Applied Animal Behaviour Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Research Paper

Behavioural and physiological responses of laying hens to automated monitoring equipment

Stephanie Buijs[a,*], Francesca Booth[a], Gemma Richards[a], Laura McGaughey[a], Christine J. Nicol[b], Joanne Edgar[a], John F. Tarlton[a]

[a] School of Veterinary Sciences, University of Bristol, Langford house, Langford, BS40 5DU, United Kingdom
[b] Royal Veterinary College, Hawkshead Lane, Hatfield, AL9 7TA, United Kingdom

ARTICLE INFO

Keywords:
Automated monitoring
Aggression
Preening
Thermography
Domestic fowl

ABSTRACT

Automated monitoring of behaviour can offer a wealth of information in circumstances where observing behaviour is difficult or time consuming. However, this often requires attaching monitoring devices to the animal which can alter behaviour, potentially invalidating any data collected. Birds often show increased preening and energy expenditure when wearing devices and, especially in laying hens, there is a risk that individuals wearing devices will attract aggression from conspecifics. We studied the behavioural and physiological response of 20 laying hens to backpacks containing monitoring devices fastened with elastic loops around the wing base. We hypothesised that backpacks would lead to a stress-induced decrease in peripheral temperature, increased preening, more aggression from conspecifics, and reduced bodyweights. This was evaluated by thermography of the eye and comb (when isolated after fitting backpacks), direct observations of behaviour (when isolated, when placed back into the group, and on later days), and weighing (before and after each 7-day experimental period). Each hen wore a backpack during one of the two experimental periods only and was used as her own control. Contrary to our hypothesis, eye temperature was higher when hens wore a backpack (No backpack: 30.2 °C (IQR: 29.0–30.6) vs. Backpack: 30.9 °C (IQR: 30.0–32.0), $P < 0.001$). Eye temperature of hens wearing a backpack was strongly correlated to the time spent preening ($r_s = 0.8$, $P < 0.001$), suggesting that the higher temperatures may have been due to preening itself, or to a low head position or decreased heat dissipation when preening under the wings. Aggressive behaviour was very rare and no effect of the backpacks was found. In line with our hypothesis, backpacks increased preening on the day of fitting, both when isolated (No backpack: 0% (IQR: 0–1) vs. Backpack: 22% (IQR: 1–43), $P < 0.01$) and when back in the group (No backpack: 0% (IQR: 0–27) vs. Backpack: 43% (IQR: 5–77), $P < 0.001$). However, no effect on preening was observed 2–7 days afterwards. Other behavioural changes suggested that on the day of fitting hens prioritized attempts to (re)move the backpack and were less attentive to their surroundings. However, only equipment pecking (i.e., pecking the backpack or leg rings) was still affected 2–7 days after fitting (No backpack: 0 pecks/hen/minute (IQR: 0–0), vs. Backpack: 0 (IQR: 0–0.07), $P < 0.05$). We found no effect of our backpacks on bodyweight. In conclusion, our backpacks seem suitable to attach monitoring equipment to hens with only a very minor effect on their behaviour after a short acclimation period (≤2 days).

1. Introduction

Automated technology is increasingly used to monitor animal behaviour (Barron et al., 2010; Siegford et al., 2016). It allows efficient continuous data collection from many individuals simultaneously, in situations where human observations are inconvenient (e.g., at night), difficult (e.g. when focal animals are hard to discern or reach), or may disturb behaviour. In addition, automation may eliminate certain types of observation bias (Marsh and Hanlon, 2004). However, except for technologies that do not differentiate between individuals or are purely video-based, automated monitoring necessitates the attachment of monitoring devices to animals. This can alter behaviour, and even invalidate the data collected. Monitoring devices increase energy expenditure, decrease foraging and increase preening in several free-living bird species (Barron et al., 2010). Such effects occur in species that primarily walk as well as in species that primarily fly and are therefore likely to apply to laying hens. Hens wearing monitoring devices may also attract aggression from their conspecifics, as devices

* Corresponding author.
E-mail addresses: stephanie.buijs@bristol.ac.uk, jahoorikheberookeen@gmail.com (S. Buijs).

https://doi.org/10.1016/j.applanim.2017.10.017
Received 31 July 2017; Received in revised form 26 October 2017; Accepted 29 October 2017
0168-1591/

usually alter their appearance. Even minor changes in appearance can attract aggression and lead to decreased bodyweights and altered adrenaline and dopamine levels (Dennis et al., 2008; Liste et al., 2015; Campderrich et al., 2017). Chickens also peck each other during social exploration (Riedstra and Groothuis, 2002) and equipment may renew the motivation for such exploration, increasing the number of pecks received.

No previous studies have assessed whether adult chickens adapt their behaviour when fitted with devices for automated behavioural monitoring, and only two have assessed this in sub-adults. Daigle et al. (2012) found that devices mounted on the backs of pre-lay pullets led to short-term decreased feeder and drinker use, whilst increasing perch and nest box use. No indications of increased energy expenditure or agonistic behaviour were found 17 and 8 days after device fitting, respectively. In slow-growing broiler chickens wearing back-mounted devices, walking and pecking was affected in the week after fitting only (Stadig et al., 2017). Although this suggests that there are no long-term effects, short-term effects are also of interest, as often the intention is to collect data shortly after fitting. Crucially, literature on wild birds (Barron et al., 2010) suggests that behaviours not included in previous studies, such as time spent preening, may be affected. Also, effects on adult laying hens may substantially differ from those observed in young chickens.

In our pilot studies we used ‘vests’ of stretchy fabric or plastic cases in contrasting colours to fit devices and observed immediate marked responses including sidestepping/reversing (interpreted as attempts to escape from underneath the equipment), running away in apparent panic, and simply lying down during the first 15 min after fitting. Several days later hens still pecked or pulled the devices frequently, were often attacked and chased by conspecifics, and were seen to isolate themselves in nest boxes or on perches. We therefore developed a less visible and obtrusive attachment system. This consisted of a ‘backpack’ only slightly larger than the devices contained, with smooth angles and in the same colour as the hen, which was attached by elastic loops around the base of the wings. In a small scale trial on a commercial farm (Buijs et al., 2017), these backpacks had only a minor effect on behaviour (i.e., equipped hens received slightly more pecks but did not show other significant differences in behaviour). The current study was designed to systematically evaluate the behavioural and physiological response to these backpacks.

We hypothesised that if our backpacks would not be well tolerated, hens would increase the time they spent preening, sidestepping/reversing, sitting/lying, and the frequency of equipment pecking (i.e., pecking the backpack and leg rings, the latter being fitted continuously on all hens for identification purposes). We also hypothesised that hens wearing a backpack would be pecked and attacked more often, leading to increased plumage damage and attempts to withdraw by fleeing, perching, or hiding in the nest box. This was predicted to reduce foraging and eating/drinking resulting in lower body weights.

Physiological responses shortly after fitting the backpacks were analysed by infrared thermography, a non-invasive indicator of arousal. Acute stress leads to an initial decrease in peripheral temperature due to vasoconstriction (Cabanac and Aizawa, 2000; Moe et al., 2012). Mild stressors like handling and air puffs reduce comb, wattle and eye temperature (Edgar et al., 2011; Edgar et al., 2013; Herborn et al., 2015), although reward-downshift or more difficult decisions do not (Davies et al., 2014; Davies et al., 2015). We hypothesised that backpacks would reduce peripheral temperature. Peripheral temperature can also drop in situations that are likely to be positively valanced (Moe et al., 2012) but, in combination with behaviour supposedly aimed at removing the backpack, we would interpret fitting as an aversive experience. Defaecation rate was used as a second stress indicator (Hall, 1934; de Haas et al., 2010) and was hypothesised to be higher when wearing a backpack.

2. Methods

The study was carried out following ethical approval by the University of Bristol (license number UB/17/002).

2.1. Animals and housing

Twenty 18-week-old British Blacktail laying hens were obtained from a commercial rearing farm and transported to the test facility after weighing and fitting leg rings for individual identification. All hens were housed together throughout, in a 13.8 m^2 floor pen covered with wood shavings. Hens had continuous access to commercial layer mash, water, a three-tier perch, nest boxes, a slatted ramp and environmental enrichment (an alfalfa bale and pecking block), except when put in the holding pen (2 × 5 min per hen in total). Room temperature was maintained between 16 and 19 °C throughout the study.

In the week before data collection the hens were habituated to human presence. In addition to the normal exposure to humans during routine husbandry procedures (replacing feed and water and egg collection), at least one person was present in the house during most of the light period. During the first two days of habituation she moved around the pen freely, but did not enter the pen. On the third and fourth day she entered the pen, but did not actively approach any of the hens. Hens that approached her calmly were picked up briefly and placed back on the floor immediately and carefully. All hens had allowed this by the end of the fourth day and none showed clear avoidance behaviour after being picked up. Two days before the experiment started all hens were picked up, handled, weighed, mite-treated, and put back in the pen.

2.2. Fitting backpacks

Each hen was fitted with an approximately 50 g backpack when 23–24 weeks old. Each backpack contained three monitoring devices intended for later studies: a light sensor (Biotrack Ltd, Wareham, United Kingdom), tri-axial accelerometer (Custom Idea Ltd, Shepton Mallet, UK), and a location device (Tile Mate, Tile Inc., San Mateo, United States). The equipment was wrapped in brown electrical tape and attached to the back of the hen using elastic loops around the wing base. This meant that the larger part of the package was covered by the neck feathers when the head was up (Fig. 1). On day 0 (five weeks after arrival at the test facility) half of the hens received backpacks, which were removed at the end of day 7. On day 8 the other half of the hens received backpacks, which they wore until day 15. These two groups were balanced for initial body weight and the order in which they had

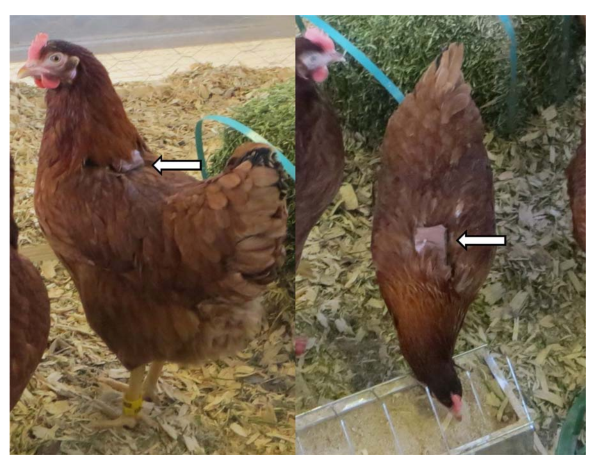

Fig. 1. Arrows indicate the backpack containing the equipment as visible when standing up and bending down.