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Social effects on dustbathing behaviour in laying hens: using video images to investigate effect of rank

Anna S. Lundberg, Linda J. Keeling*

*Department of Animal Environment and Health, Swedish University of Agricultural Sciences,
P.O. Box 234, Skara SE 532 23, Sweden*

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Abstract

We chose to study dustbathing behaviour in laying hens, since it is often assumed that this behaviour is socially facilitated, but it has not been tested. In addition, we investigated the effect of social rank, since this is known to be important in other aspects of hen social behaviour. Twelve high and 12 low ranked birds were used as test animals and 4 middle ranked birds were recorded on video and used as stimulus birds. After 9 days of litter deprivation, each bird was tested in a cage with sand on the floor in front of a video monitor. After a 1 h pre-test period, during which the test hen could dustbathe and get familiarised with movements on the television screen, the 2 h test period began. Three different test videos were used; a dustbathing hen, a standing hen, and an empty cage, with each bird seeing all three videos. Differences were found in the number of birds dustbathing, the number of dustbathing bouts and the latency to dustbathe. Fewer high ranked birds than low ranked birds started to dustbathe in response to the standing hen video and they had fewer dustbathing bouts. High ranked birds dustbathed sooner if they were shown a video image of a dustbathing hen compared to a standing hen. There were no effects on the duration or intensity of dustbathing in either high ranked or low ranked birds. We suggest two interpretations for these results, either high ranked birds were socially facilitated to initiate dustbathing by a video image of a dustbathing hen, or high ranked hens were inhibited in starting to dustbathe by the image of the standing hen. We propose that our results raise the question as to whether social facilitation is as clear phenomenon as earlier workers, who have only worked with feeding and drinking behaviour, suggest.

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Keywords: Social facilitation; Social rank; Laying hens; Dustbathing; Video

* Corresponding author. Tel.: +46-511-67220; fax: +46-511-67204.

E-mail address: linda.keeling@hnh.slu.se (L.J. Keeling).

1. Introduction

The behaviour of social animals can be influenced by conspecifics in many different ways. For example, some behaviour patterns are diminished while others are enhanced and even new behaviours can be developed or learnt. Social inhibition refers to a decrease in the performance of specific behaviour patterns in a social context (Clayton, 1978). This suppression of certain behaviour patterns can be a consequence of disturbance or competition, both of which have been found in experiments where the stimulus and the test animals are in direct contact during the test (Strobel, 1972; Forkman et al., 1994). Social animals can also be inhibited from performing certain behaviour patterns due to isolation, so called solitary inhibition. When an animal which normally lives under social conditions is kept alone, it may cease to show certain behaviours because of the increased need for vigilance or because essential social stimuli are needed as, for example, during courtship (Stamm, 1961). On the other hand, enhancement of the behavioural repertoire may occur as a result of interactions with conspecifics and new behaviours can even be acquired by imitating behaviour patterns exhibited by others (for review, see Galef, 1988). The last in this list of social influences is when the performance of an already known behaviour increases due to the sight of others performing this behaviour (Clayton, 1978). This is called social facilitation and it was this phenomenon that was the focus of this study. We were interested in whether or not the rank of the birds had an effect on social facilitation and in studying social facilitation of dustbathing, which had not been investigated before. The methodological way of testing this was by using satiated birds (in respect to dustbathing) of different rank and investigating if and how their dustbathing behaviour was influenced by seeing another bird dustbathing. Laying hens in conventional battery cages, in furnished cages or in free range systems often have no or just limited access to a dustbathing substrate and therefore the understanding of this behaviour might have implications for welfare.

There are various hypotheses concerning the function of social facilitation. According to Tolman (1964), social facilitation is a type of local resource competition. Another theory is that social facilitation of eating is a way of learning about new food types or food locations (Turner, 1964; Alcock, 1969; Murton, 1971; Mason and Reidinger, 1981; Forkman, 1991). It has also been shown that for domestic chicks the performance of novel learning tasks, such as pecking on certain colours or running down a runway, may be enhanced by social facilitation (Smith, 1957; Meyer and Frank, 1970; Frank and Meyer, 1974). A third suggestion for the function of social facilitation is that it is an anti-predator response, since it may lead to flocking and synchronisation within the flock, thereby decreasing the risk of predation for each individual (Lazarus, 1972, 1979; Forkman et al., 1994).

The Red Jungle Fowl, the ancestor of our domestic fowl (Fumihito et al., 1994) lives in flocks among bushes and dense forest (Collias and Saichuae, 1967). Under these conditions, it is at times difficult for the flock to stay together if some birds are showing stationary behaviours such as resting, preening, dustbathing, etc. while others are walking around and searching for food. Synchronisation of behaviour facilitates keeping the group together thereby allowing the individuals to benefit from group life. Under wild or feral conditions hens live in small groups, with a clear dominance hierarchy, where dominant birds have priority of access to limited resources. The rank of the bird has been shown to

influence many other aspects of behaviour including social learning (Nicol and Pope, 1994) and fear (Jones and Faure, 1982). It is therefore possible that there is also a difference between high and low ranked animals in how they are influenced by social facilitation. The rank of the demonstrator bird may influence how the receiving bird is affected and the rank of the receiver bird may be important for how it responds. Indeed, when investigating this, Forkman (1996) found that low ranked domestic hens were more easily facilitated to drink than high ranked birds.

Hens are known to dustbathe at the same time and this synchronisation might be caused by social facilitation, but this has not been tested experimentally. A dustbathing bout follows a relatively predictable sequence (Kruijt, 1964; Vestergaard et al., 1990; van Liere, 1992). Adult fowl generally dustbathe only every other day (Vestergaard, 1982; van Liere and Bokma, 1987; van Liere, 1992) and a dustbath lasts for, on an average, 27 min (Vestergaard, 1982). Dustbathing behaviour is thought to maintain the amount and quality of the feather lipids and the structure of the feathers (Healy and Thomas, 1973; Borchelt and Duncan, 1974; Levine et al., 1974; van Liere and Bokma, 1987; van Liere et al., 1990, 1991). However, dustbathing also occurs in featherless birds (Vestergaard et al., 1999) and no effect was found on the dustbathing behaviour of birds whose oil gland had been removed (Norgaard-Nielsen and Vestergaard, 1981) leading to the conclusion that it is not solely triggered by a build-up of lipids on the feathers, but that an internal mechanism, of the type proposed in Lorenzian regulation of behaviour, can trigger dustbathing (Vestergaard et al., 1999).

Nevertheless, just because birds often perform a behaviour in the same location at the same time may not mean that it is socially facilitated and even behaviours that are usually socially facilitated may not be so under all conditions. If the occurrence of certain behaviours depends, for example, on the weather, the temperature, or on visual stimuli, then these demands will be fulfilled at the same time for all animals. It has been found that light and (or) heat stimuli and environmental temperature can control the time of the day at which dustbathing occurs and even whether or not it occurs at all (Hogan and van Boxel, 1993). Furthermore, the visual stimuli of a substrate has been shown to have an effect on the triggering of dustbathing behaviour (Petherick et al., 1995) and the visual stimuli of other hens has an effect on the dustbathing duration (Duncan et al., 1998). Thus, while social facilitation may have the consequence that behaviour is synchronised among the animals in the group (Lazarus, 1979), other factors in the environment could also result in behaviour being synchronised.

A difficulty in studying social facilitation in behaviour patterns other than feeding and drinking is that it is difficult to get the stimulus bird to perform the behaviour at the time of the test. One method to overcome this is to use video images. Video images have been used previously to study social behaviour (Evans and Marler, 1991; Keeling and Hurnik, 1993; McQuoid and Galef, 1993, 1994). However, there are limitations using video images that should be taken into consideration when designing an experiment (Patterson-Kane et al., 1997). One disadvantage is that it does not seem to work where higher levels of discrimination are required (D'Eath and Dawkins, 1996). Another limitation with the video recordings is that we do not know what the test bird is responding to on the video (D'Eath, 1998; Lea and Dittrich, 1999). It could be basic movements on the screen. It has already been shown that birds can be easily facilitated to start pecking by simply tapping a

pencil on hard surface (Tolman, 1964) and dustbathing might well be facilitated by some similar simplistic representation.

The two aims with this study were to investigate if dustbathing can be socially facilitated and if birds are affected differently depending on their rank. To do this we designed the experiment so that birds had dustbathed just before the test started, a method often used when social facilitation of feeding is studied. Instead of using real stimulus birds, video images were used of a dustbathing bird, a standing bird and an empty cage.

2. Materials and methods

We had two groups of laying hens, each with 24 birds of the commercial hybrid Lohman Brown. All birds were 42 weeks old at the start of the experiment and 60 weeks old when the experiment finished. The lighting schedule was 12L:12D throughout the experiment. The two home pens were identical in construction with 21.6 m² floor area covered with sand. In each pen there were two communal nestboxes (total area 1.2 m²) and perches of three different heights (0.23, 0.43 and 0.63 m) giving a total perch length of 7.5 m. Food (standard commercial layer diet) and water were freely available. All birds were individually marked through the skin at the front of the wing with large plastic tags of the type used in the ear of calves. Birds did not show any signs of being disturbed by these wing tags, not even when dustbathing, and there were no adverse health effects.

Aggressive interactions and avoidance were recorded in the home pens during 2 weeks when birds were between 39 and 41 weeks old. A total of 822 rank relationships were observed (408 in one group and 414 in the other). A dominance index (Lehner, 1996) was then calculated for individual hens within each group by dividing the number of pairwise relationships where the bird was dominant by the total number of interactions. The six lowest and the six highest ranked birds from each group were then selected and used as test animals. Two middle ranked birds from each group were used as stimulus birds, since we could not exclude the possibility that hens of different rank behave differently and that this may be perceived by the test hen. These four stimulus birds were recorded separately on video while dustbathing and standing in the test cage. A video of the empty cage was also made so resulting in a total of nine videotapes being used in the study. The videos were recorded against a white background and at eye level. The videotapes of the stimulus birds were then edited into loops so that the behaviour of dustbathing or standing could be displayed continuously for 2 h. The dustbathing loop was on an average 25.1 ± 8.1 min long and the standing video loop was on an average 9.7 ± 2.5 min. Half of the test birds in each pen (half of each rank) saw the dustbathing and the standing video from one of the stimulus hens in their home pen and the other half of the test hens saw the videos of the other stimulus hen. All birds saw the empty cage video. Thus, each bird saw all three treatments and so acted as its own control.

Hens dustbathe on an average every second day (Vestergaard, 1982). To control for this and to make the deprivation time the same for all birds, the test birds, two each day, were taken out from the pen at 1600 h on a day that they had been observed dustbathing. Our definition of a dustbath was that the bird showed wing tossing behaviour, since this is the most characteristic part of dustbathing (Hogan and van Boxel, 1993). The birds were put in

individual cages (floor area 1600 cm²), just outside the home pen, for a 7-day dust deprivation period. After this, they were then moved to the test room and randomly allocated into separate test cages for 2 days to acclimatise to the new environment, although they were still dust deprived. Results from a pilot study showed that at least 9 days of deprivation were needed before birds predictably dustbathed in the test cage. The test cages were made of wire mesh, except from one side, which was made of plexiglass, and the cages were cube-shaped with all sides 51 cm long. The test room had the same lighting schedule, temperature, etc. as the home pen room. Birds were visually separated from each other by solid partitions, and during the test a recording of a fan was played with a sound level of 73–86 decibels to mask possible sounds heard by the tested birds. The videos themselves were without sound.

Each experimental period started at 1300 h and consisted of a 1 h pre-test period and a 2 h test period. At the start of this 3 h period, the food was taken away and a 10 cm high drawer was slid into the test cage (Fig. 1). The drawer contained sand 5 cm deep over the entire bottom of the test cage. Thereafter, 1 h of a recorded feature film (based in New York and not containing any pictures of chickens) was displayed on a video monitor. This was used to familiarise the hen to the light and movements on the video screen and to reduce the likelihood of the hen turning towards the screen and being initially immobile, something which was found in a study by Keeling and Hurnik (1993) when the hens had no familiarisation period with the monitor screen prior to the start of the actual experiment. The pre-test video was followed by 2 h of test video. Three different test videos were used: (1) a video image of a dustbathing hen, (2) a video image of a standing hen, and (3) a video image of an empty cage. All birds were tested with the three different treatments on different days with at least 2 weeks between tests, and it took in total 18 weeks to test all birds with all three treatments. Birds were tested according to a Williams design (Williams, 1949), so treatment and treatment order were balanced. Between the tests, birds were returned to the home pen where they had access to sand.

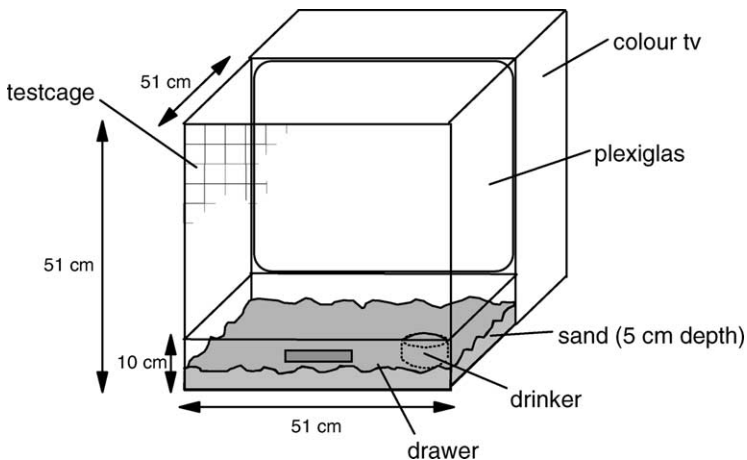


Fig. 1. Picture of the test cage.

The experimental period of 3 h was video recorded to decrease the influence of humans on the behaviour of the test hen. From the video tapes, data on the latency to start dustbathing, the dustbathing duration, wing toss frequency and number of dustbathing bouts were recorded. Latency to dustbathe was measured in minutes from the start of the pre-test or test period until the bird gave its first wing toss. Latencies for non-dustbathing birds were therefore 60 min for the pre-test period and 120 min for the test period. The duration of dustbathing was measured by counting the number of minutes from first wing toss to last wing toss. This was chosen since not all dustbathing bouts finished with a body shake. The body shake that sometimes occurs at the end of the dustbathing period occurs when the bird is standing and seems to function to remove the loose litter material from among the feathers. The intensity of the dustbathing was calculated by counting the number of wing tosses and dividing it by the duration of the dustbathing bout. To determine an appropriate inter-bout interval, a log survivorship plot of time between wing toss bouts was performed and the 'breaking point' in the plot identified. This technique has been used previously to investigate appropriate inter-bout intervals for feeding behaviour (Slater, 1974). From the plot it was decided that if the time between wing tosses exceeded 8.3 min then it would be counted as a new dustbathing bout.

By comparing the responses of the test hen to the video image of a dustbathing and a standing hen, the effect of social facilitation was studied. By comparing the responses of the test hen to the standing hen and the empty cage, solitary inhibition was determined. Finally, by comparing the responses of the test hen to the standing and dustbathing hen with the responses to the empty cage, social inhibition was measured.

2.1. Statistical analysis

Categorical data, such as whether or not the birds dustbathed, were analysed using a non-parametric test (a simple distribution-free statistical method) (Maritz, 1995), whereas continuous data, such as number of dustbathing bouts, were analysed using non-parametric Mann–Whitney's *U*-test. Latencies and duration were analysed using parametric statistics. The experiment was a three-treatment by three-period crossover study and for the parametric analyses we used the GLM procedure in SAS (SAS Institute Inc., 1996). To satisfy requirements for the parametric analysis, the data were log-transformed. For the test period, we first tested if there was a significant carry-over effect between treatments. If not, this factor was excluded from the model. After this, the effect of the other factors (home pen, rank, hen, treatment, test occurrence) were tested on the dependent variables described in the previous section (latency to start dustbathing, duration of dustbathing and number of wing tosses). Since the dustbathing behaviour during the pre-test period could affect how the hens behaved during the test period, latency to start dustbathing, dustbathing duration and number of dustbathing bouts during the pre-test video were put into the model as co-variables.

The following statistical model was used for the data from the test period (carry-over effect excluded):

$$y_{ijklm} = \mu + Y \times x_{iklm} + \alpha_l + \beta_m + s_{iklm} + \pi_j + \tau_{d(ij)} + \beta_m \times \tau_{d(ij)} + \varepsilon_{ijklm}$$

where Y is the regression coefficient, x the co-variable, α_l the effect of home pen l , β_m the effect of rank m , s_{iklm} the random effect of hen k in sequence i in home pen l and rank m , π_j the effect of test occurrence j , $\tau_{d(ij)}$ the effect of the treatment in test occurrence j for the sequence i and ε_{ijklm} is the within subject deviation for the j th test occurrence. We assume s_{iklm} and ε_{ijklm} to be independent and normally distributed with mean zero and variances σ_s^2 and σ_ε^2 , respectively. When a significant effect of treatment was found we compared the means of specific treatments, controlling the simultaneous confidence level.

3. Results

3.1. Pre-test period

All 24 test birds were tested using the three different treatments resulting in a total of 72 test occasions, all of which started with 1 h of pre-test video. On all occasions, except six, the test hen dustbathed during the pre-test period. On an average, 13.6 ± 2.2 min (mean \pm S.E.) elapsed before birds started to dustbathe, the mean duration of the dustbath was 24.2 ± 2.1 min and the number of dustbathing bouts were 1.06 ± 0.06 during this 1 h pre-test period. Thus, in almost all cases the test hen had a dustbathing bout of a typical duration before the test started.

3.2. Test period

3.2.1. Number of birds dustbathing

In a large proportion of tests (62%) hens dustbathed during the test video. For high ranked hens, 67% dustbathed during the dustbathing video treatment, 25% during the standing video treatment and 50% during the empty cage treatment. For low ranked hens, 67% of the birds dustbathed during the dustbathing video treatment, 92% during the standing hen treatment and 75% during the empty cage treatment. When comparing responses to the video of the standing hen, fewer high ranked birds dustbathed compared to low ranked birds (non-parametric test, 97.9% confidence interval = $[-6, 5]$, observed difference = -8 , $P = 0.0013$). When comparing number of birds dustbathing in response to the video of the dustbathing bird or the empty cage, there were no significant differences between high and low ranked hens.

3.2.2. Latency to first dustbathing bout

No carry-over effect was found, but there was a statistically significant difference of latency to first dustbathing bout between home pens ($F_1 = 5.40$, $P = 0.03$). The hens in pen 1 had a shorter latency to the first wing toss (41.8 ± 8.6 min) compared to the hens in pen 2 (72.5 ± 7.5 min). There was no significant difference between low and high ranked hens or between treatments, but when rank and treatment were combined there was a significant interaction effect ($F_{2,43} = 4.41$, $P = 0.018$). High ranked hens dustbathed sooner if they were shown a video image of a dustbathing hen (latency 41.5 ± 14.2 min) compared to a standing hen (latency 96.2 ± 13.5 min). There was no significant difference in latency time between high ranked hens that saw the standing hen or the empty cage

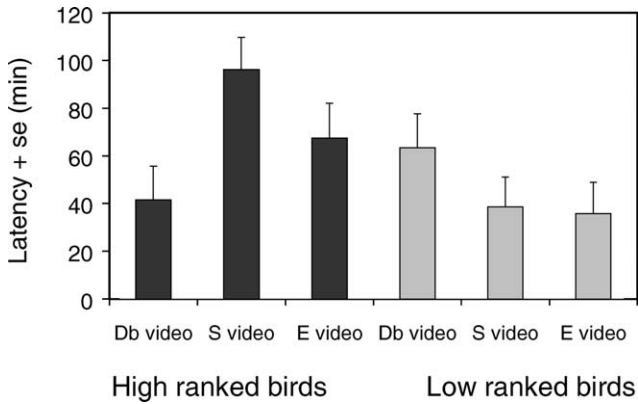


Fig. 2. Latency of high and low ranked birds to start dustbathing in the different treatments. Db, dustbathing; S, standing and E, empty cage video treatment.

(latency 67.5 ± 14.5 min) or the dustbathing hen and the empty cage. For low ranked birds, no significant differences were found between any of the treatments. On an average, the low ranked birds had a latency time of 46.0 ± 7.7 min before they started to dustbathe (Fig. 2).

3.2.3. Number and duration of dustbathing bouts

On an average, 1.1 ± 0.1 bouts of dustbathing were made during the 2 h long test period. This value includes zeros when a bird did not perform any dustbathing. The number of dustbathing bouts for each treatment and rank reflected the number of birds who did or did not dustbathe (Fig. 3). High ranking birds had fewer dustbathing bouts (0.42 ± 0.23) than low ranked birds (1.75 ± 0.41) in response to the standing video (Mann–Whitney's *U*-test: $T = 103$, $N_1 = N_2 = 12$, $P = 0.0044$) and there was a tendency for fewer dustbathing

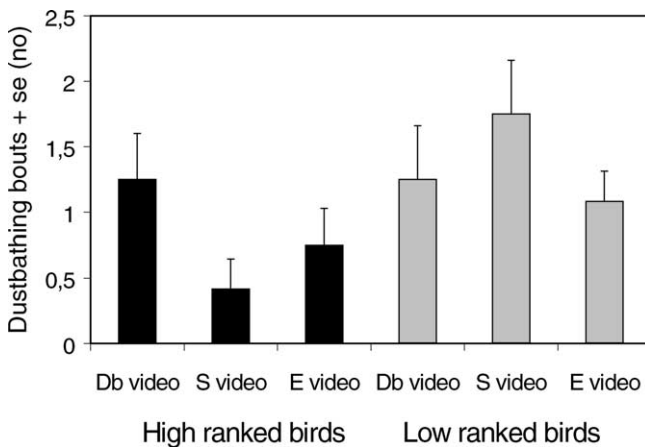


Fig. 3. Number of dustbathing bouts in the different treatments. Db, dustbathing; S, standing and E, empty cage video treatment.

bouts in response to the standing video (0.42 ± 0.23) than the dustbathing video (1.25 ± 0.35) for high ranked birds (Mann–Whitney's U -test: $T = 120$, $N_1 = N_2 = 12$, $P = 0.056$). For duration of each bout, no significant differences were found between any factors (carry-over, test occurrence, home pen, test hen, rank, treatment or the interaction between treatment and rank). The average duration of a dustbath was 10.0 ± 1.3 min during the test period.

3.2.4. Intensity

No significant differences were found between treatments when studying the number of wing tosses the bird made during the dustbath. On an average, birds made 1.4 ± 0.08 wing tosses min^{-1} during dustbathing.

4. Discussion

In this experiment, we studied if dustbathing could be socially facilitated by showing high and low ranking hens video recordings of a dustbathing hen, a standing hen and an empty cage. Our results showed that fewer high ranked birds than low ranked birds started to dustbathe in response to the standing hen video and that they had fewer dustbathing bouts. High ranked hens also had a shorter latency time to first wing toss if they were shown a video image of a dustbathing hen compared to a standing hen, but this effect was not seen in low ranked hens, whose dustbathing behaviour was unaffected by treatment. There were no significant effects on the duration or intensity of dustbathing in either high ranked or low ranked birds. From this result, we could conclude that high ranked birds were socially facilitated to initiate dustbathing by a video image of a dustbathing hen, since they dustbathed sooner. However, we feel we cannot exclude the possibility that high ranked hens were inhibited to start dustbathing by the image of the standing hen, since high ranked birds dustbathed less than low ranked birds in this treatment. We discuss our results in the light of the proposed possible functions of social facilitation and conclude with some methodological considerations for future studies of dustbathing behaviour.

Palestis and Burger (1998) propose that the benefit of social facilitated preening, another comfort behaviour shown by birds, is the increased time spent preening. They propose that this will compensate for the increased parasite load which is a cost associated with group living (Alexander, 1974). A major function of dustbathing is thought to be the removal of ectoparasites and so this explanation is also likely to hold for the function for social facilitation of dustbathing in hens. When dustbathing, the ectoparasites are dislodged (Heinroth, 1955; Simmons, 1964; Borchelt et al., 1973) and the removal of excessive and stale feather lipids (van Liere and Bokma, 1987; van Liere, 1992) may also influence the parasite load if stale feather lipids attract parasites (Borchelt and Duncan, 1974; van Liere, 1992). Although there was no effect of social facilitation on the duration of dustbathing in our study, the fact that dustbathing occurred a shorter interval after the preceding bout means that birds in a social group will dustbathe more often than otherwise, so increasing the total time each bird spends dustbathing.

We cannot speculate on the possibility that social facilitation is a way to learn about new resources since hens in our experiment were given the same dustbathing material during the

test that they had in the home pen. But we can comment upon the third possibility for the function of social facilitation, which is an increased synchronisation and group coherence (Clayton, 1978). Latency, which was one of the factors influenced in this experiment could be important regarding fine scaled synchronisation within a group. For animals like the Red Jungle Fowl, who live in a complex environments where the different resources like dustbathing areas are dispersed and the group is moving between these resources, synchronisation could be especially important, not least as an anti-predator response (Kruuk, 1964; Lazarus, 1972; Forkman et al., 1994). Dustbathing could be considered a “high risk” behaviour to perform since, in common with feeding or preening where the head and eyes of the hen may be covered by high grass or feathers, visibility is obscured during dustbathing. For this reason, it would be better to dustbathe simultaneously and near other birds. Reduced latency for a bird to start dustbathing in the presence of an already dustbathing bird would promote such coordination. Synchronisation might be less important for “low risk” behaviour, like standing or walking where the head is high and presumably vigilance is greater. One might predict social facilitation therefore to occur for some behaviour patterns but not for others. Although one could argue that dustbathing asynchronously, but near vigilant birds, would reduce an individual’s predation risk even more, dustbathing material is not always available and the bird may be left alone or forced to interrupt its bout if the other birds moved away.

While, on the one hand, it can be argued that social facilitation may function to improve coordination of behaviour, and in this way promote the benefits of group life, a consequence of increased synchronisation can be increased competition between group members. This emphasis has led to a fourth suggestion; that social facilitation is a type of local resource competition (Tolman, 1964). For limited resources, like food, it is an advantage to feed when others are eating and food is available. A dustbath could also be considered as a limited resource, since the material needs to be dry and friable, although we are not aware of any studies that have investigated this in the wild. The size of the dustbath may also be a limitation, if not all birds can dustbathe at the same time without interfering with each other. Such limitations would have different consequences for high and low ranked birds. So far no competition has been found for litter dusting areas (Banks et al., 1979).

In an experiment studying hens and drinking behaviour, Forkman (1996) found that low ranked hens were more influenced by a drinking conspecific compared to high ranked hens. As low ranked individuals are considered to take larger risks compared to high ranked individuals (Ekman and Lilliendahl, 1993; Suhonen et al., 1993), it was proposed by Forkman (1996) that being socially facilitated was more risky. Following the results of our experiment, where it was the highest ranking hens that were facilitated, we would like to propose the opposite. That is to say, individuals taking the least risk are the ones expected to be socially facilitated. If low ranked hens are less socially facilitated to dustbathe, and so are less synchronised with the flock, then they are the ones taking larger risks, since they will have to perform this vulnerable behaviour at another time and so without the protection from other hens. By being socially facilitated and starting dustbathing when others are already dustbathing, the higher ranked individuals decrease their risk of predation in the long-term. That high ranked individuals are the ones to be affected by social facilitation is supported by findings from an experiment made by Hsia and Wood-Gush (1984). They

found that high ranked pigs were the ones most stimulated by a feeding conspecific and that these pigs ate more and for longer time than the lower ranked individuals.

Although our analysis showed a significant difference in the latency of high ranked individuals to dustbathe in response to the video of a dustbathing bird compared to a video of a standing bird, in Fig. 2 it is the longer latency to start dustbathing in response to the video of the standing bird that is the exception in the histogram, not the shorter latency to dustbath in response to a dustbathing bird. Thus, although it would be statistically valid to claim that we have demonstrated social facilitation in high ranked birds in this experiment, we feel that alternative explanations should also be considered. This doubt is further justified by the finding that fewer high ranked birds dustbathed and that they had, on an average, fewer dustbathing bouts than low ranked birds in response to the standing video, again implying that it is this treatment that is the exception in our results. Although social facilitation is presented in most standard text books, some researchers have failed to find it under their experimental conditions (Shelley, 1965; Platt et al., 1967; Cooper and Levine, 1973; Morgan, 1973; Lynch and Hedges, 1979). We have results to support social facilitation of dustbathing in high ranked birds, but we found no evidence of social facilitation in low ranked birds and so question that it is such a clear phenomenon as is often implied.

While we may question our results regarding social facilitation of dustbathing, we have clearly shown that there is no evidence for solitary inhibition of dustbathing. Almost all birds dustbathed during the pre-test period, when the feature film video was being shown. Furthermore, there was no evidence of less dustbathing in response to the video of the empty cage. Neither is there evidence for social inhibition of dustbathing. The traditional test for this would be if dustbathing was more frequent when the empty cage video was shown than when the videos of either the dustbathing or the standing bird were shown.

We feel our results can be explained in several ways. Firstly, even if the standing hens on our test videos were standing in a relaxed position, it is possible that high ranked hens found the standing hen threatening or provocative. This interpretation might have more credence if it were the low ranking birds who had shown the significant difference in response to the middle ranked bird on the video. However, other studies suggest that birds cannot discriminate between familiar and unfamiliar birds from a video image (D'Eath and Dawkins, 1996), and if they cannot achieve this level of discrimination, they are unlikely to distinguish rank. Thus, it is possible that high ranked birds may have paid more attention to the stimulus bird on the video just because its rank was unclear. A possible way around this would have been to use a control where the stimulus hen performed a variety of different behaviours instead of standing. However, we rejected this when designing the experiment as we did not want to introduce the possibility of socially facilitating other behaviour patterns such as feeding or drinking.

In a study made by Patterson-Kane et al. (1997), it was found that hens failed to discriminate between videos of hens versus empty test boxes. Their explanation for this was that both the stimulus hen and the background in the test box were white which entailed that the stimulus hen was difficult to detect. In our study, we used brown hens in front of a white background. But we cannot exclude such an effect since the sand in the dustbathing treatment was light brown.

Another possible interpretation of our results is that low ranked birds in our experiment were generally more dustbathing deprived than were high ranked hens even in the home pen. This effect may have carried over to the test period despite the fact that the controlled duration of the dust deprivation was the same for all birds. This would explain their generally short latency to dustbathe in the test situation and the lack of an effect of social facilitation in these birds, without necessarily questioning our results of social facilitation in high ranked birds. This is supported by our casual observations of the birds in their home pens. Firstly, it was often difficult to locate a low ranked dustbathing bird. When such a bird lay down, it was often disturbed by another bird pecking at it and so stood up and moved away before it had shown any wing tossing behaviour. Secondly, although the groups were kept in identical home pens and treated in the same way during the experiment, there was feather pecking in group one. Feather pecking is when a hen pecks at or pulls out feathers of another hen (Keeling, 1994; Leonard et al., 1995; Savory, 1995) and as a consequence the birds in this group had poorer plumage condition. This poorer plumage in itself may have altered their dustbathing. Noteworthy is that the pecking was often directed at a dustbathing bird and produced a similar response in these birds as it did in the low ranked birds. That is to say, they interrupted their dustbathing bout. The latency to dustbathing in the test period was significantly shorter in this group. Thus, it is possible that the generally shorter latency to dustbathe in low ranked birds is due to that they were repeatedly disturbed when dustbathing in their own pen. An argument against this, nevertheless, is the lack of difference in the duration of dustbathing in high and low ranked birds, which might have been expected if low ranked birds were more dustbathing deprived.

Social facilitation of feeding usually occurs within minutes of the satiated test bird seeing the feeding bird. In our study, even in response to the dustbathing video, there was a relatively long latency to start dustbathing (41.5 ± 14.2 min). This difference may be inherent in the nature of feeding and dustbathing. A bout of dustbathing takes longer than a bout of feeding and usually occurs once every other day, whereas feeding occurs several times within the same day. On the other hand, one can question whether this is socially facilitated dustbathing at all, or whether it is a consequence of the birds not being completely satiated with regard to dustbathing, by the end of the pre-test period. If they were not satiated, then it might have been expected that birds would dustbathe a second time. This may explain why dustbath duration in the test period was shorter (10.0 ± 1.3 min) than in the pre-test period (24.2 ± 2.1 min), but this would not explain the significant treatment effect.

Social effects influencing dustbathing have been studied previously. Duncan et al. (1998) found that hens dustbathed more when visually exposed to a group of hens with at least one bird dustbathing, compared to when the hens were absent. But this result can be interpreted as social facilitation of dustbathing in the presence of other hens (irrespective of whether or not one of the stimulus birds dustbathed) or as solitary inhibition of dustbathing when the test bird was alone. A likely explanation for their experimental design, however, was the difficulty of reliably manipulating dustbathing behaviour. The behaviour patterns most easily manipulated in the stimulus animal are feeding and drinking and it is for this reason that almost all studies of social facilitation have involved these two behaviour patterns. But, by using video recordings of animals as the stimuli instead of live animals in real time, it is

possible to standardise the behaviour of the stimulus hens and so study other behaviour patterns. We hope that we have demonstrated that this technique can be used to study social facilitation of dustbathing, as long as the limitations of the video technique are taken into consideration (Patterson-Kane et al., 1997; D'Eath, 1998). We, for example, could probably not have used it to study the effect of the stimulus birds' rank on social facilitation of another bird. Nevertheless, that we got an effect on dustbathing in response to a less than perfect representation of a dustbathing bird implies that there may be scope to manipulate the image even further to distil out the key stimuli. One method to study this in detail would be to use a video image made up of a random assembly of body parts from a hen dustbathing, so that the stimuli has the same intensity of movement as a dustbathing hen but not in the same shape. An alternative would be to show only restricted parts of a dustbathing hen.

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