# THE PUSH-DOOR FOR MEASURING MOTIVATION IN HENS: LAYING HENS ARE MOTIVATED TO PERCH AT NIGHT

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**Abstract** *Animal Welfare 2002, **11**:* 11-19

*Free-living hens perch on branches in trees and domestic hens (*Gallus gallus domesticus*) show signs of unrest if they cannot reach a perch, suggesting that night-time perching is a behaviour that hens are motivated to perform. This motivation was quantified in two experiments using a weighted push-door that hens had to push open in order to gain access to a perch. First, the motivation of individual birds to perch, and second, the effect of a companion bird on perching motivation, were measured. Eight adult laying hens (Lohmann Selected Leghorn) were trained to push through the door at increasing resistances, and the individual capacity of each hen was determined. Hens were then tested once per day, at lights-off, in a test pen where pushing through the push-door gave access to the resource. Two consecutive series of increasing resistances were used in the experiment: 25, 50, 75 and 100 per cent of each bird's maximum capacity. In the first experiment, the resources offered were either a perch (treatment) or a 'sham perch' that could not be used for perching (control). Hens opened significantly heavier doors in order to gain access to a perch than to gain access to the sham perch. In the second experiment, pushing through the door gave access either to a perch with a companion hen already perching on it (treatment) or to a perch and a companion hen roosting on the floor (control). In this comparison, four of the hens did not push through the door, probably because of aggressive interactions with the companion, and no significant differences between treatments were found. We conclude that hens are motivated to use a perch for night-time roosting and that they should be housed in systems with perches.*

**Keywords:** *animal welfare, behaviour, motivation, perches, poultry, roosting*

## Introduction

Free-living hens spend the dark period roosting on branches in trees and each group has preferred roosting sites within its home range to which group members move at night (McBride *et al* 1969; Wood-Gush *et al* 1978). Under natural conditions, perching at night in the company of flock-mates is an adaptation that reduces the risk of predation and helps birds to conserve heat. Dawkins (1990) suggested that a behaviour that is adaptive under natural conditions will still be motivated in domestic animals by the same causal mechanisms, although the fitness effects will have been eliminated in the protected environment. In commercial housing systems that allow the birds access to perches, the majority of birds use these perches for roosting at night and also make extensive use of them during the day (Faure & Jones 1982a,b; Tauson 1984; Braastad 1990; Duncan *et al* 1992; Appleby *et al* 1993; Lambe & Scott 1998). Recently, we have shown that birds deprived of the ability to perch at night display signs of unrest (Olsson & Keeling 2000). Thus, there are strong indications that domestic birds are motivated to perch at night but, to our knowledge, there has been no experimental attempt to measure this motivation.

The concept of motivation is central to animal welfare in that good welfare requires that animals are given the possibility to perform behaviours for which they are motivated (Hughes & Duncan 1988; Dawkins 1990; Jensen & Toates 1993; Fraser & Matthews 1997). Motivation has been studied using a variety of methods, of which the combination of operant techniques (in which animals have to perform a task in order to gain access to a resource) and consumer-demand theory from economics research (Dawkins 1983, 1990; Kilgour *et al* 1991; Fraser & Matthews 1997; Mason *et al* 1998) has been predominant during the last decade. The most common application has been to measure the elasticity of demand, which describes how consumption of a resource changes when its price changes. It is necessary that the animal is allowed sufficient access in order to allow full expression of the behaviour and, in the case of a perch for night-time roosting or a nest for egg-laying, generating a demand curve by varying the cost for access would be extremely time-consuming. Nevertheless, if the maximum performance of each individual in the task is measured separately, the actual motivation to access the resource can then be measured using trials set at fixed percentages of this maximum capacity. This way, the duration of the experiment may be kept at a standardised length, in contrast to the time-consuming method of gradually increasing the cost until the bird stops responding. To this end, we have adapted the existing push-door (see Petherick & Rutter 1990) as an alternative method for measuring birds' motivation to perform this type of 'all-or-nothing' behaviour (see Olsson *et al*, pp 1–10, this issue, for details and a validation of the method).

If hens are motivated to perch at night, it is important that housing systems allow the behaviour to be performed. Despite this, conventional battery cages have no perches and, even in alternative systems such as aviaries and percheries, lack of perching space or inappropriate distribution may prevent hens from perching. Motivation to roost is affected by several factors, but the triggering stimulus seems to be the decline in light intensity below a certain level (Kent *et al* 1997). However, several other external stimuli may be important. In a social context, the sight of one individual performing a behaviour enhances the motivation of others to perform that behaviour (Colgan 1989). Therefore, the sight of another hen perching may enhance hens' motivation to perch.

In the present study, we aimed not only to quantify the motivation to use a perch for night-time roosting, by measuring the amount of work hens are prepared to perform in order to gain access to a perch at night, but also to investigate the effects of social factors on perching motivation. Work was quantified using a weighted push-door, which the hens had to open in order to access the perch. In the first experiment, we measured the amount of work hens would perform to gain access to a perch alone, and in the second experiment we measured how much work hens would perform in order to be able to perch together with another hen.

## Experiment 1 — Perching Motivation

### Materials and methods

Seven hens of the commercial breed LSL (Lohmann Selected Leghorn) were used in the experiment (an eighth hen had been discarded because she had escaped on the first day of the experiment and thereafter did not go through the door voluntarily). The hens were litter-reared with access to perches. They arrived at the experimental farm at the age of 16 weeks and were thereafter housed on the floor in a group of 30 birds with access to litter, nests and perches. The hens were kept in this home group before and between tests and were moved to the experimental pen only for the nights on which they were tested. The birds were kept on an artificial light–dark regime of 12L : 12D (30.0 lux and 0.5 lux, respectively), with the lights coming on at 0230h. A twilight period lasting 10 min, when the room was illuminated only by spotlights, signalled the coming dark period. Experiment 1 was performed when the hens were 24 (group 1) or 32 (group 2) weeks old.

Motivation was measured using a push-door similar to that developed by Petherick and Rutter (1990). The push-door is a swing-door, hinged at the top and held closed by an electromagnet. The door is made of thin metal bars which enable the bird to see through to the other side, and can be pushed open by the hen putting her head through the central opening in the door and pushing with the front of her wings. Starting at 20 weeks of age, the birds were trained to push through the door at increasing resistances. The maximum resistance that each bird would overcome was determined in an experiment in which the birds were initially food-deprived and then food was used as a reinforcer (see Olsson *et al*, pp 1–10, this issue, for details of the training procedure). The testing apparatus comprised two parts, a start compartment and a resource compartment, separated by a wall of netting into which the push-door was inserted. The resource compartment during the treatment condition contained a perch (1 m wide with perching space available at 23 cm and 43 cm above the floor). During the control condition, this perch was exchanged for a similarly shaped 'sham perch', which was covered by a solid board and did not allow perching. At the start of the twilight period, the hen was placed in a start cage, a netting cage (32 x 32 x 32 cm, without a floor) in which the hen could stand up and see in all directions but could not walk or flap her wings. At the end of the 10 min twilight period, this floorless cage was lifted up by a string-and-pulley system so that the hen was released into the start compartment. By this time, the room was dark except for a spotlight giving a light level of approximately 0.5 lux in the experimental pen. Once released, the hen was free to choose to go through the push-door into the resource compartment or to stay in the start compartment. Hens stayed in the experimental apparatus until the following morning, when at approximately 0730h they were returned to their home pen. The push-door opened in only one direction, but no hen was ever seen to try to return to the start compartment once she had gone through to the resource compartment.

All hens were exposed to both perch and sham-perch treatments in a balanced within-subject design. A schedule with a series of four resistance levels in ascending order was used. The resistances were individually adapted to each hen, the maximum resistance used corresponding to the maximum resistance overcome in order to access food when food-deprived during training (see Olsson *et al*, pp 1–10, this issue). Each series started with one session in which the door was left fully open allowing free passage to the resource pen. On the second day, the door was left ajar so that the hen could still easily pass through the door, but once on the other side she could not return to the start compartment. This was followed by the four-day series of increasing resistances: 25, 50, 75 and 100 per cent of each bird's individual maximum. During the days when the door was unweighted, no data were collected; thus, data collection was begun on the 25 per cent resistance trials. Each series was presented twice and, following standard practice in operant studies, results from the second series only were analysed.

Behaviour was recorded throughout the dark period using a multiplexer video system (JVC BR-S925E) which made it possible to record observations from the four pens simultaneously in 24 h time-lapse mode (0.16 s playback interval). A black and white camera with a wide-angle 3.5 mm lens and an attached infrared light was installed in front of each pen. Detailed behavioural observations were made during the first hour of video recordings (ie hours 0–1 of the dark period). The variables recorded from the video tapes were: latency to the hens' first contact with the door (ie latency to their first attempt to open it); latency to open the door; number of attempts to open the door; latency to first 'landing' on perch; latency to roost (sitting in the same location on the floor or on the perch for 10 min); repetitive pacing (walking uninterruptedly along the wall at least four times); and location for roosting. In addition, the maximum resistance that each bird overcame in the different situations was recorded. In order to record behaviours performed during hours 2–12 of the dark period, less detailed behavioural observations were made from video recordings of the second day in the series (the day on which the push-door was left ajar). These observations recorded the length of time that the hens spent sitting and standing and how many times they changed position.

All results were analysed using the statistical software MINITAB. The maximum resistance opened was analysed in pairwise comparisons between treatments using Wilcoxon signed rank matched pairs tests. Behavioural variables were compared between treatments within resistance in pairwise comparisons using Wilcoxon signed rank matched pairs tests. Data are presented as median [interquartile range].

## Results

Birds pushed through significantly heavier doors when the resource presented was the perch (75 [25–75]% of individual maximum) compared to the sham perch (0 [0–0]% of individual maximum; $W = 21.0$; $P = 0.018$). In fact, only one bird pushed through at any resistance to gain access to the sham-perch, whereas six out of seven birds pushed through to gain access to the perch.

Hens showed a shorter latency to contact the door when the perch was available than when it was not, a difference that was significant for resistances of 50 and 75 per cent of individual maximum. The trend ($P < 0.1$) remained for resistances of 25 and 100 per cent. Very few hens (two at resistances 25% and 50% and one at resistances 75% and 100%) made any attempt to open the door in the control treatment, with the result that most of the hens scored the maximum latency to their first contact with the door. Consequently, the hens made significantly fewer attempts to open the door for the control than for the perch at all resistances. Results are presented in Tables 1 and 2. There were no significant effects of treatment on any of the other behavioural variables recorded during the first hour of the dark period.

**Table 1 Experiment 1: Latency to first contact with the push-door. Data are median (interquartile range).**

| | Latency (s) | | | |
|---|---|---|---|---|
| *Resistance (%)* | *Perch* | *Control* | *W* | *P* value |
| *25* | 65 (21–126) | 3600 (30–3600) | 18.0 | 0.071 |
| *50* | 26 (15–87) | 3600 (511–3600) | 20.0 | 0.030 |
| *75* | 40 (22–231) | 3600 (3600–3600) | 20.0 | 0.030 |
| *100* | 68 (23–3600) | 3600 (3600–3600) | 14.0 | 0.053 |

During the following 11 h of the night, hens changed position more often when they had a perch than when they did not (number of position changes: perch = 15 [11–18]; control = 12 [6–18]; $W = 1.0$; $P = 0.035$). There were no significant differences between the treatments for time spent sitting and standing throughout the night.

**Table 2 Experiment 1: Number of attempts to open the door. Data are median (interquartile range).**

| | Attempts | | | |
|---|---|---|---|---|
| *Resistance (%)* | *Perch* | *Control* | *W* | *P* value |
| *25* | 1 (0–1) | 0 (0–2) | 0 | 0.030 |
| *50* | 5 (1–7) | 0 (0–2) | 0.0 | 0.018 |
| *75* | 4 (2–6) | 0 (0–0) | 0.0 | 0.018 |
| *100* | 6 (0–11) | 0 (0–0) | 0.0 | 0.030 |

## Experiment 2 — Social Aspects of Perching Motivation

### Materials and methods

The same birds as in Experiment 1 were used, but by now they were 51 (group 1) or 55 (group 2) weeks old. During the time between Experiments 1 and 2, the hens had been kept in their home pen. To ensure that the hens were still familiar with the push-door, they were given four days of training in the runway before starting the experiment.

The same apparatus as in Experiment 1 was used, but now the resource pen contained either a perch with a companion hen perching (experimental treatment) or a perch with the companion hen on the floor (control). The companion hen, which had been accustomised to the treatment during one week of training, was kept in a plexiglass cage measuring 21 x 47 x 30 cm (l x w x h). When the companion hen was perching, this cage was attached onto the second perch level (ie 43 cm above the floor). Companion hens were placed in the cages at the beginning of the 10 min twilight period, whereas test hens were placed in the start cages 3 min before lights-off. All other aspects of the experimental procedure were identical to those described in Experiment 1.

In this experiment, behaviour was recorded manually based on prior experience from Experiment 1. Only variables for which we had found a treatment effect in Experiment 1 were recorded, and only data from the second series of resistances were collected. Behavioural recordings were begun when the test hen was released from the start cage and ended when she was roosting (ie had been sitting in the same position for 10 min). The following variables were recorded: latency to first contact with the door; latency to open the door; number of attempts to open the door; latency to settle down for roosting (either on the floor or on the perch); and location for roosting. The following morning, the location of the test hen (start compartment or resource compartment) was registered. Data analysis was identical to that of Experiment 1.

### Results

Of the eight hens in the experiment, only four opened the weighted door during the time when behaviour was recorded. These four hens opened the door both in the treatment and in the control situation, and the maximum resistances overcome are shown in Table 3.

On the morning after testing, it was often found that hens which had not opened the door during the hour immediately after lights-off had, nevertheless, pushed through the door to the resource compartment at some time during the night. From these morning records, we know that the four hens that had not actually been observed to open the door all went through it on the first two days of each series (when the door was open or ajar), and three of them also opened the door at least at 25 per cent resistance. Nevertheless, even when these data were analysed together with the data from the four birds that pushed through the door before settling down to roost, there was still no effect of treatment on the resistances overcome. No other behavioural differences were found between treatments.

**Table 3 Experiment 2: Maximum resistance opened.**

| | Resistance (%) | |
|---|---|---|
| *Hen* | *Perching hen* | *Control* |
| *92* | 100 | 75 |
| *98* | 50 | 25 |
| *99* | 100 | 100 |
| *193* | 50 | 50 |

## General discussion

Previously, we have demonstrated that hens show signs of unrest when they are deprived of the opportunity to perch at night (Olsson & Keeling 2000), suggesting that hens are motivated to use a perch for night-time roosting. The present study corroborates and extends these findings by showing that hens are prepared to work for access to a perch at night. In the experiment in which hens had to push through a weighted door to gain access to a perch, we found that hens pushed through heavier resistances for a real perch than for the control sham perch. Furthermore, hens showed a shorter latency to contact the door, took a shorter time to open the door and made more attempts to open it for access to the perch than for access to the sham perch. However, the opportunity to perch together with another hen was not found to have any effect on motivation.

In the first experiment, we studied hens' motivation to use a perch for roosting at night by allowing the hens to push through a weighted door presented to them at four individually adapted resistances. As the median scores show, the maximum resistance that a hen would overcome in order to gain access to a perch was 75 per cent of her individual maximum — that is to say, 75 per cent of the door resistance that she would open for access to food when she was food-deprived. If, as has been suggested by Dawkins (1983), the demand for food is used as a standard against which other demands are titrated, this indicates a high motivation for perching. Furthermore, both the latency to first contact and the latency to open the door were shorter in the treatment with the perch than with the control, and the hens made more attempts to open the door.

We have previously found that birds take a longer time to roost when no perch is available (Olsson & Keeling 2000). In the present experiment, we found no effect of the availability of a perch on the latency to roost. There are several possible explanations for this. First, in the present experiment, hens had to push open the door to get to the perch, and this in itself took time, especially at higher resistances. As hens in the control treatment roosted on the floor of the start compartment, in most cases without attempting to open the door, this meant that reaching the roosting site took longer in the perch treatment than in the control treatment. Second, in our earlier experiment, groups of three hens were tested together. In these groups, birds would disturb each other while trying to find a suitable roosting site on the floor, which increased the latency to roost. In the present experiment, behaviour was measured throughout the night with the aim of detecting differences in resting behaviour between treatments, and we found that birds changed position more often when they were on a perch than when they



https://doi.org/10.1017/S0962728600024283 Published online by Cambridge University Press

were not. This is contrary to what we had expected, as birds clearly preferred the perch as a roosting site and so would be expected to rest more quietly. We have no good suggestions to explain this finding and, in the absence of data on how often birds normally change position during sleep, it is difficult to say whether the difference has any biological significance.

In the second experiment, the effect of social factors on perching motivation was studied. The hens were presented either with a perch with another hen perching on it, or with a perch with another hen roosting on the floor. No significant differences were found in behaviour between treatments — not even when the data on hens' locations the following morning were included, increasing the number of subjects to seven. This implies that the presence of a companion bird perching neither increased nor decreased the motivation of the test bird to perch. Unexpectedly, only four out of eight hens pushed open the door during the observations, despite the high tendency to open the door for access to the perch in the first experiment. One possible explanation for why half of the hens did not push through the door during the observation period is that the hens found the set-up with the companion hens behind perspex aversive. Although the companion hens appeared quiet, they could nevertheless have signalled distress to the experimental hens, discouraging these from approaching. However, if there was anything aversive about the situation, one would expect all hens to react in a similar manner, and they did not. Whereas one hen made no attempts at all to open the door, two of the hens opened the door at the maximum resistance. We feel that such individual differences are better explained by an effect of dominance. The choice of companion and experimental hen in this study was random and may have resulted in different dominance combinations. We later found that hens, although coming from the same group, may show aggression when taken out of the group and paired in an unfamiliar arena. Such aggressive encounters were possible in this experiment, as some companion hens escaped by lifting the lid off the cage from the inside (presumably when activity increased at lights-on the next morning). Freire *et al* (1997) found that hens that were motivated to nest would persist in gaining access to a nestbox even though they had to pass a dominant hen to do so. If an experimental hen paired with a dominant companion was hesitant to perch together with her, but still entered the resource compartment when searching for a nest the following morning, the resistance opened after the end of the observation period could reflect motivation to nest rather than to perch.

The assumption is that perching together has adaptive value in terms of temperature regulation and protection against predators. However, there are few data to confirm that perching tightly together with body contact is the normal behaviour of free-living hens. Wood-Gush *et al* (1978) reported that in contrast to hens kept semi-intensively, which did indeed roost with inter-individual distances approaching zero, free-living domestic hens were rarely seen to roost in contact with one another. In fact, these free-living hens were often seen to roost in separate trees. McBride *et al* (1969) described that group members come together at the same roosting site, but unfortunately gave no information about how the individuals were distributed over the site. In our experiment, the birds perched tightly together when undisturbed in the home pen, and this is similar to our previous findings (Olsson & Keeling 2000). In the present experiment with a companion hen, body contact between the birds was prevented as the companion hen was kept in a cage. Given this, the test hens may not have discriminated between the proximity of a hen next to her on the perch and a hen on the floor, hence leading to similar results in the control and experimental treatments.

With the presented results, we have the first experimental evidence that hens are motivated to perch at night. It does not seem that the opportunity to perch together with another bird increases the attractiveness of the perch, although we are cautious with this interpretation because of methodological problems in the second experiment. Taking these problems into account, it would be interesting to determine whether the presence of a companion bird has any effect on hens' motivation to perch, using an experimental paradigm in which motivation for a perch with an unrestrained companion bird already perching on it was compared to motivation for a perch only. It would also be of interest to study causal factors for differences in perching motivation in birds that regularly use perches. One bird in this study never opened the door in either the first or the second experiment, although she perched at night in the home pen and had opened the push-door successfully for access to food during training. This could imply either that the perch offered during the experiment was not as attractive to her as the one in the home pen, or that, while capable of using perches, she was not sufficiently motivated to work for access to them.

## Conclusions and animal welfare implications

In conclusion, hens were prepared to work by pushing open weighted doors for access to perches for night-time roosting. When comparing the work performed for access to perches with that performed for access to food, we conclude that hens with prior experience of perches have a strong motivation to perch at night. If these hens are housed in systems that do not allow all birds to perch, they are likely to experience reduced welfare. We do not know whether this motivation is also present in birds that have had no prior access to perches. However, because housing hens with perches has other beneficial effects on bird welfare, such as improved bone strength (Abrahamsson 1996) and decreased risk of cannibalism (Gunnarsson *et al* 1999), housing in systems with access to perches should be recommended throughout rearing and production.

## Acknowledgements

The authors wish to thank Catherine Sumpter and Barry Hughes for comments and suggestions during the planning of the experiment, Hans Gustafsson and Bengt Edwinsson for technical assistance, Tina McAdie and Gunilla Jacobsson for help with behavioural observations and John Öhrvik for statistical advice. The study was funded by The Swedish Council for Forestry and Agricultural Research.

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