To see, or not to see: Rearing activity as a function of changes in the visual field[1]

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Rats of the Maudsley Reactive and Nonreactive strains were used to study changes in rearing activity as a function of changes in the visual field. The results were evaluated in terms of the "preference" and "scanning" theories, which were not supported. However the results were consistent with the "stimulus change" theory. Rearing is advanced as a simple measure of sensory reinforcement.

An extensive number of reports have appeared in the literature describing response-contingent behavior. Most of these refer to experiments using light reinforcement as the stimulus. Kish (1966) and Hurwitz (1964) have summarized some of these and discussed various related theories, including the "preference" theory (Lockard, 1963), the "stimulus change" theory (Forgays & Levin, 1959) and the "scanning" theory (Hurwitz, 1956; Robinson, 1961). According to the "stimulus change" theory reinforcement is attributed to changes of sensory stimulation, whereas the "preference" theory places little emphasis upon the change in stimulation but stresses the preferred stimulus. In the "scanning" theory visual scanning of the environment is taken to be equivalent to motor exploration.

The majority of experiments in the field of sensory reinforcement employ the Skinner box, where lever-pressing results in changes in illumination. To interpret the reinforcing stimulus in terms of scanning, while plausible, tends to involve somewhat anthropomorphic assumptions. Hence an experiment was devised which could permit a more objective assessment of the concept of scanning through control of the environment. An exploratory motor activity, i.e., rearing, was examined for differences attributable to the experimental manipulation of the environment.

The experimental method used here was based on that of a previous study (Holland, Gupta, & Weldon, 1966), using a black-hooded strain of rats. The results obtained in this earlier study were discussed in terms of exploration, and could be interpreted as evidence in favor of the "scanning" theory.

Subjects.

The Ss used were 40 rats, 20 from the Maudsley Reactive strain (MR) and 20 from the Maudsley Nonreactive strain (MNR). These were subdivided into equal numbers of males and females. All Ss were between 100 and 161 days old at the beginning of the experiment and were taken from the 31st generation of selection. The standardized maintenance of these strains and their respective characteristics are described elsewhere (Broadhurst, 1960; Eysenck & Broadhurst, 1964).

Apparatus.

The apparatus consisted of a cylindrical test chamber and a proximity sensing device, together with a counter and stop-clock. The chamber was 10½ in. in diameter and 12 in. high with a perspex wall, parts of which could be covered externally to restrict direct vision. The floor, which was fixed 2 in. above the bottom of the perspex wall, consisted of a 3/8 in. galvanized steel mesh, and the lid was an 18 SWG tin plate. This lid served also as the sensing head of a modified proximity meter (Fielden, type PM 2), the output of which was in effect a bi-stable relay contact. The proximity meter was set up, so that the relay contact was "closed" whenever the S reared up on its hind legs to at least 5 in. above the floor, and the contact was "open" at all other times. The relay contact was utilized both for counting the number of "rears" on an electro-mechanical counter, and for recording by means of an electric clutch-operated stop-clock the cumulative time that the S reared up in an experimental session. The apparatus was set up in a room lit by a ubiquitous ceiling-suspended 100 W electric light bulb, and "white noise" at 78 dB (reference sound pressure 0.0002 dynes per sq cm) was provided as a soundscreen to maintain constant experimental conditions. The round shape of the chamber was chosen in order to eliminate corner effects, i.e., the tendency for Ss to sniff and "explore" more in corners than elsewhere.

Procedure.

Each S was brought from its home cage in a white enamelled bucket with lid, and then placed into the apparatus for a single session of 10 min. The total number of "rears" and the cumulative rearing time were recorded.

For half of the Ss (Group A) the lower part of the test chamber was covered with translucent paper, so that Ss had to rear up to obtain a view of the external environment. For the other half of the Ss (Group B), the upper part of the chamber was covered with paper, so that the external environment could be viewed only through the lower half of the wall, i.e., without rearing.

Results.

The experiment had a 2 by 2 by 2 factorial design, with five Ss per cell. There were two strains, two sexes, and two treatment groups (i.e., Group A with the lower part of the wall covered, and Group B with the upper part of the wall covered). Three analyses of variance were computed on the mean scores of each of the cells.

The first analysis tested the frequency of the rears. There was a significant strain effect at the 1% level ($F = 8.09$, $df = 1, 32$), the MNR strain rearing more than the MR strain. The *strain* by *sex* by *treatment* interaction was significant at the 5% level ($F = 5.56$, $df = 1, 32$). The other F ratios did not reach an acceptable level of significance.

A second analysis tested the cumulative rearing durations. The strain effect was significant at the 0.1% level ($F = 20.23$, $df = 1, 32$), the MNR strain spending more time rearing than the MR strain. No other F ratio reached an acceptable level of significance.

Finally, an analysis of variance of the quotient, cumulative rearing times by rearing frequency, was computed. No main effect or interaction reached an acceptable level of significance.

Discussion.

The object of the experiment was to compare the amounts of rearing of the two groups. If Group A reared more than Group B, the results would support the "scanning" theory: if Group B reared more than Group A, this would support the "preference" theory; whereas no differences in rearing between the two groups would favor the "stimulus change" theory.

In fact, this experiment supports the "stimulus change" theory. Irrespective of the positioning of the translucent paper similar amounts of rearing occurred, so that the hypothesised scanning did not appear to be a crucial factor in reinforcement and there was no apparent relationship between the positioning of the paper and the rearing behavior of the S. Hence, rearing activity was consistent with the "stimulus change" hypothesis: the changes involved could operate through the visual field or through another modality, e.g., for the Ss the motor activity itself may be reinforcing.

In a study on response-contingent behavior, using light reinforcement as the stimulus with the two Maudsley strains of rats (Weldon, 1968), the results obtained also favored the "stimulus change" theory. The Ss showed no apparent preference in responding to one lever that made the houselight brighter, over the second lever that darkened the light. However they did discriminate against a dummy lever which effected no change in illumination.

The present investigation showed no significant difference between the sexes. This is in agreement with Holland, Gupta, & Weldon (1966) using a black-hooded strain, but contrary to the findings of Gregory & Liebelt (1967) with the two Maudsley strains. The significant *strain* by *sex* by *treatment* interaction in the rearing frequencies is probably attributable to random error, since the other interactions did not reach a required level of significance.

The highly significant strain effects obtained are in line with the known strain differences. Rearing can be taken as the "vertical component of ambulation" (Holland, Gupta, & Weldon, 1966); it is a well-established fact that the MNR strain ambulate more than the MR strain (Eysenck & Broadhurst, 1964).

Rearing has been advanced as an indication of central nervous system excitability (Lát, 1963), or alternatively as an indication of arousal level (Berlyne, 1960). It is taken as an innate behavioral manifestation, which also necessitates making many theoretical assumptions. However, rearing has here been put forward as a simple measure of sensory reinforcement of changes in the visual field.

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NOTES

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