Calling collars for cows - experimental design

By Will Russell, student from a Far South Coast dairy farm

Will and Ali joined forces in an experimental trial for their university research project.

Trial design

In Ali's Trial, she used a group of six heifers to apply classic conditioning to a 500Hz alarm. The conditioning had the group approach a T-maze with the option of going either way at the top of the T-section. The experiment was setup for the heifers to receive the 500Hz alarm whenever they received concentrate at the feed bins at either end of the T.

The heifers spent 21 days in this trial with the end experiment of the last few days being whether they could identify that the feed was associated with the 500Hz alarm. This last experiment involved the heifers approaching the T-Maze with the alarm going off in the bin with the concentrate reward. The heifers therefore had to choose between the arms of the T: one with the alarm coming from the end with the reward; and the other with no sound and no reward. Ali said that by the last day, the heifers were picking the alarm/reward side 95% of the time across the whole group.

Although the data isn't fully analysed, it looks as though Ali can conclude that when an audio sound is used at the feed source, cows can be conditioned to recognise that this sound means there is feed available at the point where the sound originates. This aligns with anecdotal evidence that farmers can call their cows to a feed source if the farmer is standing where the feed is available.

In Will's trial, five heifers were chosen randomly out of this same group of six. They were each given a smartphone in a 3D printed case connected to a halter on the cheek of the animal. The smartphones were used to programme the 500Hz alarm to go off at predetermined times. This is the same 500Hz alarm used in Ali's trial.

The key difference between the Ali's and Will's trial was how the source of the alarm changed. Instead of sounding from the feed source in Ali's trial, the alarm in Will's trial sounded from the cheek of the heifer. This means that the heifer not only has to remember that the alarm means feed but it also has to remember where the feed is situated and walk to that point.

The conditioning from Ali's trial helped to start the process of the cows being conditioned to Will's subsequent trial. However further conditioning was needed to teach the cows that the alarm did not originate from the feed source but meant that feed was available at the feeding station.

The heifers were placed in a paddock situated around 70-80m away from the feeding station. This feeding station had the same feed bins as the ones used in Ali's trial and it was in the same location as one of the T-ends.

Days 1-6 Group Habituation – The five heifers were played the alarm 3-times each day for 6-mins each. At every sounding, the heifers were given 1-minute to respond to the alarm before Will pushed them through to the feed station where they were given to the end of their 6-minutes to finish eating. Once the alarm stopped, the cows were herded back into their paddock with the gate closed off to the feed station. The gate was then reopened when the alarm started again for their next calling. The gate was a cord electrified. (NOTE: The cows had no visibility of the gate from the paddock only when they were right next to it. Pink noise was also utilised to cancel any sound of the gate opening.)

The five cows were split into two groups of 3 and 2 cows from days 3-6. This was to help the subordinate cows get a feed from the feeding station. The feeding station was a competitive feed source where the dominant cows got the majority of the feed available. The alarm was still sounded 3-times a day for each heifer.

Day 7-12 Individual Testing – The trial took the five heifers and put them individually in the paddock from which they were to be called. Over each day the heifers were called 2-times each. Once again the heifer was given 1-minute to respond to the alarm; if they didn't respond, they were herded out of the paddock and they were allowed to finish their feed until the end of the 6-minute alarm.

Day 13-18 Group Testing – The five heifers were returned to one large group where they were either all called at once or individually called but in a group setting. A typical day would have a group calling followed by each of the animals being called individually – this would then be repeated again. This meant the heifers receive 12 callings in total each day.

The final 6 days – When the heifers were given the alarm it was again for 6 minutes but they were not herded through from the paddock to the feed after 1 minute had passed. They had to respond to the alarm independently; and if they didn't respond, they were not given a reward.

Results

From being around the animals over the 18 day period, it was obvious that they recognised the alarm the majority of the time and knew that it meant feed. The challenge was to get the incentives right to make the heifers transition to the feed stations.

For example: Up until day 9 in the individual testing period, there was limited response by the cows to come to the feed areas. A decision was made to cut their feed down of a night time to make them hungrier in the mornings. The trial saw an immediate response with the heifers going from 0/10 successful callings per day, meaning they walked to the feed without any human help, to 4/10 successful callings per day over the next 3-days.

It was also noted that the two subordinate heifers were the ones who started responding successfully. Their reward to going to the feed station was greater than that of the dominant cows because they were at greater hunger levels than the others, so a 500g reward of concentrate was enough to make them respond. In contrast, 500g was not sufficent to make the fuller dominant cows respond.

Over the trial testing days 13-18, and taking a general look at the results, a few conclusions were made:

- When the group callings were made, as in all heifers were called at once, it was more likely to get both a large number of animals coming to the feeding area and with a quicker response time. This is compared to individual callings.
- When the individual callings were made, the animal being called was more likely to be leading the group out or at least first to respond to the alarm to what they would be compared to when it was an animal that was given no alarm in the individual callings.
- Over time the subordinate animals who responded best in days 10-12, deteriorated with their responses. This was because even when they responded to the alarm they were beaten to the feed by the more dominant cows. This meant there was no reward for them at the end of the calling.

Conclusions

- If farmers were to call animals, the reward needs to be guaranteed. This would mean farmers would call a subordinate animal to an individual cow feeder or individual milking robot. They should not be called to a competitive environment like a feed pad or feeding station which is able to be controlled by dominant animals.
- Dominant animals could be called to any feed source and maybe feed pads would be more beneficial for that animal as they are being called to an environment where they can gorge on and eat more than their fair share, therefore giving them more incentive to move.
- Having more personalised devices than being on their neck or collar would help guarantee that the intended animals receive the alarm – ensuring the noise does not drift to other animals causing the wrong animal to respond. The design could be improved by having the device as an ear tag within the cow's ear and assigning a personalised alarm sound to individual cows instead of a generic one.
- The conditioning of the cows is too time consuming to be completed by human labour. A conditioning program would have to be automated with it starting from birth and continuing throughout their life. This could be implemented with automatic calf feeders and milking robots synced into the devices and activating a calf/cow’s alarm when they approach the feeders.