer while restrained in a head gate. The time taken until the sheep ceased struggling, as denoted by pulling and stamping, was recorded.

All handling procedures and testing were conducted by the first author, with various individuals assisting in moving the sheep into the pens. Apart from periodic health checks, the animals were not handled in any other manner. Additional details are in Mateo (1990).

Testing

All sheep were tested three times. The pre-test was conducted immediately before the handling trials, with the post-test immediately following the han-

dling periods. The re-test was conducted 3 weeks after the post-test. Four separate tests were conducted during each of the three test sessions.

During the approachability test, three sheep, one from each group, entered a 4 m×4 m pen with the trainer seated in the middle. The latencies for each of the three sheep to sniff the trainer's outstretched hand, or for the nose to come within 2 inches of the hand, were recorded.

Additional recordings were made of the number of times each sheep approached and sniffed the trainer and allowed tactile contact, with the trainer placing her hands on the animal. Observations were made for 5 min.

For the chute test, each sheep was taken singly to the start of a 9 m curved solid-sided chute and released. Latencies to traverse the chute were recorded. For those sheep which did not complete the chute within 7 min, the actual distance travelled was measured and noted, with a recorded time of 7 min.

The halter-restraint test consisted of fitting each sheep with a halter and tethering it to a post. The trainer sat quietly next to the ewe. The amount of time each sheep spent actively pulling on the halter in a 2 min period was recorded, as well as occurrences of vocalizations.

During shearing, sheep were restrained in a manner typical of shearing (first on their hindquarters then on their sides) and had a bladeless pair of shears passed over their bodies for 2 min. The number of kicks and vocalizations were recorded.

To determine if differences existed among the experimental groups prior to training, one-way analyses of variance (ANOVA) were conducted for all dependent variables on the pre-test measures alone. For these analyses, the independent variable was handling condition (gentle, restrained, and control). For all variables showing significant condition effects before training, three-way repeated measures analyses of covariance (ANCOVA) were performed, with pre-test scores serving as the covariate. However, for those dependent variables showing no significant differences prior to handling, three-way ANOVAs for unequal subjects were conducted (source×handling condition×test session) using post- and re-test scores. The purpose of this test was to determine what differences, if any, existed between the groups after handling, and whether these differences were retained for 3 weeks. Newman–Keuls post-hoc tests were used to determine specific significant differences between means for all analyses, and α was set at $P<0.05$. The decoy sheep participated in all three of the test sessions, but her data were not included in any of the analyses.

RESULTS

During the 21 days of differential handling training, latencies for sheep in the gentle group to approach the trainer were recorded daily, as were the times taken until restrained sheep ceased struggling in the head gate. Gentle han-

dling of the sheep resulted in a decrease ($P<0.01$) in latencies to approach. The means ± standard error, were 203.55 ± 35.92 s on Day 1 to 88.55 ± 32.12 s on Day 21. In addition, the sheep in the restrained condition appeared to habituate to their situation, as evidenced by the decrease ($P<0.05$) in time spent struggling, from 49.55 ± 21.96 s on Day 1 to 0 s on Day 21. In fact, after Day 8 of handling training, only one sheep continued to resist restraint.

Pre-test dependent variables

Significant pre-training differences existed between groups only for the number of kicks delivered by sheep during shearing, with restrained sheep kicking more often than the gentle or control sheep. Means for these groups were 4.27 ± 0.91 kicks for RH, 1.46 ± 0.25 kicks for GH, and 2.50 ± 0.52 kicks for UH. No other dependent variables showed significant differences.

Post- and re-test data

As there were pre-existing differences in the number of kicks made during shearing, a repeated measures ANCOVA was performed on the post- and re-test number of kicks. This analysis revealed no significant differences due to source, training condition, or test session.

Three-way ANOVAs for unequal subjects were conducted on the dependent measures that were not affected by pre-existing differences. Handling treatments affected the latencies to approach the trainer during the approachability test. Gently handled sheep had significantly lower latencies to approach than either the control or restrained groups ($P<0.05$). The mean times for approach were 144.95 ± 37.74 s for GH, 269.95 ± 20.63 s for RH, and 270.60 ± 17.43 s for UH. A main effect ($P<0.001$) for handling condition was seen for the number of times each sheep sniffed the trainer's hand in the approach test. The gently handled group sniffed the trainer more often than the other handling groups (1.82 ± 0.53 sniffs for GH, 0.43 ± 0.12 sniffs for RH and 0.40 ± 0.25 sniffs for UH). Although the restrained group was exposed to human contact more than the control group, the restrained sheep failed to seek out human contact more than the non-handled control sheep.

There was a source × handling condition interaction ($P<0.05$) for the number of tactile contacts allowed by the sheep during the approach test. Source 1 GH sheep allowed more tactile contact than any other combination of source and handling condition (Fig. 1). Source 2 sheep in the restrained group did not permit any physical contact.

There was a main effect ($P<0.05$) for the source of the subjects when the data on the number of sniffs made during the 5 min approach test were analyzed. Source 1 sheep sniffed the trainer's outstretched hand more frequently (1.38 ± 0.43 sniffs for Source 1 and 0.47 ± 0.24 sniffs for Source 2).

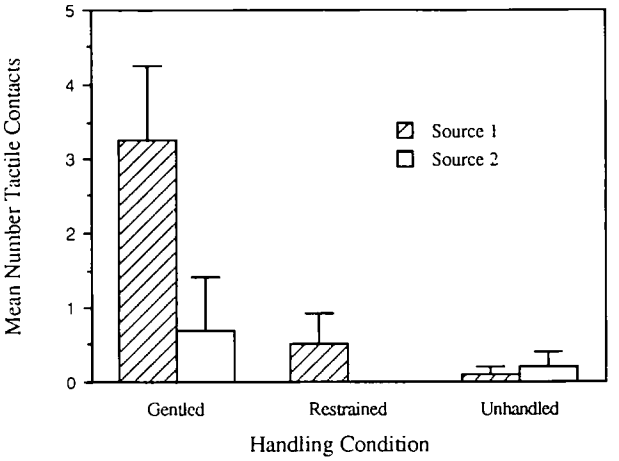

Fig. 1. Mean frequency (±SEM) of tactile contact across post- and re-test approach measures for animals from two sources in three handling groups.

Finally, there were no significant differences across the three handling groups in latencies to complete the chute test or for the amount of time spent pulling on the halter. A Cochran's Q analysis of the presence or absence of vocalizations during halter-restraint revealed no significant differences between groups or across time. There was insufficient variation in the number of vocalizations made during the shearing test, with only one vocalization made during the re-test from a control sheep.

DISCUSSION

We hypothesized that differential handling would affect the responses of sheep to various standardized tests. Indeed, such handling did affect sheep performance in the approach test, both immediately after training and 3 weeks later. Gently handled sheep approached more quickly and sniffed the trainer's hand more often than the restrained and control group sheep. In addition, the gently handled sheep from Source 1 allowed tactile contact more often than the other groups

Thus it appears that unforced handling of sheep results in decreased avoidance behaviours, characterized by a greater willingness to approach and contact humans. However, this attenuation of avoidance responses did not generalize to other situations such as shearing, halter-restraint, or running through a chute. Changes in behaviour were specific to the test measures that most closely paralleled actual training. Recall that the gentle handling situation was an active interaction between the sheep and the trainer, rather than a passive presentation of human stimuli typical of habituation procedures. This may

account for the lack of a general socialization to humans across the different testing situations.

Although there was a trend towards diminished responsivity to restraint in the head gate, such forced handling did not reduce evasive responses during subsequent interactions with humans. There were no significant differences in behaviour between sheep that were forcibly handled during restraint and those that received no handling. In the present study the decline of avoidance responses owing to forced restraint and handling was not found to be the persistent phenomenon anecdotally reported by other authors (Kilgour, 1987; Grandin, 1989). However, it is possible that by extending the restrained handling period by either using longer sessions each day or continuing handling over several months, negative responses to humans would eventually cease.

Fell and Shutt (1989) proposed that the passive nature of the handler during voluntary approach measures does not interfere with sheep behaviour as much as the aggressive nature of the handler who must push sheep through a system or onto a truck. In the present study, RH sheep, who were often forced into the head gate, experienced more disruptive encounters with handlers than the GH group, perhaps increasing the animals' fear of humans. Although the trainer was not the person who moved the sheep into the head gate, the reactions to such negative experiences could have generalized to her, preventing a potential decrease in fear responses as a function of handling training.

The source of the animals influenced the number of times sheep would approach and sniff the trainer's hand. Sheep acquired from the relatively small flock of the University of Georgia (Source 1) sniffed more often than the sheep obtained from the large commercial flock. There are a number of possible explanations for this finding. First, the genetic variation between the two sources could have been a significant factor in these observed differences. Sheep breeds vary in their flight distances (Grandin, 1987) and their responses to handling (Albright, 1987).

Second, the experiences of the sheep from the two sources prior to this study differed, and thereby may have contributed to the differences in handling effects seen in the approach measure. Being part of a much larger flock than Source 1 sheep, Source 2 sheep may have encountered fewer interactions with humans prior to the study. Perhaps Source 1 sheep, because of the somewhat small size of their original flock, had more positive encounters with humans, as the chances of being individually attended to were much greater. For example, these sheep most likely associated feeding time with the presence of particular people.

It is also possible that the environment each source was raised in differed in terms of its complexity. It is known that Source 1 sheep routinely had experience with barns, foot-baths and health checks, whereas Source 2 sheep did not. Pearce et al. (1989) found that pigs raised in enriched environments with 'toys' such as tyres and chains displayed less fear of humans than pigs

raised in barren environments, regardless of whether they received pleasant or unpleasant handling. The authors speculated that the availability of the stimuli improved the pigs' welfare by reducing their fear of humans. However, as individual sheep histories were not available in our study, the actual influence of prior experience or genetics on responses to handling could not be determined.

Hemsworth et al. (1990) showed that pigs who tended to avoid proximity and contact with humans also tended to have fewer matings. Such a finding suggests that human–animal relationships can indeed influence farm productivity. In fact, sheep may actually benefit from some forms of intensive management coupled with unforced handling, rather than infrequent and aversive interactions with humans that many large free-ranging flocks encounter.

The mechanisms of how handling influences human–animal relationships need to be investigated further. For example, the approach behaviours seen in the present study may generalize to other humans, rather than remain specific to the handlers involved. The persistence of such approach behaviours are not known. Anecdotally, when Source 1 sheep were returned to their pasture upon completion of the study, farm workers could immediately determine which sheep had been handled gently, based on the sheep's behaviour during interactions with them. These same workers later reported that the differences among the sheep were not readily apparent in passing months. Periodic re-training may be necessary to maintain approach behaviours. While unforced handling clearly affects the approach behaviours of sheep and pigs to humans, it is not known what other species would respond similarly to such treatment.

The results of the present study suggest that brief gentle handling of sheep does not affect the general ease of handling sheep, and therefore is probably not in itself a practical endeavour for the typical farmer. However, further research on the effects of early handling and intensive handling systems might reveal more generalized and long lasting effects of gentle handling. Such findings would lead to better, more efficient and more humane management of domestic livestock.

ACKNOWLEDGEMENTS

This material is based upon work supported under a National Foundation Graduate Fellowship to the first author. W. G. Holmes is gratefully acknowledged for his helpful comments on the manuscript, as are the anonymous reviewers. We also thank Allison Adams and Lauren Lewis for their assistance with the sheep.

REFERENCES

Albright, J.L., 1987. Human/farm animal relationships. In: M.W. Fox and L.D. Mickley (Editors), Advances in Animal Welfare Science 1986–1987. Martinus Nijhoff, Boston, pp. 51–56.

Belschner, H.G., 1962. Sheep Management and Diseases, 7th edn. Angus and Robertson, Sydney.

Fell, L.R. and Shutt, D.A., 1989. Behavioural and hormonal responses to acute surgical stress in sheep. Appl. Anim. Behav. Sci., 22: 283–294.

Gonyou, H.W., Hemsworth, P.H. and Barnett, J.L., 1986. Effects of frequent interactions with humans on growing pigs. Appl. Anim. Behav. Sci., 16: 269–278.

Grandin, T., 1987. Animal handling. In: E.O. Price (Editor), The Veterinary Clinics of North America, Food Animal Practice. Farm Anim. Behav., 3: 323–338.

Grandin, T., 1989. Voluntary acceptance of restraint by sheep. Appl. Anim. Behav. Sci., 23: 257–261.

Hargreaves, A.L. and Hutson, G.D., 1990. The effect of gentling on heart rate, flight distance and aversion of sheep to a handling procedures. Appl. Anim. Behav. Sci., 26: 243–252.

Hediger, H., 1964. Wild Animals in Captivity, Dover, New York.

Hemsworth, P.J. and Barnett, J.L., 1987. Human–animal interactions. In: E.O. Price (Editor), The Veterinary Clinics of North America, Food Animal Practice. Farm Anim. Behav., 3: 339–356.

Hemsworth, P.H., Gonyou, H.W. and Dziuk, P.J., 1986. Human communication with pigs: The behavioural response of pigs to specific human signals. Appl. Anim. Behav. Sci., 15: 45–54.

Hemsworth, P.H., Barnett, J.L. and Hansen, C., 1987. The influence of inconsistent handling by humans on the behaviour, growth and corticosteroids of young pigs. Appl. Anim. Behav. Sci., 17: 245–252.

Hemsworth, P.H., Barnett, J.L., Treacy, D. and Madgwick, P., 1990. The heritability of the trait fear of humans and the association between this trait and subsequent reproductive performance of gilts. Appl. Anim. Behav. Sci., 25: 85–95.

Hutson, G.D., 1980. The effect of previous experience on sheep movement through yards. Appl. Anim. Ethol., 6: 233–240.

Hutson, G.D., 1985. The influence of barley food rewards on sheep movement through a handling system. Appl. Anim. Behav. Sci., 14: 263–273.

Kilgour, R., 1987. Learning and the training of farm animals. In: E.O. Price (Editor), The Veterinary Clinics of North America, Food Animal Practice. Farm Anim. Behav., 3: 269–284.

Lynch, J.J. and McCarthy, J.F., 1967. The effect of petting on a classically conditioned emotional response. Behav. Res. Therapy, 5: 55–62.

Mateo, J.M., 1990. Effects of gentle and restrained handling on the behavior of domestic sheep (*Ovis aries*). Unpublished master's thesis, University of Georgia, Athens.

Pearce, G.P., Paterson, A.M. and Pearce, A.N., 1989. The influence of pleasant and unpleasant handling and the provision of toys on the growth and behaviour of male pigs. Appl. Anim. Behav. Sci., 23: 27–37.

Pearson, R.A. and Mellor, D.J., 1976. Some behavioural and physiological changes in pregnant goats and sheep during adaptation to laboratory conditions. Res. Vet. Sci., 20: 215–217.