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**The Effect of Restricted Homogeneous Visual Input
Upon Exploratory Behavior
Of the Hooded Rat**

William Parke Fitzhugh, Jr.

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts in Psychology in the
Graduate School of the University of Richmond

August 1964

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INTRODUCTION

During the last decade increasing attention has been paid to the effects of the perceptual variables in the environment of an organism upon the behavior of that organism.

The importance of deprivation of exteroceptive stimulation is shown by the study of Bexton, Heron, and Scott (1954). Human Ss were placed in an isolated cubicle and wore equipment restricting visual and tactual stimulation. The Ss' reactions included hallucinations, deterioration of intellectual abilities, and inability to tolerate the treatment for extended periods.

Research has also been done indicating that environmental stimuli may influence behavior through an apparent reward function seemingly independent of any homeostatic drive in the organism. Berlyne (1955, 1960) has shown that organisms are attracted by novel stimuli, i.e., stimuli with which the organism has had little or no contact. He hypothesized that novel stimuli evoke a drive to explore them, and that any response followed by contact with a particular novel object will be reinforced.

In one study by Berlyne (1955) rats were allowed to explore a rectangular box with two corners at one end cut off by convexly curved walls forming a small alcove. When

a one-inch unpainted cube was placed in the alcove, the rats approached that section of the box significantly more often than when no such object was present. When rats were exposed to the cube outside the box for five minutes previous to testing, they made significantly fewer approaches to the cube than the rats which did not have such a preliminary exposure. When the rats were repeatedly placed in the box with the cube for three-minute trials at ten-minute intervals, the number of approaches to the cube in the first minute decreased significantly from trial to trial although not for the total three-minute period, suggesting that exploration of novel objects declines as exposure to those objects is increased.

The reinforcing function of exploration of novel stimuli hypothesized by Berlyne received support from experiments by Montgomery (1954) and Montgomery and Segall (1955). Rats learned to choose the arm of a Y maze which led to a Dashiell-type maze rather than an arm ending in a normal goal box, and they reversed their preference when the maze and goal box were switched after 24 trials. The rats showed a progressive decrease in latency in choices to the Dashiell-maze. Rats also learned a black and white discrimination when the correct choice was followed by such exploration.

Although it is clear from the above studies that novel stimuli have incentive value, the source of that incentive is not clear. There are two conflicting theoretical positions concerning the mechanism behind exploratory behavior. One position (Myers and Miller, 1954; Symmes, 1959) holds that exploratory behavior is the function of internal drive stimuli which are homeostatic in nature, so that the organism seeks an optimal level of exploration. Deprivation of exploratory behavior by limitation of stimulus input, therefore, results in a heightened exploratory drive level. The opposing theory (Harlow, 1953; Charlesworth and Thompson, 1957) predicates that exploratory behavior is the function only of drives that have their source of stimulation in cues external to the organism and therefore postulate that restricted visual input does not arouse an internal exploratory drive. Experimental evidence apparently supports each of these theories.

Support for the internal exploratory drive theory is offered by Symmes who placed rhesus monkeys in a box illuminated only by a six-watt florescent light. In the first half of the study the monkeys could open a door to see outside. The time spent looking out increased significantly with the length of time spent in the box. In the second part of the experiment the monkeys were able

to look from a small peephole. There was also a significant increase in visual exploration within testing sessions. The author infers that this is an indication of a "boredom drive" operating in the test box. When constantly changing slide photographs could be seen through the peephole, visual exploration increased significantly within sessions. The reinforcing property of the visual exploration apparently diminished with continuing exposure since exploration time decreased across sessions.

A study by Woods (1962) presents evidence that rats are affected by restricted visual input. In this experiment rats lived in "restricted" cages 10 in. by 12 in. by 9 in. with solid walls. The cages were placed on racks so that rats could see only a few inches above and below. Another group lived in standard laboratory cages $7\frac{1}{2}$ in. by 9 in. by 7 in. with a wire mesh front. A third group lived in free environment cages 24 in. by 44 in. by 12 in. having wire mesh on three sides. Within the cages were a small maze, a tunnel, a seesaw, and peanut hulls. The rats were tested in a light gray 30-inch square closed field with a wire mesh ceiling and a start box in one corner. The rats were kept in their cages for an average of 24 hours before testing. At the end of this period they were allowed access to the exploratory box for one

24 minute trial.

There was no significant difference between the groups in latency of entry into the exploratory box, apparently indicating there were no intergroup differences in exploratory motivation. There were significant differences between groups in the amount of sniffing and grooming as indicated by analysis of variance. Woods states the significant differences were due to the drop-off of sniffing and the increase in grooming responses in the free environment group, indicating there was no significant difference between the restricted and standard cage treatment but between those groups and the free environment group.

Woods concluded the free environment Ss were less motivated to explore the novel environment, and therefore the differing experimental treatments resulted in different levels of exploratory motivation.

A study by Jones, Wilkinson, and Branden (1961) indicates that humans are also affected by limitation of visual input, longer periods of limitation producing a greater need for visual stimulation. Human Ss were confined in lightproof chambers for eight-hour or twelve-hour periods for four days. In the first section of the

experiment Ss could press a button causing patterned series of red or green classes of lights to appear in the ceiling. The flashes were in series of 24 appearing singly at one-second intervals. Response rate of pressing the button was an increasing linear function of the number of hours of confinement. In the second part of the experiment Sg were confined in the chamber for a single ten-hour session. One group of Sg was allowed access to a dial which produced lights on the ceiling after one hour of confinement; another group could use the dial after five hours. The five-hour group had a higher response rate than the one-hour group.

The preceding studies seem to indicate that exploratory behavior is a function of an internal drive produced by limitation of visual input. The following studies, however, apparently support the external drive analysis of exploratory tendencies.

A study of the exploratory behavior of rats following deprivation of varied visual stimulation was conducted by Charlesworth and Thompson (1957). Three groups of rats were confined in pine boxes with gray interiors measuring 12 in. by 6 in. by 9 in. for periods of three, six, and nine days respectively. Half of the experimental animals lived in boxes permitting dull illumination through

a smoked glass window; the second half of the experimental group lived in boxes permitting no light to enter. There was also a control group having full view of the laboratory.

At the conclusion of the monotonous confinement period, the rats were permitted access through a guillotine door to an exploratory box of the same dimensions as their confinement cages. Within the exploratory box was a triangular block of wood (one side black, one side white, and one black and white striped) which served as a stimulus to arouse exploratory behavior.

The rats were exposed to the exploratory box for two ten-minute trials, separated by a 50-minute inter-trial interval. For each five-second interval during the two sessions the following measures of behavior were recorded: active exploration of the object, roof and corners; latency of the rat's entry with all four paws into the exploratory section; "autonomic" activity, i.e., scratching, grooming, licking, etc.; and the total time spent by each group during both sessions in the exploratory section of the box.

The internal drive theory predicts that the visually restricted groups would explore more and have lower latency scores than the non restricted group.

There were no significant differences between the amount of time spent in the exploratory box between groups during the first or second sessions or between sessions. There was no significant difference in latency time among groups. There was a highly significant difference for latency time between sessions, the latencies being lower in the second session. The authors report there was no significant difference between the groups during the first or second session in the total amount of time spent exploring roof, corners, and the object, although the differences were in the direction predicted by the hypothesis being tested ($.10 < p < .20$) but did not meet the level of significance required.

Studies by Montgomery and Zimbardo (1957) and Hill (1961) found no difference in performance measures of exploration or responses leading to exploration after periods of visual restriction.

Montgomery and Zimbardo confined rats in common laboratory cages and another group in cages of the same size made of sheet metal. The periods of confinement were 25, 50, and 100 days. There was no significant difference between the groups in the amount of exploratory behavior in a Y maze.

Hill confined rats for 24 hours in small opaque cages 7 in. by 4 in. by $4\frac{1}{2}$ in. and in wire mesh cages of

the same size. The rats were then placed in a T maze with alternatives being a Dashiell maze containing novel objects on one side and a dead end alley on the other. The Dashiell maze was on one side for half the Ss and on the other arm of the maze for the remaining Ss. The increasing number of choices to the side leading to the Dashiell maze was significant; however, there was no significant difference between groups in the number of choices to the D-maze side of the maze. There was no significant difference between groups in the time taken to traverse the maze from the start box to the choice point.

Thus the conflicting experimental evidence precludes the full support of either theoretical approach, and the apparently discrepant data offer no immediately tenable hypothesis.

The results of studies by Symmes and Jones et al. indicating that periods of visual restriction result in increased exploratory response tendencies may have been a function of general anxiety induced by confinement. The responses recorded as indices of exploratory motivation may not have been exploratory responses, but rather responses which reduced anxiety by introducing extrinsic visual stimuli into the experimental environment, thereby making that environment more similar to the normal living

by food or water deprivation. The approach used in this study postulates that drive--in this instance drive to explore--serves as an activator of responses dominant in the behavioral repertoire of the organism. The greater the drive, the greater the activation of the dominant response. In this experiment that response was locomotion toward a novel environment.

If the null hypothesis is correct, there should be no difference between groups in the time taken to reach the activity incentive. If, however, the internal exploratory drive analysis of exploratory behavior is valid, there should be differences in exploratory motivation, due to differences in visual restriction in the living environments, and therefore differences in runway time, i.e., the runway time of the restricted environment group would be lower than that of the non restricted group. No differences between groups in learning would be expected on the assumption that drive is a performance variable rather than a learning variable.

METHOD

Subjects. The Ss were 25 male hooded rats of the Long-Evans strain divided into two groups of eight and one group of nine rats. During testing three Ss were dropped from the experiment, two due to disease and one to "freezing" in the test apparatus apparently resulting from fear produced by a minor injury occurring when the rat caught its claw in the maze floor while being extracted from the apparatus. The Ss ranged in age from 83 through 98 days at the beginning of the testing sessions. The average weight before testing was 266 grams; the average weight at the completion of testing was 324 grams.

Apparatus. The test apparatus was an L arm Y maze, each arm 12 in. long by 4 in. wide by 4 in. high, and a goal box measuring 20 in. by 20 in. by 4 in. which could be placed at the end of either maze arm. The goal box entrance could be closed by a guillotine door.

The apparatus was constructed of pine and $\frac{1}{2}$ in. hardware cloth and painted flat black.

Six pieces of wood of different shapes were used as novelty objects in the goal box. They were shaped and painted as follows: an isosceles triangle with a 7 in.

base, $3\frac{1}{2}$ in. height, and $1\frac{1}{2}$ in. depth painted aluminum with the words "Hey rat" inscribed in black on one side; a solid black piece of wood measuring 9 in. long on its base, $5\frac{3}{4}$ in. long on its top, $3\frac{1}{2}$ in. high, and $2\frac{1}{2}$ in. wide; a solid black rectangular prism 9 in. long by $3\frac{1}{2}$ in. high by $2\frac{1}{2}$ in. wide; two white rectangular prisms 4 in. long by $3\frac{1}{2}$ in. high by $1\frac{1}{2}$ in. wide joined in an L shape with the words "No left turn" inscribed in black on one side. The fifth and sixth objects were rectangular prisms 8 in. long by $3\frac{1}{2}$ in. high by $1\frac{1}{2}$ in. wide, one black and the other black with aluminum ends.

Three types of cages were provided as experimental environments for the Ss. All were $9\frac{1}{2}$ in. long by 7 in. wide by 7 in. high.

The first type in which the moderately restricted group was confined consisted of common laboratory housing cages. These cages had $\frac{1}{2}$ in. wire mesh floors and fronts; the sides and rear were aluminum. Vision above was restricted by the cage rack; vision below was restricted by the refuse tray immediately beneath the cages. These cages were placed on one side of the cage rack facing a small window.

For the second group, restricted visual input, the front of the same type of cage was covered with wood

which served to cut off sources of visual stimulation external to the walls of the cage. Refuse trays under the cages were lined with plain brown paper in order to minimize possible sources of novel stimuli.

The third group of cages, for the non restricted group, was covered with $\frac{1}{2}$ in. hardware cloth on all sides to allow the Ss unrestricted vision. These cages were placed in two columns of four on a stand in the center of the rat housing room.

The test environment was a soundproof room measuring 11 ft. 2 in. long by 8 ft. 1 in. high by 6 ft. 11 in. wide. The room was illuminated by a ceiling light consisting of a 100 watt bulb in a frosted dome.

The maze was located on a table on one side of the room. The position of the maze remained constant throughout the testing sessions.

Procedure. Food and water were available ad libitum in the cages throughout the experiment.

Prior to experimental treatment each S was handled by E approximately five minutes a day for 10 days. This procedure included five trials, one on each of the last five days, in which each S was carried from the housing room to the testing room in its respective cage and

placed in the start box of the maze for approximately ten seconds. This was done to minimize possible sources of anxiety which might occur due to unfamiliarity with the testing situation. Such anxiety might have confounded the effects of visual restriction.

Three days prior to the initial testing session, each of the groups was placed in its respective experimental environment.

Group I (8 Ss) was placed in the non visually restricting cages.

Group II (9 Ss) was placed in the moderate visually restricting cages.

Group III (8 Ss) was placed in the severe visually restricting cages.

During the experimental sessions Groups II and III, i.e., moderate visual restriction and severe visual restriction, were transported to the testing room with a piece of wood covering the top of their cages to restrict external stimulation. Group I, i.e., no visual restriction, was transported with no visual barrier placed over its cages.

The following procedure constituted a trial. S was placed in the start box where it remained for approximately five seconds or the time thereafter required

for the S to face the front of the start box. When the guillotine door to the start box was raised, a stop watch was activated. S's initial turn to the right or left was recorded. A turn was defined as the entry into one of the maze arms with all four feet. When the S entered the goal box with all four feet, the timing watch was stopped and the guillotine door to the box was dropped behind S.

The Ss were allowed to correct turns made to the dead end maze arm rather than being removed from the maze after making incorrect choices. As indicated by Hull and Spence (1938), this correction method should result in the occurrence of the correct reaction in fewer trials than the non correction method in which the S was removed from the maze immediately after making an incorrect choice.

S was allowed to remain in the goal box for thirty seconds, then returned to the start box for the next trial. Ss were run in blocks of four consecutive trials with an average interval of fifteen seconds between their removal from the goal box and the raising of the start box door in the next trial. This interval included the time taken to remove S from the goal box and place it in the start box and the standard delay interval before

the raising of the start box door.

The groups were run in order of their numerical designation on the first block of trials. Thereafter, in order to control for the effects of diurnal activity cycles, the group run first on the previous block of trials was run last on the next block, the remaining two groups moving up one step in the order.

On the initial testing day Ss received one block of four trials in the morning and one block of four trials in the afternoon. The following day the Ss received one block of four trials. Thereafter, the Ss were given one four-trial block every other day. Ss received a total of forty trials in ten blocks of four each.

For the first twenty trials the goal box was on the right maze arm; for the second twenty trials it was reversed to the left.

The goal box pattern remained constant for the first twenty trials. During the last twenty trials the objects were rearranged prior to each block of four trials.

RESULTS

Multifactor analysis of variance with repeated measures was used to test possible group differences in runway times. As shown in Tables 1 and 2 there was no significant difference between groups in runway times on either five blocks of trials. The relationship of runway times to each block of trials for each group is shown in Figure 1. It can be seen that on the first five blocks of trials the group differences were in the predicted direction ($.10 \leq p \leq .20$), but these apparent differences did not occur on the second five blocks of trials ($p > .50$).

The increasing runway times on the first five blocks of trials and the corresponding decrease in times on the second five blocks were tested by use of the Newman Keuls test on ordered means presented in Tables 3 and 4. Both the increase and decrease in times were significant at the .01 level.

The relationship of the number of turns to the right maze arm to each block of trials for each group is presented in Figure 2. The number of turns to the goal box arm for each five blocks of trials was tested by multifactor analysis of variance with repeated

Table 1

Analysis of Variance on Runway Times per Block
of Trials (First five blocks of trials)

Source of Var.	Ss	df	Mean Square	F
<u>Between Ss</u>				
Treatment grps	95,739.84	2	47,869.92	2.43
<u>Ss w/grps</u>	424,645.78	21.6	19,659.53	
<u>Within Ss</u>				
Blocks of trials	145,951.64	4	36,487.91	7.91**
Treatment grps x blocks of trials	53,444.48	8	6,680.56	1.45
Blocks of trials x <u>Ss w/grps</u>	398,645.28	86.4	4,613.95	

$$F_{.95} (2,22) = 3.44$$

$$F_{.95} (4,86) = 2.49$$

$$F_{.95} (8,86) = 2.06$$

Table 2

Analysis of Variance on Runway Times per Block
of Trials (Second five blocks of trials)

Source of Var.	Ss	df	Mean Square	F
<u>Between Sg</u>				
Treatment grps	2,672.95	2	1,336.48	F/ 1.00
<u>Sg w/grps</u>	110,836.30	19.1	5,805.57	
<u>Within Sg</u>				
Blocks of trials	49,009.25	4	12,252.31	12.88**
Treatment grps x blocks of trials	9,531.77	8	1,191.47	1.25
Blocks of trials x <u>Sg w/grps</u>	72,672.02	76.4	951.20	

$$F_{.95} (2,20) = 3.44$$

$$F_{.95} (4,76) = 2.51$$

$$F_{.95} (8,76) = 2.08$$

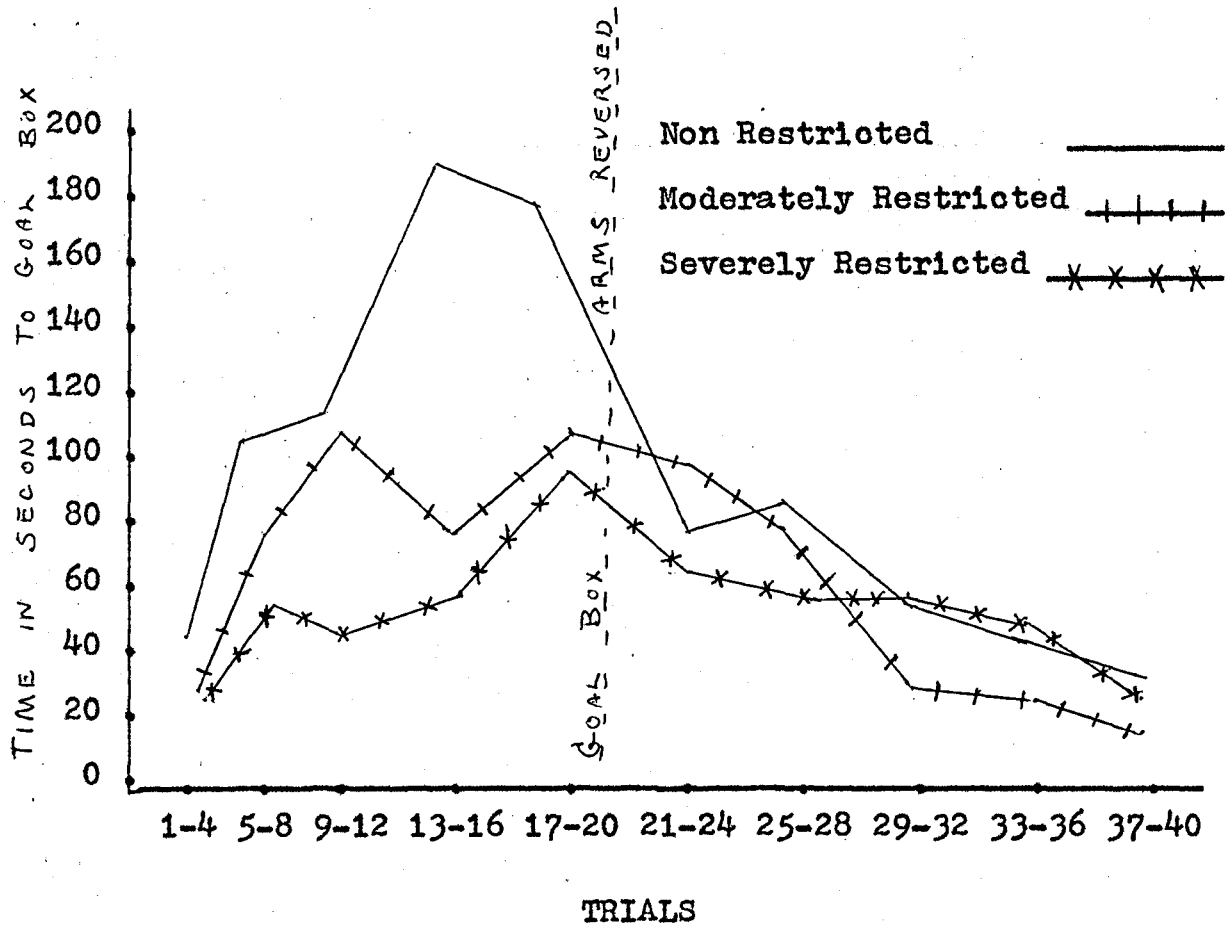


Figure 1. Mean runway times per block of four trials per group.

Table 3

Newman Keuls Test on Mean Runway Times per Block
of Trials (First five blocks of trials)

Blocks of Trials	1	2	3	4	5
Ordered Means	32.4	73.6	85.0	106.3	135.6
1		41.2*	52.6*	73.9*	103.2*
2			11.4	32.7	62.0*
3				21.3	50.6
4					29.3
Truncated Range r		2	3	4	5
$q_{.95}(r, 86)$		2.82	3.39	3.73	3.97
$\frac{S}{B} q_{.95}(r, 86)$		40.0	46.4	51.1	54.3

Table 4

Newman Keuls Test on Mean Runway Times per Block
of Trials (Second five blocks of trials)

Blocks of Trials	10	9	8	7	6
Ordered Means	26.9	35.2	46.2	78.1	79.1
10		8.3	19.3	51.2*	52.2*
9			11.0	42.9*	43.9*
8				31.9*	32.9*
7					1.0
Truncated Range r		2	3	4	5
$q_{.95}(r, 76)$		2.82	3.39	3.73	3.97
$\frac{s}{B} q_{.95}(r, 76)$		18.5	22.3	24.5	26.0

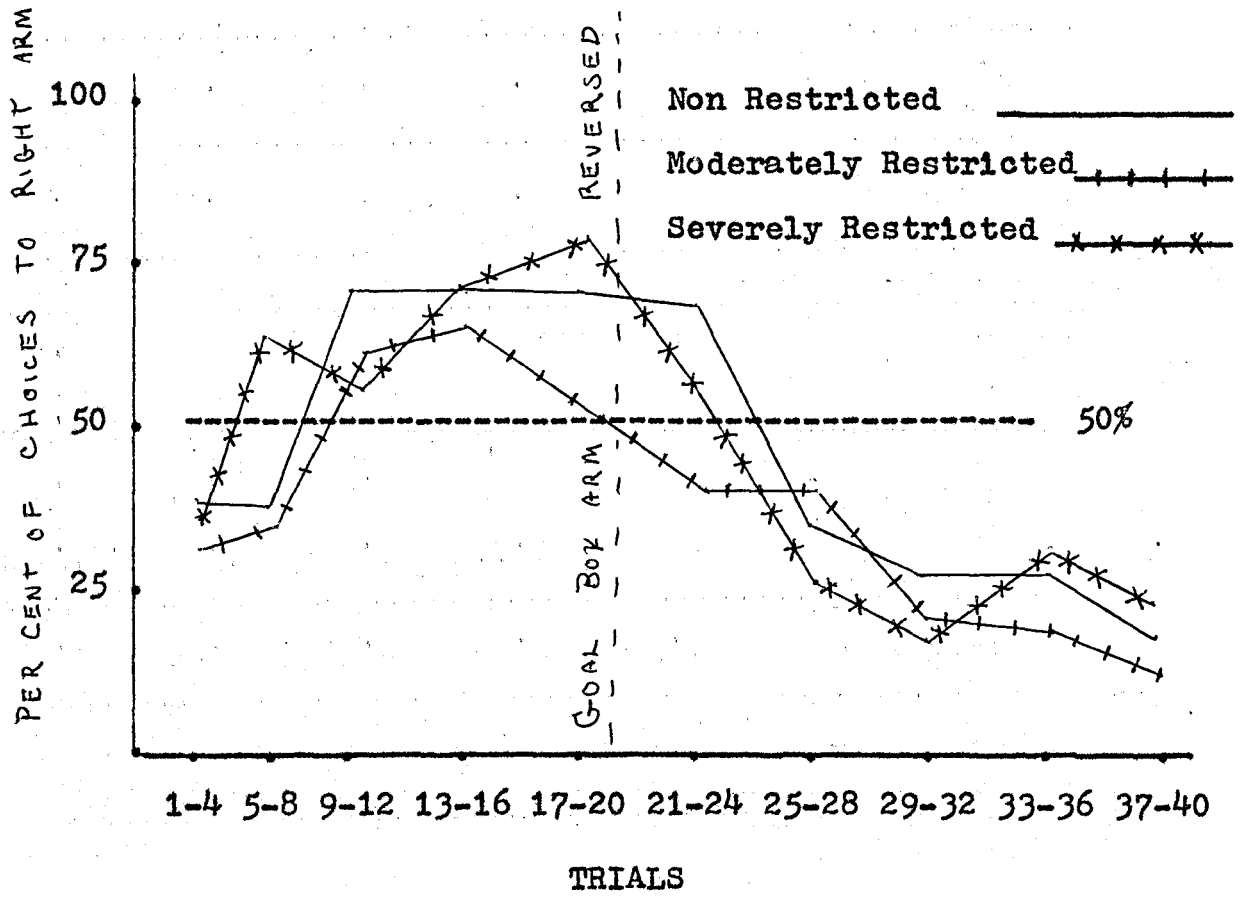


Figure 2. Per cent of choices to the right maze arm per block of trials for each group.

measures as shown in Tables 5 and 6. There were no significant intergroup differences on either half of the experiment ($p > .05$). The Newman Keuls test on ordered means was used to test the increase in the number of turns to the goal box arm of the maze which occurred on each five blocks of trials. Each five block increase in turns to the maze arm was significant at the .01 level as indicated in Tables 7 and 8.

Table 5

Analysis of Variance of Right Turns for Each Group
per Block of Trials (First five blocks of trials)

Source of Var.	Ss	df	Mean Square	F
<u>Between Ss</u>				
Treatment grps	2.91	2	1.46	F/ 1.00
<u>Ss w/grps</u>	531.20	21.6	245.92	
<u>Within Ss</u>				
Blocks of trials	23.16	4	5.79	4.94**
Treatment grps x blocks of trials	6.72	8	.84	F/ 1.00
Blocks of trials x <u>Ss w/grps</u>	101.20	86.4	1.17	

$$F_{.95} (2,22) = 3.44$$

$$F_{.95} (4,86) = 2.49$$

$$F_{.95} (8,86) = 2.06$$

Table 6

Analysis of Variance of Left Turns for Each Group
per Block of Trials (Second five blocks of trials)

Source of Var.	Ss	df	Mean Square	F
<u>Between Ss</u>				
Treatment grps	2.44	2	1.22	1.10
<u>Ss w/grps</u>	21.20	19.1	1.11	
<u>Within Ss</u>				
Blocks of trials	18.40	4	4.60	5.75**
Treatment grps x blocks of trials	5.10	8	.64	F/ 1.00
Blocks of trials x <u>Ss w/grps</u>	61.22	76.4	.80	

$$F_{.95}(2,20) = 3.44$$

$$F_{.95}(4,76) = 2.51$$

$$F_{.95}(8,76) = 2.08$$

Table 7

Newman Keuls Test on Mean Number of Right Turns
per Block of Trials (First five blocks of trials)

Block of Trials	1	2	3	4	5
Ordered Means	1.64	2.00	2.52	2.72	2.75
1		.36	.88*	1.08*	1.11*
2			.52	.72	.75
3				.20	.23
4					.03
Truncated Range r		2	3	4	5
$q_{.95}(r, 86)$		2.82	3.39	3.73	3.97
$\frac{s}{B} q_{.95}(r, 88)$.62	.75	.82	.87

Table 8

Newman Keuls Test on Mean Number of Left Turns
per Block of Trials (Second five blocks of trials)

Blocks of Trials	6	7	9	10	8
Ordered Means	1.48	2.59	2.68	3.00	3.05
6		1.11*	1.20*	1.52*	1.57*
7			.09	.41	.46
9				.32	.37
10					.05
Truncated Range r		2	3	4	5
$q_{.95}(r, 76)$		2.82	3.39	3.73	3.96
$\frac{s}{B} q_{.95}(r, 76)$.54	.64	.71	.75

DISCUSSION

The non significant differences between the experimental groups on the first and second five blocks of trials result in the acceptance of the null hypothesis that visual restriction does not act as a motivational variable affecting an internal exploratory drive state.

The increasing runway times on the first five blocks of trials suggest that the goal box decreased in attractiveness. This decrease was probably due to a reduction in the relative novelty of the goal box as a result of the non changing pattern of novelty objects.

The decreasing runway times on the second five blocks of trials suggest that the goal box maintained or increased its attractiveness due to an increase in the relative novelty of the goal box resulting from the changing pattern of novelty objects.

The significant number of initial choices to the right arm when the goal box was on the right and to the left arm when it was reversed to that side indicate that the box offered reward which supported learning of a motor response.

Although the apparent group differences on the first five blocks of trials seen in Figure 1 were in the predicted direction ($.10 < p < .20$), it is not believed that the in-

ternal exploratory drive analysis of exploratory behavior was supported. It is believed that since there was no such trend on the second five blocks of trials, the differences between the first and second five blocks of trials in intergroup order may be attributed to differences in procedure.

When the goal box pattern was not changed on the first five blocks of trials, the non restricted group had an opportunity to generalize between the relative novelty of visual stimuli in the living environment and the testing situation. Generalization of relative novelty occurred since the living environment and the test apparatus were similar in complexity of visual stimuli. The generalization of stimulus novelty between the living environment and the testing situation resulted in a reduction of the relative novelty of the goal box, and there was a corresponding decrease in the attracting properties of the goal for the non restricted group.

There was no corresponding decrease in attractiveness of the goal for the restricted groups since for these Sg there was less similarity between the test situation and the living environment, and the goal box was relatively more novel. There was less similarity

between the testing and living environments for the restricted S_g because their vision of the extra-cage environment was limited or non-existent. Thus inter-group differences in runway times can be attributed to the differences in the attractive properties of the goal box due to generalization of stimulus familiarity from the living cages to the test box and need no postulation of internal drive differences.

On the second five blocks of trials when the goal box pattern was changed on each block of trials, the similarity of the testing situation and the living environment was reduced for the non-restricted group. The reduced similarity lessened the opportunity for the non-restricted group to generalize between the relative novelty of the living environment and the test situation. This reduction in similarity was relatively greater for the non-restricted group than for the restricted groups since the latter had a minimal opportunity to generalize novelty on the first five blocks of trials. The relatively greater reduction in generalization of novelty for the non-restricted group raised the goal box to the level of attractiveness which it held for the restricted groups, and no group differences in runway time would be expected. Thus it is assumed that the change of the

goal box pattern on each block of trials resulted in the disappearance of the apparent ($.10 < p < .20$) intergroup runway time differences.

The results of this study suggest that the opportunity for generalization between the relative novelty of stimuli in the living environment and the testing situation was important in determining the response eliciting properties of the latter situation and not the degree of restriction in the living environment.

The preceding explanation is based upon the assumption that relative novelty is a function of the amount of generalization of visual stimuli as well as recency of contact. Support for this assumption is found in a study by Montgomery (1953) indicating that the decrement in exploratory behavior produced by continuing exposure to one stimulus situation generalizes to other situations, that decrement decreasing in magnitude as the similarity of the stimulus situations decreases.

It is concluded that exploratory behavior in this study was not affected by intrinsic stimuli, and the prediction made by the internal exploratory drive hypothesis was not supported. It is concluded that the results of the present study support the external stimulus

hypothesis of exploratory behavior.

This writer suggests that the results in previous studies indicating that deprivation of stimulus input affects exploratory behavior were not a direct function of the deprivation, but were the indirect results of the manipulation of other variables.

In the studies by Symmes and Jones et al. it is assumed that the critical variable was general anxiety induced by the experimental situation rather than by the arousal of a specific internal exploratory drive. This anxiety was specific to the lack of stimulation in the testing situation and occurred as a result of the contrast between it and the normal living environment. Visual stimuli introduced into the test environment served to lessen the contrast between the testing situation and the living environment, thereby reducing anxiety and rewarding responses producing these stimuli. Increasing degrees of confinement produced greater anxiety but not a greater internal exploratory drive.

A similar analysis of the effects of visual restriction upon an S's anxiety level is found in a study by Segall (1959) in which kittens were placed in a 3 ft. long by 3 ft. wide by 2 ft. high flat-gray box. In the center was a ten-inch high stand that the kittens

could climb in order to see several bright objects through a portal in the box which was opened when the top of the stand was reached. A group not allowed to see the objects "meowed" more than the group permitted to see out. Segall inferred that this reaction was produced by the limitation of exteroceptive stimulation which resulted in anxiety.

The present writer's explanation indicates that the effects produced by restricted visual input are short lived, i.e., since the anxiety is produced by visual restriction, cessation of the confinement results in dissipation of the anxiety when the S's usual range of visual stimuli is again available to it.

Such an approach indicates that Segall's model is applicable when it is utilized to predict the behavior of Ss within a visually restricted environment but not when used to predict the behavior of Ss just released or removed from such an environment.

In this study any anxiety produced by visual restriction apparently dissipated so rapidly that such anxiety did not affect the opportunity to explore.

It is concluded in the present study that restricted visual input did not affect an internal exploratory drive. Its effects upon behavior were a function of

the increased relative novelty of extrinsic stimuli. The increase in relative novelty was a result of reduced opportunity for stimulus generalization between the living environment and test environment stimuli. This conclusion supports the external stimulus hypothesis of exploratory behavior.

SUMMARY

This study tested opposing theoretical hypotheses concerning the effects of restricted visual input upon exploratory tendencies. One hypothesis postulates that deprivation of visual stimulus input acts as a motivational variable through arousal of internal drive stimuli and that periods of visual restriction result in increased exploratory drive. The opposing theory holds that restricted visual input does not arouse an internal exploratory drive and that exploratory behavior is the function of a drive having its source in cues external to the organism.

Three groups of hooded rats were placed in living environments resulting in three levels of visual restriction. The non restricted group was placed in wire mesh cages affording a full view of the housing room. The moderately restricted group was placed in common laboratory cages having aluminum sides and a wire mesh front. The severely restricted group was housed in the same type of laboratory cage with plywood placed over the wire mesh front to cut off all sources of external visual stimulation.

Exploratory tendencies were tested by recording the time taken by the Ss to travel from the start box

of an L arm Y maze to a goal box containing novel objects at the end of one arm, the lower the time, the greater the exploratory motivation assumed.

Each S received ten blocks of four trials each. For the first five blocks of trials the goal box was on the right maze arm and the arrangement of the novel objects remained constant. On the second five blocks of trials the goal box was reversed to the left maze arm and the pattern of novelty objects was rearranged prior to each block of four trials. On the first day of testing each S received one block of trials in the morning and one block of trials in the afternoon. The following day each S received one block of trials. Thereafter, testing occurred every other day until ten blocks of trials were completed.

The internal exploratory drive hypothesis predicted that the severely restricted group would have a higher exploratory drive level than the moderately restricted group, and that the drive level of the moderately restricted group would be higher than that of the non restricted group. Accordingly, the severely restricted group would have the lowest runway times, the moderately restricted group the second lowest times, and the non restricted group the highest times.

There were no significant differences between groups in runway times. On the first half of the experiment there were apparent group differences in the direction predicted by the internal stimulus hypothesis ($.10 < p < .20$). There were no differences in the second half of the study ($p > .50$). These apparent differences were discussed. It was concluded that restricted visual input does not affect an internal exploratory drive but may influence exploratory tendencies through its effect upon opportunities for stimulus generalization between the relative novelty of the living environment and the testing situation.

REFERENCES

- Berlyne, D.E. Perceptual curiosity in the rat. J. comp. physiol. Psychol., 1955, 48, 238-246.
- Berlyne, D.E. Conflict, arousal, and curiosity. New York: McGraw-Hill, 1960.
- Berlyne, D.E. & Slater, J. Perceptual curiosity, exploratory behavior, and maze learning. J. comp. physiol. Psychol., 1957, 50, 228-231.
- Bexton, W.H., Heron, W., & Scott, T.H. Effects of decreased variation in the sensory environment. Canad. J. Psychol., 1954, 8, 70-76.
- Campbell, B.A. & Kraeling, Doris. Response strength as a function of drive level during training. J. exp. Psychol., 1953, 47, 101-103.
- Charlesworth, W.R. & Thompson, W.R. Effect of lack of visual stimulus variation on exploratory behavior in the adult white rat. Psychol. Rep., 1957, 3, 509-512.
- Harlow, H.F. Motivation as a factor in the acquisition of new responses. In Marshall Jones (Ed.), Current theory and research in motivation. Lincoln: Univer. of Nebraska Press, 1953.
- Hill, Winifred F. Effects of activity deprivation on choice of an activity incentive. J. comp. physiol. Psychol., 1961, 54, 78-82.
- Hull, C.L. & Spence, K.W. "Correction" vs. "non-correction" method of trial-and-error learning in rats. J. comp. Psychol., 1938, 25, 127-145.
- Jones, A.; Wilkinson, H. Jean; & Branden, Ina. Information deprivation as a motivational variable. J. exp. Psychol., 1961, 62, 126-137.
- Montgomery, K.C. Exploratory behavior as a function of "similarity" of stimulus situations. J. comp. physiol. Psychol., 1953, 46, 129-133.

Montgomery, K.C. The role of the exploratory drive in learning. J. comp. physiol. Psychol., 1954, 47, 60-64.

Montgomery, K.C. & Segall, M.H. Discrimination learning based upon the exploratory drive. J. comp. physiol. Psychol., 1955, 48, 225-228.

Montgomery, K.C. & Zimbardo, P.G. Effect of sensory and behavioral deprivation upon exploratory behavior in the rat. Perc. mot. skills, 1957, 7, 223-229.

Myers, A.K. & Miller, N.E. Failure to find a learned drive based on hunger, evidence for learning motivated by exploration. J. comp. physiol. Psychol., 1954, 47, 428-436.

O'Kelly, L.I. & Heyer, A.W., Jr. Studies in a motivation and retention. I. Retention of a simple habit. J. comp. physiol. Psychol., 1948, 41, 466-478.

Segall, M.H. Curiosity---motivated learning and anxiety reduction. J. genet. Psychol., 1959, 60, 201-204.

Symmes, D. Anxiety reduction and novelty as goals of visual exploration by monkeys. J. genet. Psychol., 1959, 94, 181-198.

Woods, P.S. Behavior in a novel situation as influenced by the immediately preceding environment. J. exp. anal. of behav., 1962, 5, 185-190.