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Automated behavioural response assessment to a feeding event in two heritage chicken breeds

Garrett A. Fraess [a], Clover J. Bench [b], Keith B. Tierney [a,*]

[a] Department of Biological Sciences, University of Alberta, Edmonton T6G 2E9, AB, Canada
[b] Department of Agricultural, Food, and Nutritional Science, University of Alberta, Edmonton T6G 2R3, AB, Canada

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ABSTRACT

Video was recorded for three consecutive days for two pens each of two breeds of heritage chickens, Rhode Island Red (RIR) and Barred Plymouth Rock (BPR) (34 birds/pen), before and following a feeding event. The feeding event occurred when a technician entered the pen to refill the food trough at 08:00 daily. Changes in overall activity were assessed using a software-based automated quantitative method, and changes in mobility, resting, comfort and feeding behaviour were scored manually. With the software method, activity was determined for 30 min pre- and post-feeding event, and was defined as the percent pixel change of the total arena per 30 s (a change in one pixel indicated a change in the use of an area of ~0.69 cm^2). Video recordings were also scan-sampled by a human observer every 30 s for 15 min pre- and post-feeding event, and behaviours were scored according to an ethogram. The ethogram data tended to support the findings of the automated analysis. Activity levels increased before and were at their highest following the feeding event. Breed differences were apparent, as BPR were more active but reduced activity faster than RIR. Resting, ground pecking and comfort behaviour were decreased post-feeding event for both breeds. Feather pecking was more prominent in RIR, but did not differ before or after the feeding event. In this study we have shown that an automated, software-based behavioural assessment method can be applied to chickens, and it is capable of detecting subtle changes in activity. In future, use of such an automated method has application in production systems in its ability to serve as an early warning system of health concerns by finding deviations from baseline activity.

1. Introduction

Animals will modify their behaviours in response to changes in their environment (Johnson et al., 1992; Laporte et al., 2010). Behavioural responses may be measured and used as a non-invasive method to assess changes in animal condition. Recent advances in technology have allowed for automated measures of behavioural assessment that can be carried out efficiently, in real time and at low cost. A question is whether such technology and methods may be applied to poultry, which may be reared in large groups and under relatively low light.

The activity of broiler chickens was assessed using passive infrared (motion) detectors (Nielsen et al., 2003); however such a method is limited as it cannot be used to determine qualitative behaviour (i.e. the types of behaviours displayed). Video recording and analysis has been used to determine activity levels, and can allow for qualitative behavioural measurements (Kristensen and Cornou, 2011). Such measurements may have importance as certain behaviours such as grooming, resting, and feather pecking can be indicators of animal condition (Delius, 1988; Daigle et al., 2014a). Yet, gleaning qualitative data from videos becomes increasingly difficult as animal numbers in the field of capture increase. However, in two pioneering studies, automated video analysis was used to detect injurious feather-pecking behaviour in laying hens (Lee et al., 2011), and video changes were correlated with percent mortality, damaged leg skin and impaired walking gait in broiler chicken flocks (Dawkins et al., 2012). In these studies, optical flow was used, which is a method to estimate the velocity of image motion of relatively large objects. The further development of an automated analysis method that assesses the activity of large groups while permitting qualitative behavioural analysis would be beneficial to the study of poultry welfare.

In our experiment, we had four goals: (1) apply a software-based method to quantitatively score activity for a group of birds, (2) use

* Corresponding author.
E-mail address: ktierney@ualberta.ca (K.B. Tierney).

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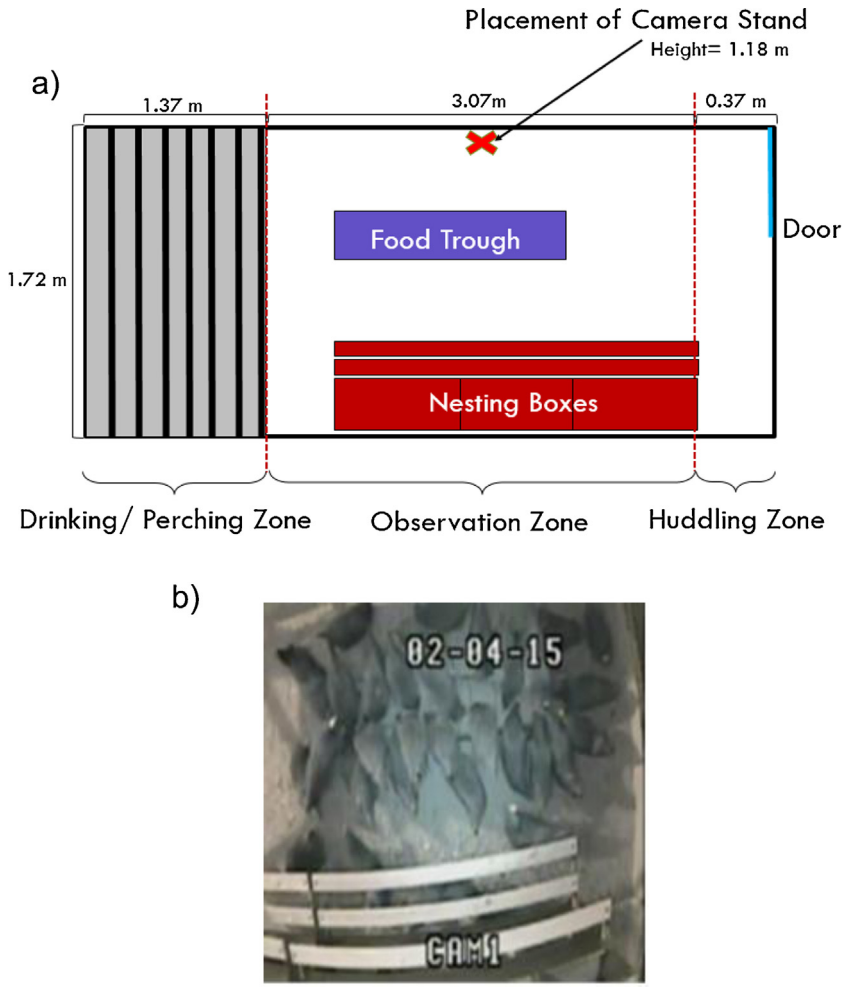

Fig. 1. a) A top view diagrammatic representation of the pen layout. The video surveillance camera was placed to maximize capture of area around the food trough. The drinking/perching zone consisted of slatted flooring, as well as water dispensers. The huddling zone refers to an area of the pen where chickens would pack together densely. b) A screenshot of the video analyzed by software and a human observer. Each pen of contained 34 chickens.

the method to assess the effect of a feeding event, (3) demonstrate the utility of the method by comparing the results to manually scored behaviours, and (4) determine if the method was sensitive enough to detect differences between two chicken breeds. We elected to examine behaviour around a feeding event (a technician entering to replenish the feed), as the event would be expected to be associated with changes in behaviour. Even though poultry have been domesticated, human presence can act as a stressor (Barnett et al., 1992). Furthermore, after the technician has left, space limitations around feeders may restrict which members can access food, resulting in social stress as birds attempt to avoid agonistic interactions. The maintenance of inter-individual distance is important in poultry and subordinates will actively avoid encroaching on a dominant bird's space (Keeling, 1994), as dominant birds may be aggressive (Pagel and Dawkins, 1997). However, we note that in large groups of hens, agonistic behaviours may actually be infrequent (Hughes et al., 1997). For our subjects, we looked at two breeds of heritage chickens, Rhode Island Reds (RIR) and Barred Plymouth Rocks (BPR), owing to possible differences in their behavioural phenotypes. The RIR chickens are colloquially characterized as being a docile, easy-to-keep, conducive to modern production systems, and productive, making them one of the more common heritage breeds. In contrast, BPR are colloquially characterized as being intelligent, hardy, more active, and as a result, tend to be less conducive to modern production systems.

2. Methods

2.1. Study area & housing conditions

This study was conducted at the Poultry Research Facility at the University of Alberta, Canada in early February 2015. The study involved video analysis of two pens of RIR and two pens of BPR, each containing 31 females and 3 males aged 30 weeks, and was recorded over the course of three consecutive days. The chickens were fed a 19% heritage layer mash ration *ad libitum* and the food was refreshed by a technician at ~8 a.m. daily. The lights in the building were incandescent and turned on at 4 a.m. and turned off at 7 p.m. The light level at hen-height was 7 lx. Water was supplied to the birds using a nipple system, which consisted of 8 nipples per pen. The water pressure was controlled by a pressure reducer at the end of the line which held a low pressure to reduce flooding. Closed circuit TV dome infrared color cameras (SAV-CD120; Schaumburg, IL, USA) were used to collect video of the pens from directly overhead and were set up three weeks in advance, giving ample time for habituation to their presence.

All chickens were housed indoor in a 'free-run' pen system (Fig. 1a). Video of the pen area was separated into three zones: observation, drinking/perching, and huddling. The observation zone, which was the area analyzed, included the area around the feeding trough. The drinking/perching zone consisted of a slatted floor with water dispensers above, where birds could perch