Activity level in rats as a function of hyperstimulation and sex of animal*

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Previous research has suggested that decrements in curiosity, following overstimulation, may be due to increases in general activity. The present study attempted to define the relationship between hyperstimulation and activity in male and female animals. Animals were preexposed to 30 sec of intense strobe light before being allowed access to an open field. Control animals did not have this preexposure. The procedure was repeated over a 3-day period. The results indicated a significant increase in general activity following hyperstimulation. There were no significant differential effects of hyperstimulation upon males vs females.

Previous evidence has indicated that decrements in curiosity behavior can be obtained if rats are preexposed to highly arousing stimulation before exploration. This phenomenon has been replicated regardless of whether the stimulation was intense shock (Haywood & Wachs, 1967; Thompson & Higgins, 1958), high levels of white noise (Haywood & Wachs, 1967), or intense strobe light (Wachs, 1969). These findings have been considered as support for the optimal-arousal theory of curiosity behavior (Hebb, 1955). In the last study in this series (Wachs, 1969), it was suggested that one effect of intense stimulation might be to increase the animal's general activity level. It was suggested that this increase in general activity was antagonistic to curiosity, which is traditionally defined in terms of stimulus-seeking behavior (Berlyne, 1960). The present study was designed, in part, as a direct test of the relationship between preexposure to intense stimulation and subsequent activity.

One possible factor which could confound these findings is sex of the animal. Significant sex differences in the amount of open-field activity, favoring females, have been noted by Snowdon, Bell, & Henderson (1964) and Broadhurst & Bignami (1965). The latter found these differences to hold across two strains of rats. The relationship between sex and open-field activity is not, however, completely consistent, as Lester (1968) found nonsignificant differences in activity between male and female rats.

In addition to the data on activity per se, there is also the possibility of a differential reaction to stress by male and female animals. In this regard, Henderson (1967) noted differential activity levels for males and females as a function of cold stress and familiarity of stress situation. Henderson also noted significantly more activity for females who had been exposed to early intense stimulation than for males who had received this treatment. Thus, a second aspect of the present study was to determine the possibility of an interaction between sex and intense stimulation as they relate to subsequent activity.

SUBJECTS

The Ss were 20 male and 20 female Holtzman albino rats. The animals were between 109 and 116 days of age at testing. They were gentled 2 min a day for 5 days prior to testing.

APPARATUS

Activity level was measured in a standard open-field apparatus consisting of a 45 x 45 in. square divided into 25 equal squares. The height of the side walls of the field was 18 in. The entire field was painted flat black, with white lines marking the squares. Visual hyperstimulation was provided by means of a General Radio Stroboslave, flashing at a rate of 4 flashes/sec and set at high intensity (11 million beam candelas at a distance of 1 m from the beam center). The strobe light was placed at the top of the corner square at a distance of 12 in. from the field floor. The testing room was illuminated by a 25-W red light bulb with a rated value of .15 fc on the open-field floor.

PROCEDURE

All animals in the hyperstimulated group were placed in a hollow aluminum square, 8 x 8 x 12 in., which was situated in a corner square of the open field. A clear Plexiglas lid was then lowered and attached. The animals remained in this situation for 30 sec. Following this period, the

strobe was placed on top of the Plexiglas cover and the animals received 30 sec of visual stimulation. Immediately following the termination of the visual stimulation, the square was lifted and the animal was free to move about in the open field. Each animal was allowed 3 min in the open field. This procedure was repeated on each of 3 subsequent days. Animals in the control group received identical treatment, with the exception that the strobe light was not turned on while placed over the square.

The dependent variable was the number of squares entered per minute. The criterion for entrance in a square was having all four paws within the square. Data were analyzed by means of a four-way repeated measures analysis of variance (Winer, 1962), with the dimensions being sex (male vs female), conditions (stimulation vs control), time periods (first minute vs second minute vs third minute), and days (Day 1 vs Day 2 vs Day 3).

RESULTS

The mean number of squares entered as a function of the independent variables utilized is shown in Table 1.

The analysis indicated that none of the four-way or three-way interactions were significant. All the second-order interactions, with the exception of Conditions by Time Periods, were also nonsignificant. The Conditions by Time Periods interaction was significant ($F = 11.4$, $p < .01$). The main effects for sex ($F = 21.90$), time periods ($F = 31.21$), and days ($F = 11.61$) were all significant at p values less than .01. The main effect for conditions was not significant.

Breakdown of the significant main effects indicated that females were significantly more active than males ($t = 9.76$, $p < .01$). Analysis of the time periods main effect by Newman-Keuls test (Winer, 1962) indicated a significant decrease in activity from Period 1 to Period 2 ($p < .01$) and from Period 2 to Period 3 ($p < .01$). When the means of days were compared by the same procedure, it was found that Days 2 and 3 were both significantly different from the mean of Day 1 ($p < .01$) but were not significantly different from each other. A breakdown of the Conditions by Time Periods interaction indicated significantly more activity for the hyperstimulated animals than for the control animals in Period 1 ($t = 2.31$, $p < .025$). Differences between the conditions in Time Periods 2 and 3 were nonsignificant.

An a priori hypothesis suggested by the previously cited data of Snowdon et al (1964) was that males and females would react differentially to

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hyperstimulation. Specifically, it was hypothesized that females would remain unaffected by hyperstimulation, whereas the males would be highly affected in the direction of increased activity. Independent tests on the differences in activity for the two conditions for each sex showed that the activity of females under hyperstimulation closely resembled the activity score of the control females (HS = 27.74; control = 27.18). While the difference in activity between the males was greater (HS = 18.86; control = 15.39), this difference was not statistically significant.

DISCUSSION

From previous evidence (Wachs, 1969), it was predicted that one effect of hyperstimulation might be to increase an animal's locomotor activity. The significant Conditions by Trials interaction found in the present study tends to support this hypothesis, in that hyperstimulated animals showed significantly more activity than nonstimulated animals in the first time period following hyperstimulation. By showing an increase in activity level following hyperstimulation, these data lend support to the hypothesis that the increase in an animal's locomotor activity following hyperstimulation may lead to a decrease in the attention that it pays to the stimulus characteristic of its environment. One major difference between the results of the present study and the results of previous studies (Haywood & Wachs, 1967; Wachs, 1969) revolves around the decline in the observed effects of hyperstimulation within each 3-min period, as compared to the stability of these effects in previous research. These differences between studies could be attributed to different dependent variables. A more likely explanation, however, would be strain differences, in that previous studies have utilized Wistar rats, while the present study utilized Holtzman animals. Although evidence is lacking on the reactivity of these particular strains to different stimulus intensities, other evidence has indicated that strain differences in reaction to different intensities of stimulation do exist (Harrington & Kohler, 1966).

Table 1
Mean Activity Scores as a Function of Sex, Condition, Days, and Time Periods

		Days (Time Periods Collapsed)			Time Periods (Days Collapsed)		
		1	2	3	1	2	3
Males	Hyperstimulated	16.33	20.10	20.13	24.30	17.17	15.37
	Control	14.07	18.27	15.63	16.57	14.90	14.70
Females	Hyperstimulated	24.53	29.37	29.33	32.57	27.27	23.40
	Control	22.80	28.13	30.60	29.80	27.53	24.20

In spite of differences between conditions and measurements, the present results are also supported by findings of Ireland & Isaacson (1968), who noted significantly greater activity in gerbils following exposure to high-intensity visual or auditory stimulation than in gerbils presented with low-intensity stimulation in these modalities. The similarity of results between the present study and the Ireland & Isaacson (1968) study plus the nonsignificant sex differences in the present study suggest that the observed effects of hyperstimulation upon activity may have considerable generalizability to various kinds of organisms.

In addition to the above data, the results of the present study yielded a days main effect such that the activity scores of Days 2 and 3, though not significantly different from each other, were significantly different from activity as measured on Day 1. These data suggest the need for some caution in generalizing from the results of studies using only a single day's activity measure. The present study also supports the previous findings of Snowdon et al (1964) and Broadbent & Bignami (1965) in showing significantly more open-field activity by females than by males.

Although sex differences were noted in reaction to hyperstimulation, they did not reach statistical significance. However, since Snowdon et al's (1964) data indicate sex differences in emotional stability and because the results of the present study were in the predicted direction, it is suggested that 30 sec of hyperstimulation may not have been powerful enough to elicit these differences. Further research using either more intense levels of

stimulation or hyperstimulation for a longer duration may prove valuable in clarifying the question of sex differences in reactivity to hyperstimulation.

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