BEHAVIOUR OF LAYING HENS NEGOTIATING PERCHES AT DIFFERENT HEIGHTS

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Research into the responses of hens on perches is important in order to assess the welfare impact of alternative systems for egg production which incorporate perches in their design. Previous studies suggest that many flight and landing accidents occur in such systems as birds attempt to move between perches and facilities, resulting in a high incidence of bone breakage. In this study three horizontal perches were set with a gradient between them of 0, 30, 45 or 60 degrees according to treatment. Four groups of 15 ISABrown laying hens were individually exposed to each treatment, being placed on the uppermost perch (Perch 1) with a food reward available at the lowest perch (Perch 3). Behaviours performed before reaching Perch 3 were recorded over time. More birds failed to move to Perch 3 in 10 minutes when perches were separated by 45 or 60 degrees. In birds which stayed on the perches for the full 10 minutes, without reaching Perch 3, downward head movements, calling, intended jump behaviours, side-stepping and wing-flapping decreased significantly with time spent on the perches. Motivation to complete the task, in order to gain the food reward, was high in all treatments. However, when birds found perches difficult to negotiate, behaviours indicating intention to move to the food decreased with time and the incidence of behaviours indicating frustration and thwarting increased. In non-cage systems such frustration could reduce bird welfare.

Keywords: *animal welfare, behaviour, laying hens, perches, slopes*

Introduction

Perching is a basic behaviour of birds (Tauson *et al* 1992). Red Jungle fowl, a direct ancestor of modern hybrid species of hens (Nicol & Dawkins 1990), and feral hens (Wood-Gush *et al* 1978) perch on the branches of trees and bushes to roost. Therefore, the provision of perches in housing systems designed for laying hens allows these birds to carry out a natural behaviour. Where perches are available to hens housed in pens or cages, they are used extensively (Nicol & Dawkins 1990). Laying hens in cages with perches spent between 25 and 50 per cent of the day perching. This increased to around 85 per cent at night, when birds used the perches to roost (Appleby *et al* 1992; Duncan *et al* 1992).

Within a perchery system, hens can move between different levels and can use perches for access to nest boxes or other facilities (Appleby & Hughes 1991). Movement between

perches also allows escape from aggressive birds (Appleby & Hughes 1991). However, there is a high incidence of bone breakage in laying hens housed in percheries, probably due to accidents which occur as birds attempt to move from one perch to another or between perches and other platforms (Gregory *et al* 1990). The design of a perchery system will, therefore, be important in determining the amount of broken bones suffered by birds (Gregory *et al* 1990). Movement from one perch to another is easier for birds if the horizontal distance between the perches is less than one metre (Scott & Parker 1994). Scott *et al* (in press) investigated the ease with which laying hens could move across a series of three horizontal perches at different heights with different slopes between them to obtain a food reward. Results suggested that angles between perches should be no more than 45 degrees for birds to move between them more easily. It was assumed that time to complete the task and the number of birds failing to reach the final perch were related to the level of difficulty for the birds. However, no account was taken of the behaviour of the birds on the perches.

When motivated hens are thwarted from obtaining food they become frustrated. This frustration can lead to displacement preening behaviour, backward and forward pacing and escape movements (Wood-Gush & Guiton 1967; Duncan & Wood-Gush 1972). If a bird is more strongly motivated to reach the food, for example, due to a longer deprivation period, then behaviours may become stereotyped (Duncan & Wood-Gush 1972).

The objectives of this study were threefold. Firstly, to compare behavioural responses of hens faced with a downward sloping series of horizontal perches, with a food reward available from the lowest perch when the perches were separated by different angles. Secondly, to investigate the changes in behaviour over time when birds found the perches too difficult to negotiate and, thirdly, to compare the initial behaviour of these unsuccessful birds with that of birds which move to the lowest perch relatively quickly.

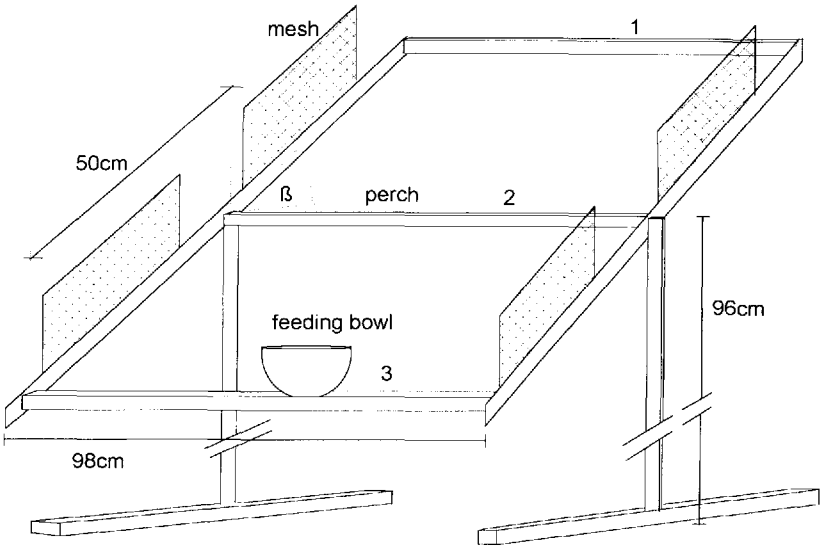
Materials and methods

Sixty ISABrown hens were randomly allocated into four groups of 15 birds and each group was leg-banded with a different colour. All birds were provided with perches during rearing. The birds were kept in pens with litter floors and nest boxes and were fed twice daily from known metal feed pans.

Birds were required to move downwards between three horizontal, wooden perches (98x4.5x7cm) at different heights, separated by 50cm (Figure 1). Each group of birds was subjected to each of the following treatments, according to a randomized block design: perches separated by 0 degrees (horizontal), 30, 45 and 60 degrees. Individual birds, tested in random order, were removed from their home pen, placed on the uppermost experimental perch (Perch 1) and observed as they moved to a food reward on Perch 3. This reward was presented in the same type of metal feed pan as was used in the pens, and given a standard shake (Scott & Parker 1994) to attract the bird's attention. On reaching Perch 3 birds were allowed to feed before being returned to the pen.

The behaviours performed by an individual on the apparatus, before reaching Perch 3, were described by the experimenter and recorded using a cassette recorder. The behaviours recorded were: resting (when a bird sat still, resting its keel bone on the perch), standing, stepping (with the bird's body facing the way in which it was stepping), side-stepping (with the bird's body facing the front), head upward (a movement of the head above the normal

position of the head when looking straight in front), head downward (a head movement in which the head was below the normal position when looking straight in front), head sideward (a head movement to the right or left of the bird), head forward (a movement of the head to the front), calling (any vocalization by the bird), preening (when the bird arranged its feathers using its bill), tail-ruffling (when the tail feathers were raised and shaken), wing-flapping (a stretching or flapping movement of the wings), intended jump (when a bird crouched with its weight forward, looking towards the next perch, as though preparing to jump, and then hesitated) and defecation. All head movements directed towards the back of the bird were classed as head sideward. Elapsed time was recorded on the cassette at five-second intervals, which allowed the number of incidents of each behaviour in each five-second period to be determined. States were recorded, ie resting or standing, when the bird showed no other behaviours within a five-second block. The remaining behaviours were recorded as events. The time spent on each of the first two perches before reaching Perch 3 was also recorded. A maximum time limit of 10 minutes was allowed, after which any bird which had failed to reach Perch 3 was removed from the perches and returned to the pen without receiving a food reward. If a bird jumped off the perch apparatus to the ground it was replaced on the perch from which it jumped, but if it jumped to the ground a second time it was returned to the pen without receiving a food reward.



ß is the angle of the side frame to the horizontal

Figure 1 **Experimental perch apparatus (all dimensions in centimetres) (after Scott *et al* in press).**

Data from the birds which remained on the perches for the full ten minutes, without reaching Perch 3, were combined to determine the change in the incidence of behaviour with time. For these trials only, the mean number of times each behaviour was observed in each

five-second period was determined for each treatment (angle) and plotted against time. Moving-averages were used and scaled to give counts per second per bird. The best fit line was determined for each data set and a single sample *t* test undertaken (Campbell 1967).

The initial behaviour of birds which successfully moved to Perch 3 within two minutes was compared to that of birds which were unsuccessful and did not complete the task in ten minutes. Birds which stayed on the perches for at least one minute without reaching Perch 3 were included. Those individuals which then moved to Perch 3 within 2 minutes were classed as 'quick finishers' and those which stayed on the perches for 10 minutes were classed as 'non-finishers'. The rates of behaviours performed in the first minute were fitted to a linear model (Box *et al* 1978) which considered the effect of angle between perches, as well as the effect of whether the birds were quick finishers or non-finishers.

Results

The percentage of unsuccessful birds at each slope (either failing to move to Perch 3 in ten minutes, or jumping to the ground) is shown in Table 1. The percentage of birds which stayed on the perch apparatus for the full ten minutes, without reaching Perch 3, increased with angle between perches. The greatest increase occurred between 30 and 45 degrees. There was a large increase in the percentage of birds which jumped off the perch apparatus to the ground at 60 degrees compared to other angles (Table 1).

Table 1 **Percentage of birds failing to reach the third perch in 10 minutes and the percentage jumping to the ground at each slope.**

Slope (degrees)	Percentage of birds remaining on the perches for the full 10 minutes	Percentage of birds jumping to the ground
0	0	0
30	5	5
45	17	5
60	18	22

In 10 per cent of trials, combining all treatments, birds remained on the perches for ten minutes. Changes in behaviour over time were examined for these trials, using *t* tests (Campbell 1967) to compare slopes of the best straight line for each behaviour with zero (Table 2). In Figures 2a to 2i these data are presented graphically for behaviours in which trends were identified over time. These graphs show the change in the rate of behaviours per bird with time for birds at each slope which stayed on the perches for 10 minutes.

The incidence of side-stepping, calling, downward head movements, wing-flapping and intended jump behaviours decreased significantly with time on the perches (Table 2). The highest frequency, and the most obvious reduction with time, in side-stepping occurred in the trials where birds were on perches separated by 30 degrees (Figure 2a). The frequency of calling decreased with time on the perches at each of the treatment angles (Figure 2b). The highest incidence of downward head movements occurred at 60 degrees when birds were first placed on the perches (Figure 2c). This behaviour rapidly decreased in frequency in the first 200 seconds at 60 degrees. With perches separated by 45 and 30 degrees birds did not

show an obvious decrease in the incidence of downward head movements with time (Figure 2c). At 30 degrees there was a lower incidence of downward head movements than at 45 degrees (Figure 2c). There were no significant differences in the incidence of wing-flapping and intended jump behaviours between slopes (Figures 2d and 2e). The incidence of head movements to the front was initially high, but decreased with time at 30 degrees (Figure 2f), though this decrease was not significant over all treatments (Table 2).

Table 2 **Results of *t* tests showing trends over time for each behaviour in birds which stayed on the perches for 10 minutes.**

Behaviour	Increasing (I)/Decreasing (D) incidence with time	*P* value
Resting	I	< 0.05
Standing	I	0.090
Stepping	D	0.053
Side-stepping	D	< 0.05
Head upward	I	0.761
Head downward	D	< 0.01
Head sideward	I	< 0.001
Head forward	D	0.250
Calling	D	< 0.001
Preening	I	< 0.05
Tail-ruffling	I	0.257
Wing-flapping	D	< 0.01
Intended jump	D	< 0.05
Defecation	I	0.124

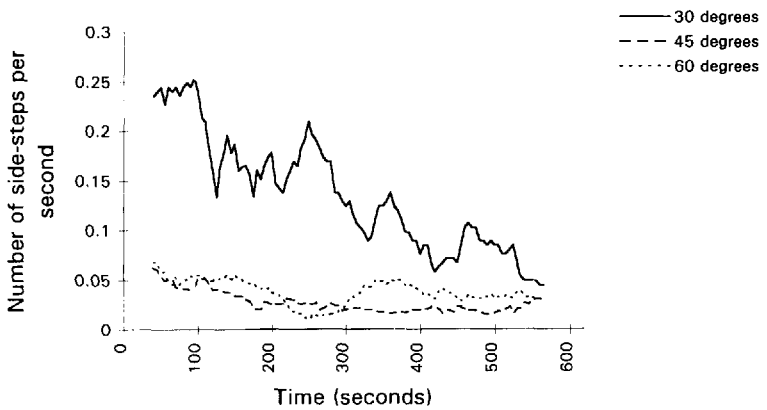


Figure 2a **Rate of side-stepping per bird in birds which stayed on the perches for 10 minutes.**

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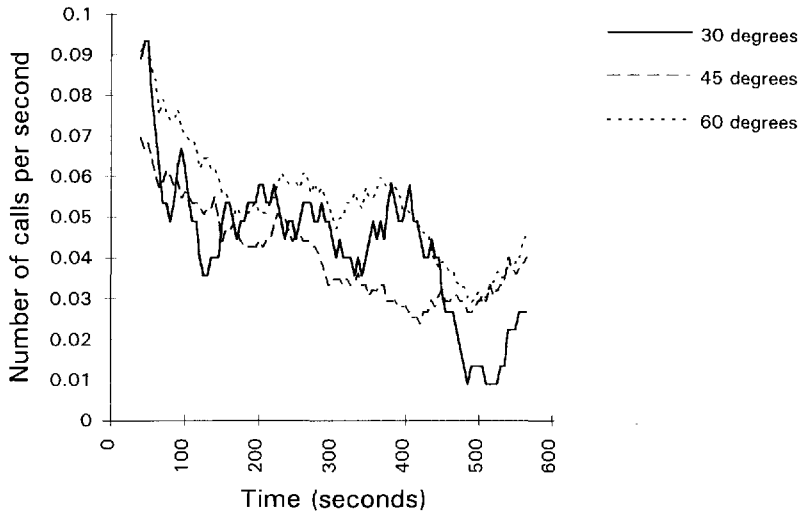

Figure 2b **Rate of calling per bird in birds which stayed on the perches for 10 minutes.**

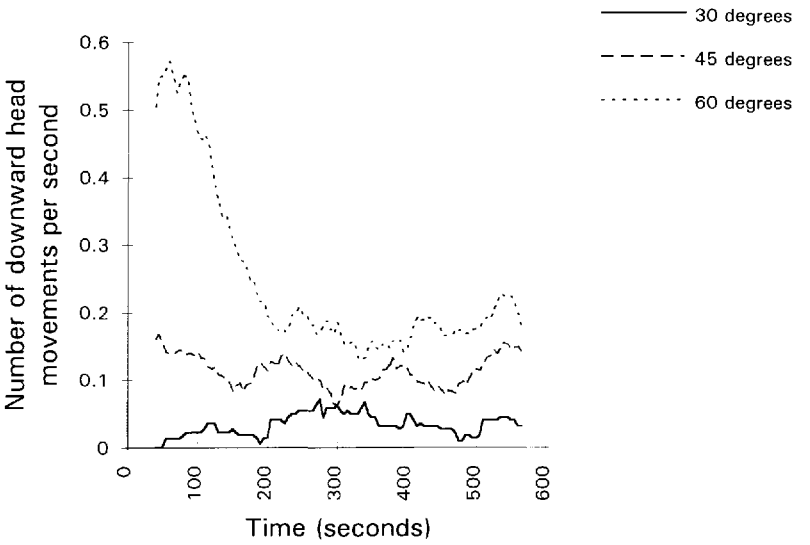

Figure 2c **Rate of downward head movements per bird in birds which stayed on the perches for 10 minutes.**

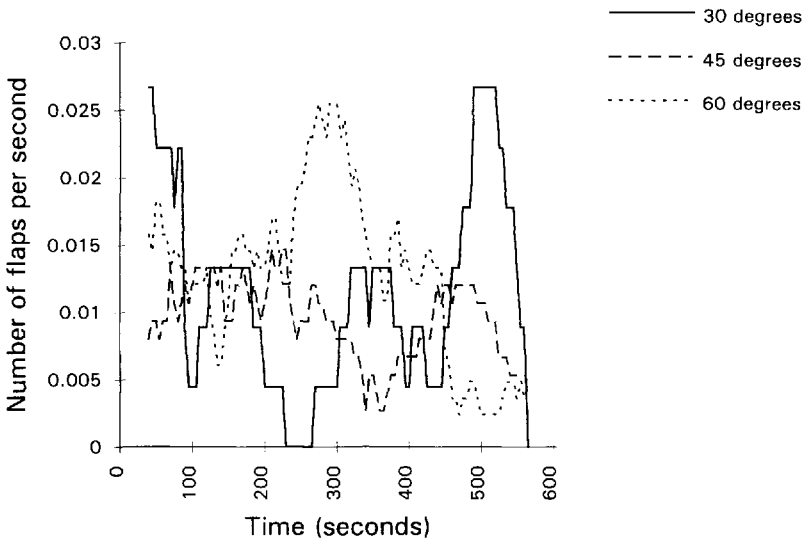

Figure 2d **Rate of wing-flapping per bird in birds which stayed on the perches for 10 minutes.**

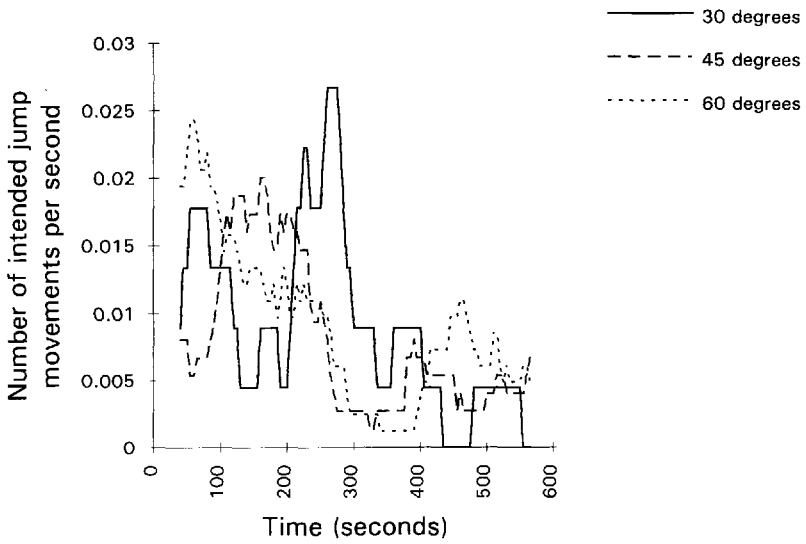

Figure 2e **Rate of intended jump movements per bird in birds which stayed on the perches for 10 minutes.**

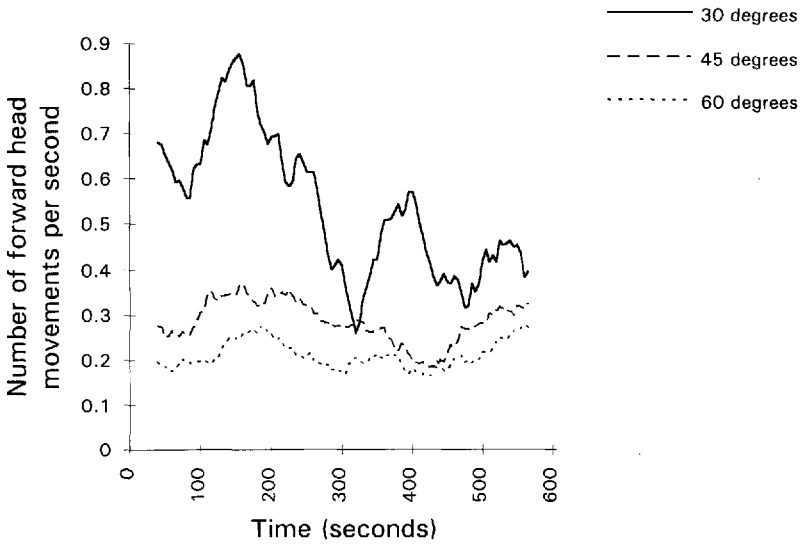

Figure 2f **Rate of forward head movements per bird in birds which stayed on the perches for 10 minutes.**

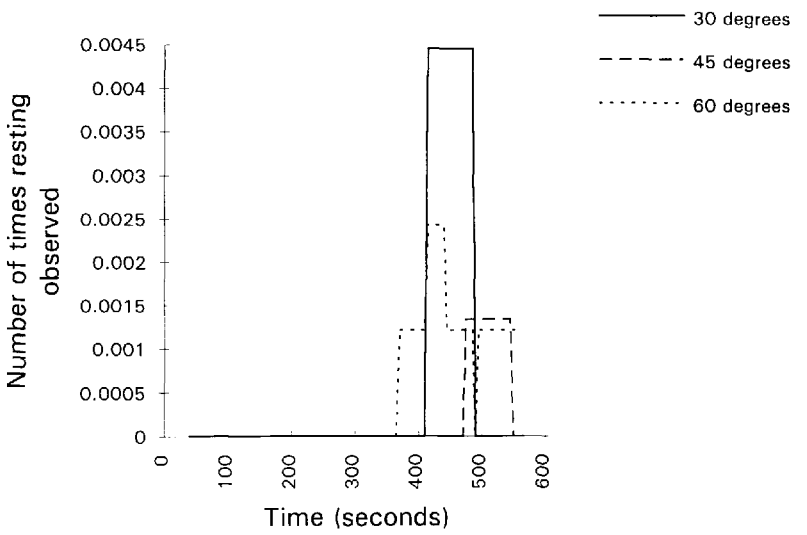

Figure 2g **Amount of time spent resting per bird in birds which stayed on the perches for 10 minutes.**

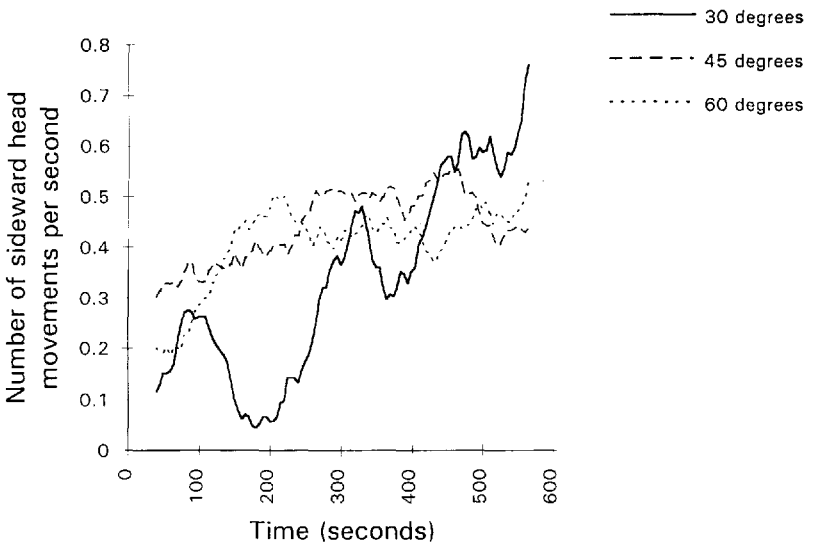

Figure 2h **Rate of sideward head movements per bird in birds which stayed on the perches for 10 minutes.**

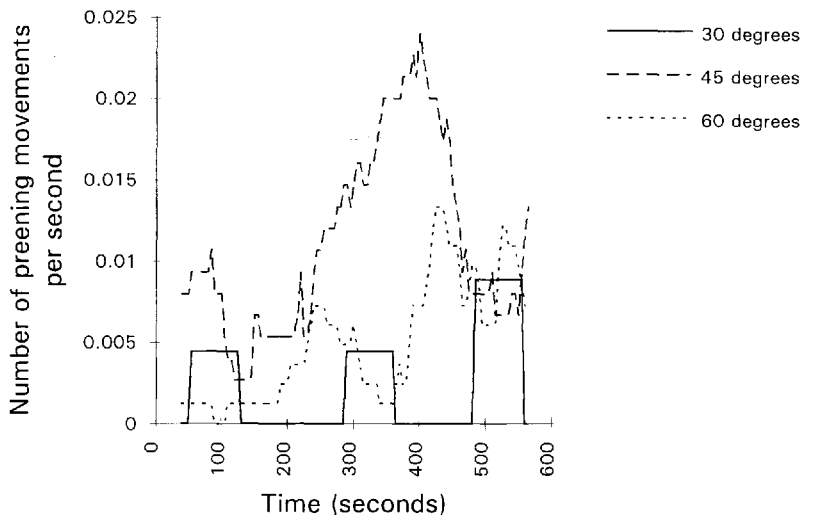

Figure 2i **Rate of preening per bird in birds which stayed on the perches for 10 minutes.**

Resting, sideward head movements and preening significantly increased with time on the perches (Table 2). Resting behaviour was only observed a few times over all the trials in which birds did not reach Perch 3 in ten minutes. In each case this behaviour was observed after at least five minutes on the perches (Figure 2g). Head sideward behaviours increased at each treatment angle with time (Figure 2h), as did preening, although at a separation of 45 degrees the incidence of preening increased to a higher level than at 30 or 60 degrees (Figure 2i).

There was no significant change in the rates of standing, stepping, upward head movements, tail-ruffling and defecation over the ten-minute period that birds remained on the perches (Table 2).

In 25 per cent of the total number of trials, the birds remained on the first perch for at least 1 minute. In a quarter of the trials included in this 25 per cent the birds then jumped to Perch 3 before two minutes elapsed (quick finishers), and in 40 per cent of the trials in which birds stayed on the first perch for at least one minute the birds stayed on the perches for 10 minutes (non-finishers). There was no significant difference in the incidence of any of the recorded behaviours (Table 3) between quick finishers and non-finishers. When comparing the effect of slope on the rate of behaviours in the first minute, step and downward head movements were performed at a significantly higher rate with increasing angle, and forward head movements were performed at a significantly lower rate (Table 3).

Table 3 **Comparison of 'quick finishers' vs 'non-finishers' and effect of slope on behaviours performed in the first minute on the perches.**

Behaviour	Quick finishers vs non-finishers (*P* value)	Slope angle (*P* value)
Resting	0.273	0.145
Standing	*	*
Stepping	0.341	< 0.05
Side-stepping	0.145	0.101
Head upward	0.386	0.141
Head downward	0.073	< 0.001
Head sideward	0.306	0.110
Head forward	0.552	< 0.001
Calling	0.441	0.319
Preening	0.596	0.103
Tail-ruffing	0.135	0.329
Wing-flapping	0.851	0.540
Intended jump	0.477	0.335
Defecation	*	*

* indicates that this behaviour was not performed in the first minute

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Discussion

Angles of 45 and 60 degrees between perches led to a greater percentage of birds remaining on the perch apparatus for ten minutes without moving to the lowest perch. There was also a greater percentage of birds jumping off the experimental apparatus to the ground at 60 degrees, which could be described as avoidance or escape behaviour. Intense frustration in the domestic fowl through thwarting of feeding behaviour can result in escape behaviour (Wood-Gush & Guiton 1967; Duncan & Wood-Gush 1972). This would indicate that these birds may experience frustration as they cannot easily obtain the food reward even though they are motivated to do so.

It is assumed that birds which stayed on the perch apparatus for the full ten minutes found the perches difficult to negotiate (Scott *et al* in press). In these birds the pattern of behavioural expression changed with time. When first placed on the perches birds exhibited a high rate of calling and head movements towards the food reward, indicating that birds were aroused. These behaviours significantly decreased in frequency with time (Table 2). There was a greater vertical separation between the bird and the food reward as the angle between the perches increased, therefore, at 60 degrees birds had to look down at the food reward, whereas at 30 degrees head forward was directed at the food reward. If the head movements of the birds were directed towards the food reward when first placed on Perch 1, this would explain why there was more head downward behaviour at 45 and especially 60 degrees than at 30 degrees (Figure 2c), and more head movements forward at 30 degrees than 45 or 60 degrees (Figure 2f). This may also explain why there was an effect of slope on the rate of downward and forward head movements performed in the first minute by birds which were compared in the quick finishers versus non-finishers test (Table 3). Side-stepping and intended jump movements decreased significantly with time. These behaviours were associated with intention or preparation to jump to the next perch. There was also a decrease in wing-flapping with time, which can be explained by the fact that most incidents of flapping which were observed were linked to intended jumps. Duncan and Wood-Gush (1972) observed a high frequency of backward and forward pacing in birds which were frustrated due to thwarting of feeding behaviour, but in the present experiment no significant changes in stepping rate occurred with time spent on the perches. If side-stepping is included, however, a significant decrease occurred with time. Birds failing to move to the next perch showed a general decrease in movement and intention to negotiate the perches. An increase in resting, where birds sat down with their keel bones on the perch, was observed with time on the perches. The incidence of head movements away from the food also increased with time (head sideward), suggesting an increasing lack of interest in the food reward. Wood-Gush and Guiton (1967) studied thwarting of feeding behaviour in the domestic fowl by placing hungry birds in a cage with a bowl of feed which was covered with clear glass, so that birds could not feed from it. Once the birds learned that they could not reach the food their attention gradually diverted from the food and their behaviour moved towards that shown by birds which were not motivated to feed. The changes observed in the present experiment may reflect an increase in the incidence of comfort behaviours. Rowell (1961) studied the behaviour of chaffinches and found that displacement grooming occurred in a situation where there was a conflict between approaching a positive stimulus (food) and avoiding a frightening stimulus (a flashing light) at the same time and, as a consequence, the bird was in a state of equilibrium. It was suggested that, if birds are in this state of

equilibrium for a certain length of time, displacement grooming occurs. If these findings can be related to hens, this may explain why in the present experiment, when birds were initially presented with perches which they found difficult to cross in order to reach food, preening behaviour was rare, but as time passed the incidence of preening increased.

The birds which remained on the perches for the full 10 minutes are likely to be the more timid birds, not risking the move to other perches. The behaviours that these birds exhibit may differ from those of the more confident birds which were more successful at the task. Birds predisposed to particular behaviours (related to motivation) may complete the task more quickly. When comparing initial behaviour of birds when placed on the perches, the incidence of behaviours performed in the first minute did not significantly differ between birds which completed the task in under two minutes and those which did not complete the task in 10 minutes. It therefore appears unlikely that birds were deciding, immediately after being placed on the first perch, whether they could or could not negotiate the perches in order to reach the food reward. It seems more probable that all birds were motivated to move to the food reward, but that gradually over time the behavioural expression of some birds (perhaps the more timid individuals) changed, when they found the task too difficult, to include behaviours indicative of thwarting. It would then be these less motivated birds who made up the population from which the main body of behavioural data were collected. This study highlights the fact that birds are individuals and have differing abilities and needs. This has to be considered in the design of housing systems. A system which can be negotiated easily by as many birds as possible is required to reduce problems such as frustration or injury and hence improve welfare.

Scott *et al* (in press) found that hens find it difficult to descend a series of horizontal perches separated by angles of 45 degrees or more. The present experiment suggests that when birds are required to move downwards at slopes which are difficult to negotiate, frustration and comfort behaviours are more likely to occur. It is not known whether birds would adapt, with long-term exposure over weeks or months, to be able to easily negotiate perches separated by greater angles.

Animal welfare implications

The design of an alternative housing system for laying hens should enable birds to move easily between different levels of the house in order to reach the various facilities provided. This would reduce the number of birds crashing into the system as they attempt to move around and so reduce the number of broken bones. Systems which provide slopes of no more than 45 degrees between perches may ease the movement of birds throughout the house (Scott *et al* in press). The findings of the present study suggest that thwarting and frustrated behaviour may result if the angle between perches is difficult for the birds to negotiate. If hens are repeatedly required to negotiate angles greater than 45 degrees to reach facilities, such as nest boxes or feed and water, then long-term frustration may occur, which can lead to serious problems, such as stereotypies (Duncan & Wood-Gush 1972).

Acknowledgements

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