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Effects of Exposure to Chicks on Maternal Behaviour in Domestic Chickens

Marie A. Richard-Yris and G. Leboucher

Laboratoire d'Ethologie, UA 373, Avenue du Général Leclerc, 35042 Rennes cédex, France

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Two different procedures were followed to induce maternal behaviour in domestic hens. When chicks were placed under hens during the night, the majority of adults presented maternal behaviour the following morning. When chicks were placed in cages at the beginning of the photophase, maternal responses appeared after a 24 h delay; hens first avoided or were aggressive towards chicks. The results are discussed in terms of hens becoming familiar with auditory, tactile and visual stimuli from chicks.

Hen *Maternal behaviour* *Night presentation* *Day presentation*

Introduction

The appearance of maternal behaviour, essential in birds and mammals for the survival and normal development of young, is related to the optimal coincidence of specific physiological states and stimuli (5, 8, 10). This behaviour can be induced outside the normal phase of the reproductive cycle by artificially recreating physiological states and stimulating situations. The responses of treated animals closely resemble parental responses observed under natural conditions (14, 16).

Stimuli from the young are essential factors in the regulation of these behaviours; they can be very diverse (tactile, auditory, olfactory or visual), and can have either positive or negative consequences on the development and on maintenance of maternal behaviour. Odors of young delay the appearance of parental responses in non-parturient rats (12), whereas they facilitate the establishment of a selective attachment between an ewe and her lamb (13). In birds, many authors have stressed the influence of auditory stimuli produced by embryos towards the end of incubation on the regulation of parental responses in brooding animals (9, 18), and of tactile stimuli on appearance or continuation of physiological and behavioural responses connected with brooding and care of young (2, 6, 11, 15).

The aim of this experiment was to investigate the chicks' ability to promote maternal responses in two distinct situations. During day exposure hens were first presented with one set of stimuli (i.e. visual, auditory and possibly tactile) and during night exposure hens were first presented with another set of stimuli (i.e. auditory and tactile). Hens presented with these two procedures showed different responses.

Methods

Subjects and maintenance. We used adult 'Vedette JV 15' hens (a heavy dwarfed strain) from an industrial breeding centre. None had previous maternal experience. Each hen was placed separately in a wire-latticed cage (100 x 70 x 60 cm) with opaque lateral partitions and wooden nests (40 x 30 x 40 cm). Each animal was thus isolated visually but not auditorily from the others. Temperature in the experimental chamber was 22° C ± 2° C. Animals were under a constant artificial photoperiod (15L:9D). The hens were layers when they arrived in the laboratory, but laying was stopped artificially by using a conventional food restriction method (20): food was withheld for seven days and water withheld concurrently during the first three days. After this deprivation period, the hens were fed unrestricted amounts of corn.

Experimental groups and protocol. Two groups were tested. The day group included 28 hens submitted to the 'day exposure' protocol. This treatment consisted of introducing two newborn chicks into each cage at the beginning of the diurnal phase of the photoperiod on day 1. The night group consisted of 17 hens submitted to the 'night exposure' protocol. On day 0, when lights were switched off, the hens were shut up in their

nest-boxes and two hours later, two newborn chicks were placed under each hen as gently as possible. The following morning, 30 minutes before the lights were switched on, the nest-box doors were taken away to allow free access to the whole cage.

In both groups, chicks were replaced under the hen in the nest-box during the nights between days 1 and 2 and between days 2 and 3, so that the chicks kept warm during the night. Wounded or killed chicks were replaced with chicks of the same age.

Observations and auditory tests. Detailed observations were made on days 1, 2 and 3 during daylight hours. Each animal was observed during 30 s every 18 min. During each sampling the following items were recorded: (i) distance between hen and chick; (ii) vocalizations, especially maternal calls, such as cluckings and food calls ('tidbits') (4); (iii) type of activity (e.g. resting, preening, feeding).

Auditory tests were made on days 4, 6 and 10 in a dark room (210 x 210 x 280 cm). During two minutes, the hen's clucks in response to chicks distress calls played back from a tape were counted.

Results

Variations in behavioural responses during the three days of observation for the two experimental groups are presented in Tables 1 and 2. Aggressive behaviour decreased gradually with time in both experimental groups, but the overall level of aggressive acts was always higher in day group hens. In this group the level of physical contact between hen and chicks was low on day 1 but increased significantly later. On the contrary, night group hens immediately presented a high contact level which tended to decline from day 3 on. Maternal calls appeared gradually in both groups. Tidbitting appeared before clucking. Again day group hens began to emit maternal calls later than night group hens.

Further analysis is presented in Figure 1; each observation day is divided into three equal parts. This figure shows the decisive influence of nocturnal separation between days of observation on the improvement of maternal performance.

The results of the auditory tests are presented in Figure 2. The number of clucks was significantly higher by night group hens on day 4 (Mann-Whitney two-

TABLE 1
PERCENTAGES OF HENS PERFORMING AGGRESSION AND MATERNAL CALLING

		Day 1	Day 2	Day 3
Aggression:				
Pecks	Day group	71.4 % **	25 %	3.6 %
	Night group	29.4 %	0 %	0 %
Wounder, Kill	Day group	50 % *	14.3 %	0 %
	Night group	17.6 %	0 %	0 %
Maternal calls:				
Tidbitting	Day group	14.3 % **	64.3 %	89.3 %
	Night group	58.8 %	82.3 %	88. 2%
Clucking	Day group	3.6 % *	25 %	46.4 %
	Night group	23.5 %	47.1 %	64.7 %

* Fisher exact probability test ($P < 0.05$)
** Fisher exact probability test ($P < 0.01$)

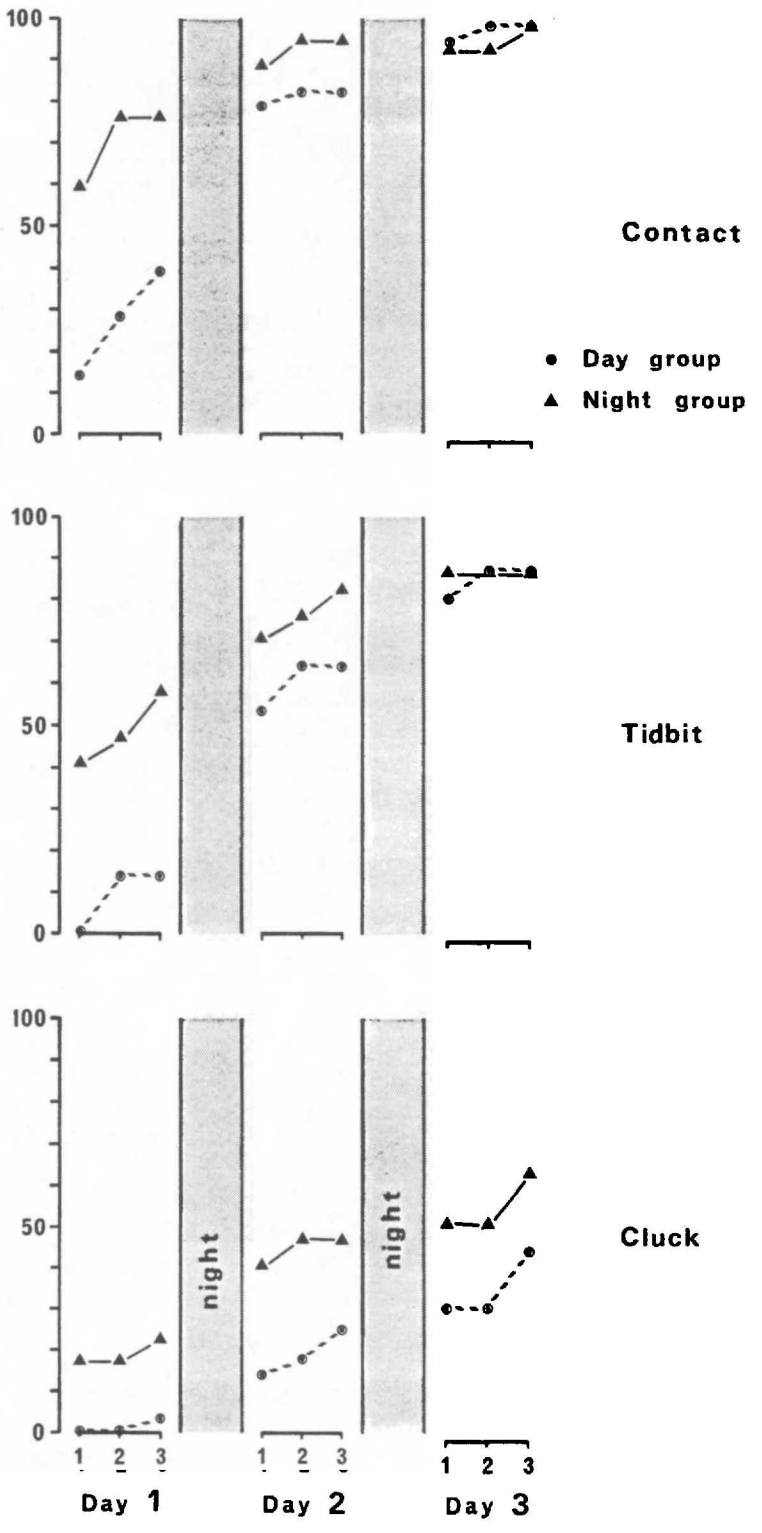


Figure 1. Cumulative percentage of hens in the two experimental groups that displayed three behavioural responses (physical contact > 50% of records, tidbit and cluck) during three observation days. Each day was divided into three equal parts (of 15 records each).

TABLE 2
AMOUNT OF PHYSICAL CONTACT BETWEEN HENS AND CHICKS ($\bar{X} \pm SE$) DURING THE THREE OBSERVATION DAYS

	Day 1		Day 2		Day 3	Friedman test (X^2r and P)
Day Group	29.4 ± 6.3 (b)	(a)	67.9 ± 5.9		68.3 ± 2.9 (b)	10.5 $P < 0.01$
Night group	61.8 ± 8.8		67.4 ± 4.5	(a)	45.1 ± 4.4	8.9 $P < 0.05$

(a) significant difference between successive days (Wilcoxon two-tailed test: $P < 0.01$)
(b) significant difference between two groups (Mann-Whitney two-tailed test: $P < 0.01$)

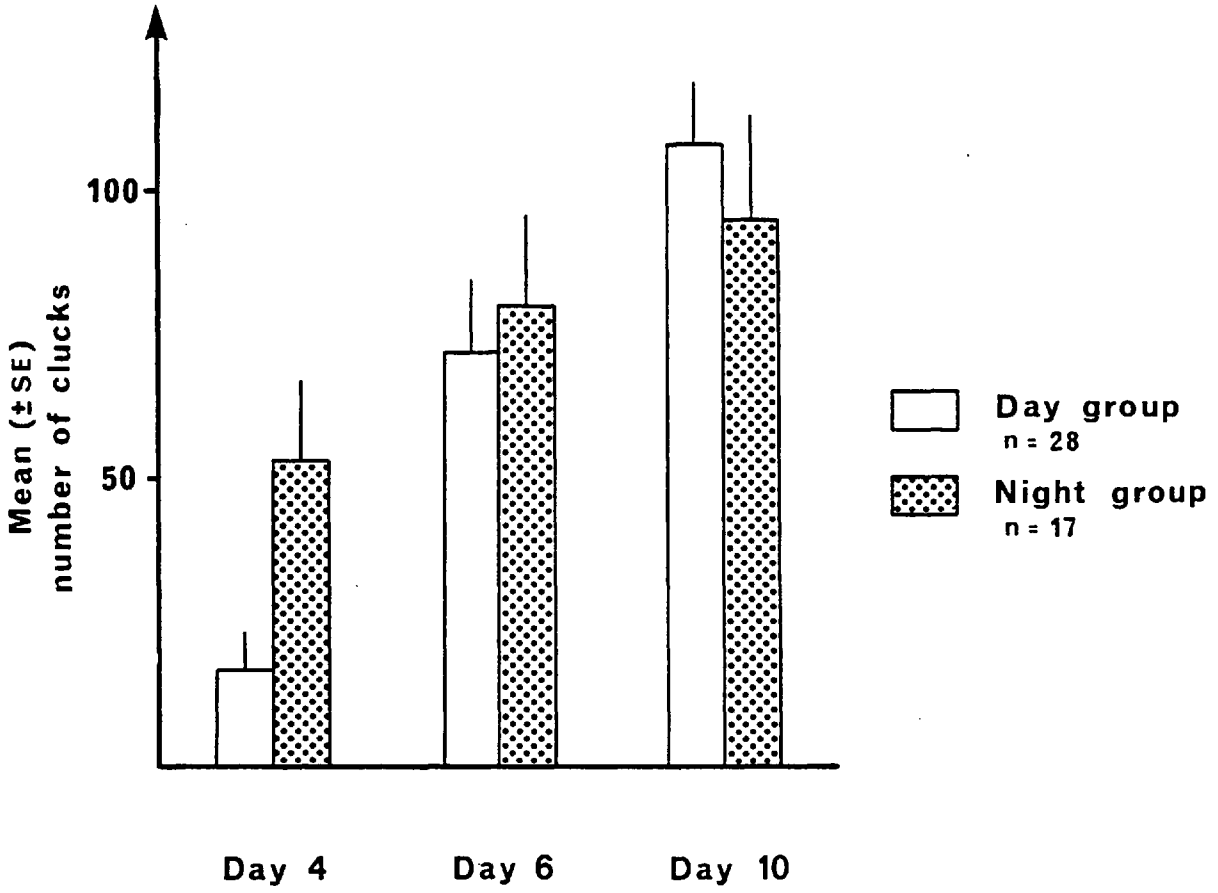


Figure 2. Variations in number of clucks recorded during auditory tests.

tailed test: $P < 0.02$), but no difference was found between the two groups on days 6 and 10. Within each group, variation in number of clucks during auditory tests was significant (Friedman test: $X_r^2 = 36.01$, $P < 0.001$ for day group; $X_r^2 = 10.3$, $P < 0.01$ for night group). The mean number of clucks increased significantly in both groups between day 4 and day 6 (Wilcoxon two-tailed test: $P < 0.002$ for day group and $P < 0.05$ for night group) and again between day 6 and day 10 in hens from the day group ($P < 0.02$).

Correlations between quantifiable elements recorded during observations and quantifiable elements from auditory tests were investigated. A positive correlation between the amount of contact recorded on the first day of observation and number of clucks counted on day 4 was found ($r_s = 0.37$, $N = 28$, $P < 0.05$ for day group hens; $r_s = 0.48$, $N = 17$, $P < 0.05$ for night group hens). This confirms that, on the whole, hens which accept chicks sooner also cluck sooner.

Discussion

The results of this experiment confirm previous reports (11, 14) that it is possible to induce a rapid onset of maternal responses in hens outside their normal reproductive cycle. However, it is evident that the experimental situation influences the appearance of these responses. When chicks were placed in a hen's cage at the beginning of the day, they were perceived as intruders: hens avoided or attacked them. However, after some delay, adults tolerated contact with young. Then, brooding behaviour appeared; later, one after the other, the two typical maternal calls (tidbitting and clucking) appeared. Finally, hen behaviour changed from rejection, which lasted on average one day, to care and protection of chicks. When chicks were placed under hens at the beginning of the night, a period of rejection was observed only in very few subjects. Maternal responses appeared on day 1 in the majority of subjects. These results show the importance of nocturnal pre-exposure to chicks on the delay of appearance of maternal behaviour. Similarly, in hens presented chicks at the beginning of the day, maternal performance improved after night exposures (Figure 1). It should be stressed that in these animals behavioural responses observed on day 2 were almost identical to those recorded on day 1 in night groups hens (Tables 1 and 2). This lag was also found the following day.

The quicker establishment of maternal behaviour in hens induced during night supports previous work (3) concerning external factors facilitating maternal responses (e.g. darkness, restricted space), and agrees with experimental results showing the crucial role of ventral tactile stimulation in the establishment of maternal behaviour (11, 15). Under natural conditions, auditory stimulations from hatching chicks occur before visual interactions between parents and young and further facilitate chick adoption (9). The night exposure provided stimulation (i.e. tactile, auditory and only later visual) comparable to natural brooding and hatching.

Another point that should be mentioned is that in the night group, as chicks get older, contact between hens and chicks declines; a significant drop is observed as soon as day 3 (Table 2). These results are in line of those of several authors working on natural broods (1, 5, 17) and may reflect the maturation of chicks' thermoregulation (17). By contrast, in day group, in which maternal responses appear later, the amount of contact between hens and chicks does not decline with time, on day 3 it is higher than in night group.

The hypothesis that maturation of thermoregulation is altered when the hen does not display full maternal behaviour, particularly brooding, cannot be discarded. However, another explanation is possible. Many experiments have shown that young actively attempt to be near the mother or surrogate mother independently of the mother's ability to give heat or food. It may be necessary for young to seek security near an attachment object before engaging in more diversified activities (7,19).

The experiment described here helps specify modalities of establishment of the relationships between mother and young in the domestic hen. Further experiments are necessary to quantify the minimum time of physical contact at night needed to hasten the appearance of maternal responses.

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