PRIOR EXPOSURE TO LIGHT AND PECKING ACCURACY IN CHICKS

by

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(With 1 Figure)
(Rec. 15-II- 1974)

After period of exposure to constant white light of about half an hour, day-old chicks approach a conspicuous visual stimulus more readily than those kept in the dark up to to the time of testing (BATESON, HORN & ROSE, 1972; BATESON & SEABURNE-MAY, 1973). Furthermore the social preferences of light-exposed chicks are restricted more rapidly to the familiar conspicuous object than those of dark-reared birds; imprinting appears to occur more rapidly in the light-exposed chicks (BATESON & WAINWRIGHT, 1972).

The superior responsiveness of chicks exposed to light cannot be attributed to handling or to the effects of temperature. Nor does it seem likely that the results can be explained in terms of general arousal since stimulation in other modalities makes chicks less responsive to conspicuous visual stimuli (GRAVES & SIEGEL, 1968; BATESON & SEABURNE-MAY, 1973). How may the results be interpreted?

One possible explanation for the effects of light is that mere use of the visual pathways facilitates the development of all visually-guided behaviour (BATESON & SEABURNE-MAY, 1973). On this view other behaviour patterns, besides approach towards a potential social companion, should be affected by prior exposure to light. What, then, is the effect of light on pecking? DAWKINS (1968) commented on the relative inaccuracy of dark-reared chicks tested on the first and second days after hatching and provided some evidence that they discriminated less well than light-reared chicks between solid and flat targets. But detailed quantitative evidence on the effects of light on pecking has not been available even though the literature on the development of pecking in domestic chicks is large and extends back over

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2) The work was supported by a grant from the Science Research Council to PPGB.

may years (*e.g.* BIRD, 1933; BREED, 1911; CRUZE, 1935; FANTZ, 1957; GOODWIN & HESS, 1969; HESS, 1950; HOGAN, 1973; MOSELY, 1925; PADILLA, 1935).

In the study reported here we have examined the effect of one hour's exposure to constant white light on the accuracy of pecking in domestic chicks. In order to control for the possibility that effects of light on pecking accuracy were mediated through practice during the period of exposure, one group of chicks was restrained so that they were unable to move their heads during exposure to constant white light.

METHODS

Subjects.

Fifty-four domestic chicks (*Gallus gallus*) from a broiler strain (Ross Chunkies from Ross Poultry Products) were used in this experiment. Six batches of fertile eggs were incubated for 18-19 days in a Western automatic incubator and then transferred to a smaller incubator (Curfew) where they hatched in darkness. The chicks were placed 3-6 hr after hatching in an incubator with individual compartments. They were kept in darkness and at a temperature of 33-34° C, until the time of experiment 24-30 hr after they hatched.

Exposure procedure.

Chicks (usually four in each of three groups) were chosen arbitrarily and put in the experimental apparatus. Those exposed to light were put in a hardboard box divided into cells (8 × 10 × 8.5 cm) open at the top and with ½ inch (1.27 cm) wire mesh floors. Chicks in the first group were placed separately for one hour in cells in one part of the box the walls of which had been painted white; this group could move without restriction (Light Group). Each chick in the second group was put for one hour in the other part of the box and had its neck restrained by collar so as to prevent movement of the neck or the beak in relation to the body (Light-restrained Group). The collars were mounted at the tops of the cells but the chicks could reach the wire mesh floor with their feet. The box with the two light-exposed groups was placed in an incubator illuminated by a 100 W bulb (Osram Extra-White) placed 50 cm above the box. The chicks in a third group were placed separately in cells of the same size as those in which the Light group were kept, but in a dark incubator (Dark Group). The temperature of both Light and Dark incubators was kept a 33.5-34.5° C. The chicks in all three groups were handled to the same extent either in darkness or under dim green light. The chicks of both Light and Light-restrained groups could hear each other.

Test procedure.

The chicks were tested 3-5 hours after initial exposure in an arena 63 cm in diameter and 23 cm high with a floor of black paper on which grains of millet seed were spread so that they did not touch one another. The apparatus was lit by a single 60 W bulb suspended 55 cm above the centre of the arena; the temperature was maintained between 32-34° C. A chick of the same age as those used in the experiment was placed in an upturned 500 ml glass beaker in the arena. This bird could peck at millet seed on the floor but its movements were not recorded. It acted as a social companion for the chick whose pecking was recorded. To eliminate any bias which the companion bird might introduce the same bird was used for all tests in a batch. The chicks in the experiment were drawn in turn from each of the three groups in the order:

Light, Dark, Light-restrained, and so on.

Measure.

On the basis of the classical studies by BREED (1911), CRUZE (1935) and others, pecking was divided into four categories graded as follows: (1) "miss": the chick pecked at a seed without touching it (2) "hit": the chick touched the seed without picking it up in its beak (3) "seize": the chick picked up the seed but dropped it (4) "swallow": the chick picked up the seed which then disappeared from the observer's view. We recorded the time from the onset of the test to the first pecking movement and the total time taken from first to 25th peck regardless of category.

RESULTS

The mean number of misses in 25 pecks is given in Fig. 1 and the mean number of hits, seizes and swallows in Table 1. The results of statistical comparisons between the groups are given in Table 2. On all four measures the chicks in the Light group were significantly more accurate than those in

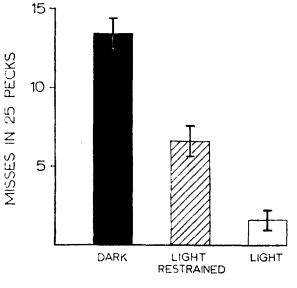

Fig. 1. The means (and standard errors) for number of misses in 25 pecks at millet seed given by chicks which were (a) hatched and reared in the dark, (b) previously exposed to light for one hour while head movements were restrained, or (c) exposed to light for one hour in social isolation but able to move without restraint.

the Dark group. The chicks in the Light-restrained group were intermediate in performance between those in the other two groups. They missed less and hit more frequently than the Dark group; on the other hand they missed more, and seized and swallowed less than the Light group.

The median latencies to first peck and the median durations of pecking are given in Table 3. The Dark group and the Light-restrained group did not differ significantly. The Light-restrained group was significantly slower on both measures than the Light group and also had longer latencies than the Dark group.

TABLE 1

Means (and standard errors) for numbers of Hits, Seizes and Swallows in 25 pecks

Group	N	Hits	Seizes	Swallows
Light-restrained	18	14.78 ± 0.83	2.00 ± 0.51	1.61 ± 0.31
Dark	18	9.11 ± 0.87	1.17 ± 0.28	1.33 ± 0.30
Light	18	15.00 ± 1.12	5.50 ± 0.94	2.89 ± 0.39

TABLE 2

Results of statistical analysis using Student's test on data given in Tables 1 and 3 and in Fig. 1

Groups Compared	Misses	Hits	Seizes	Swallows	Latency	Duration
Dark/Light-restrained	*** 6.85	*** 6.65	2.02	0.90	* 2.09	1.20
Dark/Light	*** 14.18	*** 5.86	*** 6.22	*** 4.48	0.49	1.61
Light-restrained/Light	*** 6.06	0.22	*** 4.61	** 3.63	* 2.31	* 2.19

Values of t are marked above as follows: * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

TABLE 3

Means (and standard errors) in seconds for the latency to the first peck and the duration of pecking

Group	N	Latency	Duration
Dark	18	128.1 ± 26.5	420.3 ± 51.3
Light-restrained	18	190.6 ± 33.0	520.0 ± 105.8
Light	18	113.1 ± 34.1	337.5 ± 51.5

DISCUSSION

The purpose of these experiments was to discover whether exposure to constant white light has a facilitating effect on the development of pecking accuracy in domestic chicks. The results indicate that it does, although the effects may be mediated in a number of ways. The most easily interpreted differences were those between the Dark group and the Light-restrained group. Even though the Light-restrained birds had no opportunity to practice pecking, they were significantly more accurate than the birds in the Dark group. It does not seem likely that this can be attributed to a general arousal effect, since the Light-restrained group, if anything, took longer than the Dark group from the beginning of the test to the first peck. Nor is it likely that the results were due to short-term sensory adaptation since the Light-restrained birds were kept in the dark for 3-5 hours between initial exposure to light and testing. While we believe that light exposure is most likely to act directly and lastingly on the visual pathways (see BATESON & SEABURNE-MAY, 1973), it is possible that, during the period of exposure to light, the Light-restrained birds exercised muscles in, for example, their legs more than those in the Dark group. Such non-specific practice might have enabled them to stand up more steadily than the Dark group and, as a consequence, the accuracy of their pecking was greater.

The superiority of the unrestrained group might have been due to their having had opportunities to practice pecking. To check the plausibility of

this interpretation, restrained and unrestrained chicks were subsequently watched while they were being exposed to light. The unrestrained chicks were much more active than the restrained ones and did, indeed, periodically peck at the wire mesh below them. The restrained chicks were surprisingly passive and did not struggle much; they were, of course, unable to peck and many of them closed their eyes during the period of exposure. This latter observation suggests that the differences in pecking accuracy between the Light and Light-restrained groups might be attributed to a difference in visual stimulation alone. However, the relative slowness to peck of the Light-restrained chicks indicates that the restraining procedure had a direct and adverse effect on pecking which operated against the effects of exposure to light.

What ever may explain in detail the results presented in this paper, it now seems clear that the effects of exposure to constant white light are relatively non-specific in the sense that light affects a variety of visually-guided behaviour patterns. Not only does white light affect the approach responses of domestic chicks, it also affects the accuracy of their pecking.

SUMMARY

Two groups of day-old domestic chicks were exposed to constant white light for one hour. Chicks in one group were socially isolated but unrestrained; the others were unable to move their heads. Later the accuracy of their pecking at millet seed was compared with chicks kept in the dark up to the time of testing. The unrestrained chicks exposed to light were markedly more accurate than the dark-reared birds. The restrained chicks were intermediate in performance between the other two groups hitting seeds more frequently than the dark group but missing more and picking up and swallowing less than the unrestrained Light group. The effects of light on pecking accuracy are interpreted primarily in terms of non-specific stimulation of the visual pathways.

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RÉSUMÉ

Deux groupes de poussins âgés d'un jour sont exposés à une lumière blanche constante pendant une heure. Les poussins du premier groupe sont isolés socialement mais libres de se mouvoir; les sujets du second groupe n'ont pas la possibilité de bouger leur tête. Ultérieurement, la précision avec laquelle ils picorent les grains de millet est comparée à celle d'un troisième groupe de poussins maintenus dans l'obscurité jusqu'au moment du test. Les poussins incapables de mouvoir leur tête montrent une performance intermédiaire comparée à celles des deux autres groupes; ils picorent plus fréquemment que les poussins maintenus dans l'obscurité mais ne parviennent pas à saisir et à avaler autant de grains que les sujets exposés à la lumière et libres de leurs mouvements. Les effets de la lumière sur la précision du picorement sont surtout interprétés en termes d'une stimulation non spécifique du système visuel.