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The effect of experience of ramps at rear on the subsequent ability of layer pullets to negotiate a ramp transition

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ABSTRACT

In commercial situations, laying hens must negotiate levels to reach resources such as food, water and litter. Providing ramps in aviary systems reduces collisions and resultant keel bone fractures in adults. We investigated whether providing ramps during rear improved the ability of birds to transition between levels.

Chicks were reared commercially in two flocks both of which provided access to raised structures from three weeks of age. One flock had no ramps, but the other flock was provided with additional access to two types of ramp (wooden ladders, and grids formed from commercial poultry slats placed at an angle). At 8 weeks of age, 64 birds (32 from each rearing condition) were transferred to an experimental facility. At 10 weeks of age, 32 pullets from each group were trained to run to a food reward. During testing at 12–14 weeks of age the pullets accessed the food reward by moving up or down a ramp. The pullets' behaviours and time taken to complete the task were recorded. Ramp use over three days was also observed in a room replicating a small-scale single-tier system. Four groups of 16 birds aged 12–14 weeks were housed for three days and the number of transitions between the raised tier and litter were recorded.

For upward transitions, more ramp-reared birds than control birds succeeded in reaching the food reward for both ladder (52% vs 13%) and grid ramps (74% vs 42%). Birds from the ramp-reared group took significantly less time to complete an upwards transition (68.8s ± 49.3) than the control group (100s ± 37.6) ($p = 0.001$). In addition, the control group showed more behaviours indicative of hesitancy (moving away, head orientations, ground pecking and crouching) before transitioning, and signs of difficulty when making upward transitions (crouched walks, pauses, turning, returning and escape attempts). In the group housing observations, the ramp reared groups had almost double the number of transitions between the slats and litter on day one compared to the control group. This difference was reduced by day three.

In summary, this suggests there are positive effects of providing ramp experience during rear shown by any combination of bird mobility, strength or cognitive ability leading to an increase in apparent confidence in older pullets. It is not known whether these benefits persist through to the laying period, but no detrimental effects were noted so we suggest that ramps should be included from the early rearing period onwards.

1. Introduction

In commercial loose housed laying systems in many European countries, ramps are increasingly provided to help birds with level changes in their environment. There are two principal loose housing systems for laying hens: single tier (flat deck) and multi-tier (aviary) systems. Single tier systems comprise a raised slatted area containing food, water and nest boxes with a drop down to reach the litter and range. Multi-tier (aviary) systems contain multiple tiers stacked on top of each other with food, water and nest boxes. There can be vertical drops of up to 90 cm between tiers, including to the ground level litter.

In loose housed systems, increased collisions with the environment have been observed when a level change is included (Harlander-Matauschek et al., 2015). Collisions and falls from heights can lead to injuries such as keel bone fractures (Stratmann et al., 2015). Birds with keel fractures show restricted movements and reduced willingness to jump down from perches (Nasr et al., 2012a,b). Experimental work has shown that mobility is partially restored if analgesic drugs are administered (Nasr et al., 2015) suggesting that untreated keel bone fractures are painful. In commercial systems fracture rates can be as high as 80% of the flock at end of lay in more complex housing with aerial perches (Wilkins et al., 2005, 2011). The addition of ramps in the

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laying house has been shown to reduce falls and collisions by 45% and 59% respectively, along with 44% of birds showing more controlled movements if provided with ramps (Stratmann et al., 2015). When negotiating a level change fewer hesitancy behaviours have been recorded in laying flocks provided with ramps spanning the full width of the lower tier (Pettersson et al., 2017a), suggesting that ramps can aid transitions between levels. Birds' ability to negotiate ramps of different design has also been trialled, showing easier transitions on a grid ramp and a preference for a grid ramp over a ladder ramp (Pettersson et al., 2017b).

Before transfer to the laying system at 16 weeks of age, pullets destined for loose-housing systems in Europe are commonly reared in large areas with litter covered floors and some perches and raised structures to give them experience of navigating in three dimensions. Rearing in complex environments, such as aviaries, which provide opportunities for exercise, can reduce the proportion of keel bone fractures measured during lay. For example, Casey-Trott et al. (2017) found a fracture rate of 41.5% in aviary reared birds compared with 60.3% for cage reared birds.

The cognitive effects accruing from perch or tier provision also seem to be enhanced when birds are reared with these structures, rather than encountering them for the first time when moved to the laying system. For example, Gunnarsson et al. (2000) found that rearing birds with perches to 8 weeks of age, improved their ability to negotiate a series of raised platforms to reach a food reward. Because the difference in performance between the two rearing groups increased with task difficulty, the authors argued that the rearing conditions may have influenced spatial navigational ability, and that the results could not easily be explained only by differences in physical strength. This was tested more directly by Tahamtani et al. (2015) who compared the influence of cage versus aviary rearing on spatial cognition using a two-dimensional hole board task thereby eliminating the confounding factor of physical ability. These authors reported that birds reared in the more barren cage environment had poorer working memory (i.e. short-term memory used to recall the location of food rewards in a hole board task). Further, Colson et al. (2008) showed that birds reared with vertical structures, similar to those later encountered in the laying shed, performed more long distance flights (100 cm to 300 cm), accounting for 40% of all flights compared to 35% for floor reared birds. Generally, indirect effects due to improved spatial navigation are likely to be complemented by direct effects of additional exercise. Overall it seems that, despite gaps in knowledge about possible longer- term cognitive effects, rearing birds with vertical structures has both physical and cognitive benefits, and the provision of ramps for adult laying hens aids smooth transitions between levels.

There is less evidence for the effects of ramp provision during the first few weeks after chicks hatch. In a review, Harlander-Matauschek et al. (2015) suggested that the provision of ramps at a young age may promote wing-assisted inclined running, which could affect the development of the keel bone and muscles and improve balancing abilities. Kozak et al. (2016) reared chicks in complex aviaries with ramps, low level platforms and perches. Ramp use peaked at 2 weeks of age when chicks started to use the upper levels. In this study the effect of ramps and low-level perches were confounded, and it was not clear if chicks utilised the ramps to gain access to the upper levels. LeBlanc et al. (2017) looked at the effect of ramp angle and found that from 2 weeks of age all birds were successful on inclines up to 40° which continued to 36 weeks of age. We have shown that providing ramps during the first week of age can increase the use of other raised structures in commercial systems (Norman et al., 2017).

Improving the mobility and confidence of young birds could have beneficial effects during the stressful transfer to the laying system. With resources spread throughout the house, birds must navigate the system effectively as soon as possible, to avoid welfare problems (Pettersson et al., 2016). Given that ramps appear to encourage better access and use of perches, tiers and vertical structures during the laying period, and that there are some indications of beneficial effects of ramp provision during rear, it is important to consider at what stage ramps should be provided during the rearing period. The aim of this study was to determine whether experience of inclined ramps during the early rearing period would improve birds' subsequent ability to negotiate similar ramps towards the end of rear.

The specific objectives were to compare the effects of rearing birds from 3 to 8 weeks of age with or without ramp access to elevated platforms on:

i Individual latency to move up or down a ramp at 12–14 weeks of age.
ii Individual behaviour at 12–14 weeks of age when traversing a ramp for a food reward.
iii The number of ramp transitions made by groups of birds aged 12–14 weeks over a period of three days.

2. Materials and methods

2.1. Animals and housing

For this study, British Black Tail pullets (*Gallus gallus domesticus*) from the same parent flock were reared to 8 weeks of age in two flocks of 2000 pullets in adjacent sheds (12.5 m by 8 m) on a commercial rearing farm. Housing comprised a fully littered floor, gas brooders, track feeders and bell drinkers. At three weeks of age, as normal rearing practice, both flocks were provided with four A frame perches (L:2 m, H:0.5 m) and two elevated platforms (L:360 cm, W:60 cm, H:50 cm) to encourage vertical movement in preparation for the laying house. Platforms consisted of metal frames with white plastic slats on top. One flock (ramp-reared) was additionally provided with two grid ramps (GR) and two ladder ramps (LR) that were attached to the platforms at an angle of 61 degrees (to fit between the drinker lines in the rearing sheds), with the other flock used as a control. Each GR consisted of a white plastic poultry slat (Jansen) attached to a sheet of medium density fibreboard (MDF) for support. Each LR was constructed from hardwood timber with three rungs (4.4 cm square) 30 cm apart.

At 8 weeks of age, 32 birds from each flock (ramp reared or control) were collected and transported to a research facility at the University of Bristol. Upon arrival birds were weighed and keel palpated using the method of Wilkins et al. (2004). No keel bone fractures were detected. The birds were kept in their rearing groups and were housed separately in two similar rooms (3.66 m by 3.05 m) each with floors covered in wood shaving litter, two feed hoppers (30 cm diameter) and two bell drinkers (30 cm diameter). Birds were fed ad libitum on chick crumb and gradually moved onto a layer mash. Lighting was on a 12 h dark:12 h light cycle, with room temperature maintained around 19–22 °C and fan ventilation. Each room contained one identical raised platform (L:120 cm, W:60 cm, H:50 cm). The ramp reared group was provided with a GR and LR (identical to those provided in the commercial rearing system) leading up to the platform at an angle of 61° (Fig. 1).

2.2. Negotiation of a ramp by individuals

The aim of the individual bird tests was to measure whether there was a difference between ramp reared and control birds in the individual latency to transition a ramp and to compare behaviour before and during a transition down or up a ramp.

A separate room was used for individual testing, which used a narrow pen (3.02 m by 0.65 m) set up at the side of the room with one long side fenced off with a wooden frame covered in chicken wire. During the first stage of habituation and training a white plastic slat was positioned on the floor at one end of the pen (Fig. 2, section A) with shavings covering the concrete flooring (Fig. 2, section B). During testing the ground level slat was replaced with a raised structure (90 cm