

VIRTUAL HERDING RESEARCH UPDATE

TECHNOTE 3: FACTORS AFFECTING THE RESPONSE TO VIRTUAL HERDING TECHNOLOGY



Background

Virtual herding (VH) technology may soon replace poly-tape electric fencing enabling the implementation of more intensive and complex grazing regimes in pastoral livestock systems. With increased complexity comes a potential risk of some animals not learning to avoid the electrical stimulus in the VH technology.

Other factors, such as hunger, may challenge the effectiveness of VH technology when applied to intensive grazing systems (e.g., strip or cell-grazing). An understanding of the factors that influence learning of the association between audio and electrical stimuli will inform protocols on how best to introduce naive cattle to VH technology in a manner that is efficient, lasting and ethical.

Factors that affect the response of animals to VH technology

There has been considerable basic R&D conducted in the VH project to examine some of the factors that may influence how the animal learns and responds to the technology. These have included:

- Previous experiences
 - Previous experience with an electric fence may facilitate learning of the pairing of the audio and electrical cues. An experiment conducted at the Tasmanian Institute of Agriculture (TIA) reared dairy heifers outdoors from two to six months of age with or without exposure to electric fencing. Heifers with experience of electric fencing showed more rapid learning of the association between audio and electrical stimuli during virtual fence training at six months of age.

- Furthermore, the more intentional interactions a heifer had with the electric fence the more frequently she responded to the audio cue alone during training with the virtual fence. Previous experience with electric fencing may have made the animals more attentive and responsive to the electrical stimulus that was delivered by the VH neckbands, facilitating faster training.
- Temperamental predisposition
 - Temperament may affect cognitive processes through its influence on emotional state, and consequently attention, memory and judgement. The results of another study conducted at TIA suggests that less fearful heifers were less likely to respond to the audio or electrical stimuli when VH technology was being used to prevent the animals reaching a feed attractant.
- Age at introduction to the technology
 - Although a significant proportion of dairy farmers raise their replacement stock, some may purchase or contract out the raising of their heifers. If age of introduction to the VH technology affects the response it may be possible to request stock be trained prior to purchase or being returned from agistment. TIA has conducted another experiment that examined the effects of age at introduction to VH technology on learning efficiency and long-term retainment of learning. This case study is described in more detail below.

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- Individual versus group learning
 - There is significant variation between individual animals in their speed of learning to respond to VH technology to avoid an electrical stimulus. Cattle are group living animals, so learning is often affected by social grouping. An experiment conducted by the University of Sydney trained 23 multiparous cows to a virtual fence either as individuals or in groups of 5 to 6. All dairy cows learnt to remain within the virtual fence boundary within four training tests, irrespective of group or individual training
 - The response of cows that were individually trained to the virtual fence was tested when they were in a group, and vice versa. The group trained cows interacted with the virtual fence more when on their own, compared to the individually trained cows.

While associative learning was better facilitated in individual training, all cows learned to respond to the stimuli over time. From a practical perspective, training cows in a group is more feasible for livestock producers.

- Hunger
 - In pasture based dairy systems, pasture allocations are designed to meet set nutritional requirements of each herd. This strict access to feed and the use of virtual fencing may be problematic if some individuals have increased hunger and/or a higher motivation to reach additional feed. This was evaluated by the University of Sydney across two experiments to determine the effect of feed motivation on response of cows to a virtual fence. These are presented below as case studies.

CASE STUDIES

Effect of feed motivation on response to VH technology

After an initial study to demonstrate that cows fed a maintenance ration were more likely to break through a virtual fence to get a reward of feed than cows fed ad libitum, the University of Sydney conducted another study to examine the role of hunger in a more relevant strip grazing situation.

For this experiment, 12 dry dairy cows were trained to the VH stimuli and were then moved to a 1 ha paddock divided into 8 strip pasture allocations of irrigated annual ryegrass. The pre-grazing pasture allocation was approximately 2500 kg/ha which was grazed down to about 1600 kg/ha over 24 hours. Cows were strip-grazed as a group for 10 days using a virtual fence, whereby the fence was moved daily to offer a fresh allocation. A non-electrified fence tape was used as a backing fence, and moved every second day to allow extra space for the cows to move within the virtual fence, and to accommodate differences between individual fences. On days five and 10 the virtual fence was not moved, so that cows were held from the fresh allocation of pasture, and left to graze only the residual pasture of the two day's allocations for 24 hours. The average daily consumption of pasture during the hold off days was estimated to be 25 per cent of the consumption of pasture on the fresh allocation days.

Cows received a greater number of audio cues (AC) and electric pulses (EP) on the first hold off day (day five) as compared to day one. This increase may be attributed to an increased pressure on the virtual fence as the cows became hungrier but it may have also been due to the change in routine from receiving a fresh allocation every morning. The increase in hunger, reduction in feed availability and change in routine resulted in greater interactions with the virtual fence and the increase in stimuli as cows continued to test the fence. However, the proportion of paired stimuli was not significantly different, meaning the animals were interacting more but still retained their learning.

There was no difference in stimuli delivery on the second hold off day (day 10) indicating cows may have learned the routine. Furthermore, they had the residual pasture amount of about 1600kg DM/ha from the two previous days' allocation which would have provided some opportunity to continue to graze, and remain within the inclusion zone. There were no increase in virtual fence breakthroughs on the hold off days when comparing to the normal grazing days, indicating that the stimuli were sufficient to maintain the cows within varying pasture allocations.

As with our previous experiments, the results from this study indicate a high level of variation in individual cow response, with some cows interacting more with the virtual fence than others. It was also evident from this experiment that there is a social element to cow interactions with a virtual fence, where individuals were often observed responding to a herd mate's behaviour. This has raised the question as to how social attraction may affect the response of cows within a pasture allocation established with a virtual fence.

Age of introduction

The Dairy Science group at TIA investigated the effect of age at first introduction to the VH technology on the efficiency with which dairy heifers learn the pairing of the audio cue to the electrical stimuli, as well as retention of that association in the long term. Using manual collars, 59 naive dairy heifers underwent VH training at either, six months (15 heifers), nine months (15 heifers), 12 months (15 heifers) or 22 months (14 heifers) of age. All the heifers in the six month, nine month and 12 month treatments were re-trained for a second time at 22 months of age (i.e., at the same time as the naive heifers in the 22 month treatment).

Heifers trained at 22 months of age required fewer interactions with the virtual fence before responding to the audio cue alone. In addition, there was a lower proportion of interactions with the virtual fence in which an electrical stimulus was delivered, indicating that the older animals were quicker to learn the technology (Figure 1).

Furthermore, there were no beneficial effects of previous training at an early age (i.e., 6 months, 9 months or 12 months of age) on the responsiveness of heifers to the audio and electrical stimulus when re-trained at 22 months of age (Figure 2).

The results of this experiment showed that the heifers learnt the VH technology better as they became older. It is recommended that replacement heifers should be trained to VH technology at an older age (i.e., 20–22 months of age) and before they enter the milking herd.

Figure 1 For heifers initially trained to VH technology at 6, 9, 12 or 22 months of age, the average values (± 1 standard deviation) for: (A) number of interactions until heifers responded to the audio cue alone (a technical failure meant this data was not collected for six month treatment), and (B) proportion of interactions during which an electrical stimulus was delivered over three training sessions.

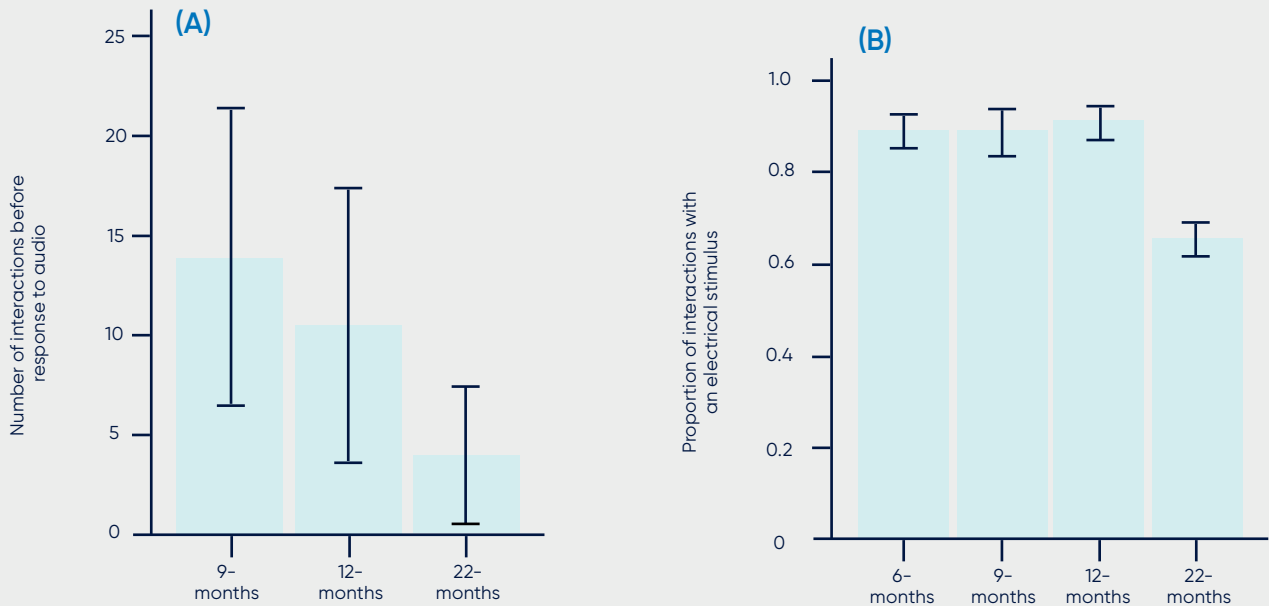
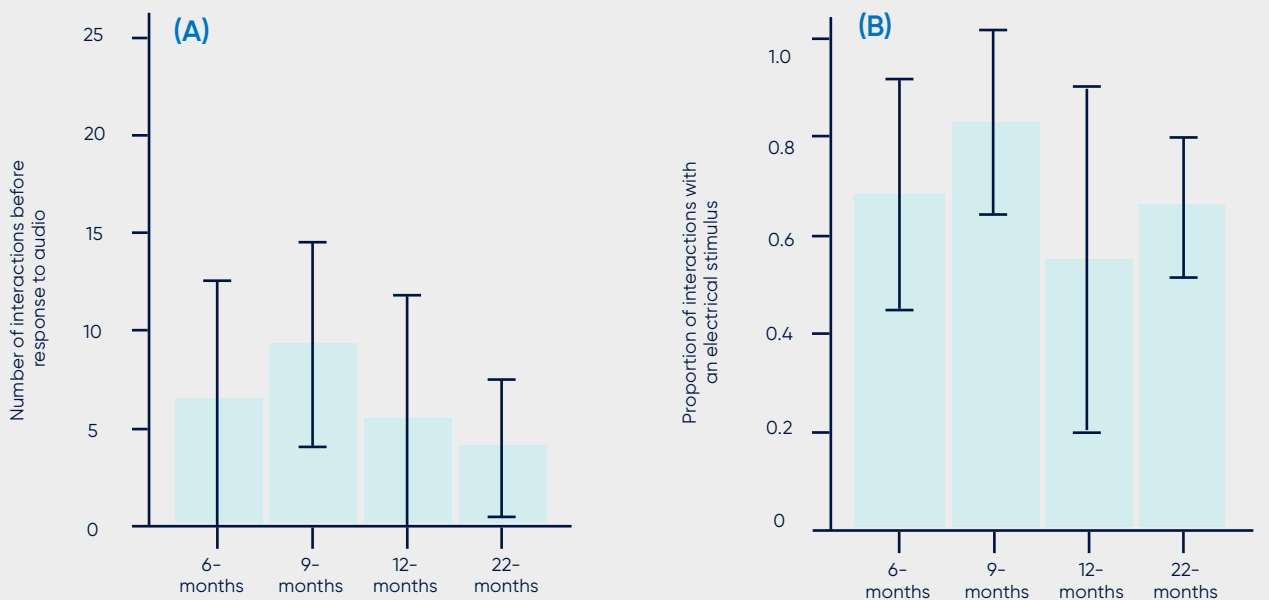


Figure 2 The response of heifers that were initially trained to VH technology at 6, 9 or 12 months of age and then re-trained at 22 months of age, compared to the naive 22 month old heifer. Average values (± 1 standard deviation) for: (A) number of interactions until heifers responded to the audio cue alone, and (B) proportion of interactions during which an electrical stimulus was delivered over three training sessions.



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