The effect of arousal on exploration in the rat

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The optimal level of arousal hypothesis was applied to the exploratory behavior of rats, as measured by approach to novel stimuli. Rats, whose current level of arousal had been depressed by optic enucleation and isolated living conditions, approached a novel stimulus, an unfamiliar human, to a significantly greater extent than rats whose current level of arousal had not been depressed. The results were interpreted as supporting the optimal level of arousal hypothesis as an explanation of both general locomotor activity and exploratory behavior.

The optimal level of arousal hypothesis, introduced by Hebb in 1955 and extended by Leuba (1955) and Berlyne (1967), suggests that animals will attempt to match their current arousal level to some optimal level by regulation of sensory input. That is, animals whose current level of arousal is below the optimal level will attempt to increase sensory input, while animals whose current arousal level is greater than the optimal level will attempt to decrease sensory input.

It is possible that rodents can regulate the amount of sensory input by increasing or decreasing general locomotor activity. Several investigators (Browman, 1942; Wimer & Stern, 1964; Lester, 1967) have demonstrated that rodents suffering sensory loss are more active than controls. Glickman (1958) and Klein & Brown (1969) have interpreted this phenomenon as supporting the optimal level of arousal hypothesis. Essman (1966) found that individually housed mice were more active than group-housed mice. Berlyne (1967) has hypothesized that not all stimuli equally affect the current level of arousal. Complex and/or novel stimuli, for example, may increase the current arousal level more than simple and/or familiar stimuli. Morlock & Meyer (1971) have supported this hypothesis by demonstrating that blinded rats are less active in complex than in simple environments.

It would appear that the general locomotor activity of rodents can be easily predicted on the basis of the optimal level of arousal hypothesis. The purpose of the present experiment was to demonstrate that exploration, as measured by approach to novel stimuli, can also be predicted on the basis of the optimal level of arousal hypothesis. Because rats reliably avoid unfamiliar humans (McCall, Lester, & Dolan, 1969; Morlock, McCormick, & Meyer, 1970), an unfamiliar human was used as the novel stimulus in the present experiment. It was hypothesized that blinded,

individually housed rats would spend more time on the side of an open field adjacent to a stranger than would nonblinded group-housed rats.

SUBJECTS

The Ss were 16 male Holtzman rats approximately 150 days old at the start of the experiment. Prior to the experiment, all Ss were housed in groups of two in an isolated room on ad lib food and water under a 12-h-on/12-h-off lighting schedule.

APPARATUS

Exploration was measured in a 1-m-square open field. The open field, constructed of wood and painted flat gray, was divided in half by a chalk line drawn on the floor parallel to two of the 20-cm-high walls. Illumination was provided by a 60-W red light bulb suspended approximately 1.5 m above the center of the open field. The stranger alternately sat on each of two stools which were placed adjacent to opposite sides of the open field.

PROCEDURE

All Ss were placed under light ether anesthesia, and the eyeballs of half the Ss were removed by lifting the eye with forceps and severing the optic nerve and connecting tissue. Nonblinded Ss were returned to their home cages in groups of two, but blinded Ss were placed in individual cages.

After a 3-week recovery period, Ss were placed in the center of the open field by their caretaker. After the caretaker left the room, the amount of time spent by the Ss on the half of the open field adjacent to the stranger during the 5-min exploration period was recorded. All testing was done during the dark portion of the Ss' lighting cycle.

RESULTS AND DISCUSSION

The mean amount of time spent on the side of the open field adjacent to the stranger by the blinded individually housed rats, 199.78 sec, was significantly greater than the mean amount of time spent on that side by the nonblinded group-housed rats (118.58 sec) ($t = 4.9648$, $df = 14$,

$p < .05$). Rats whose current level of arousal had been depressed by loss of vision and isolated living conditions approached the novel stimulus more than animals whose current level of arousal had not been experimentally depressed. Exploration, as measured by approach to novel stimuli, can be predicted on the basis of the optimal level of arousal hypothesis.

It may be hypothesized that blinded rats spent more time on the side of the open field adjacent to the stranger than the nonblinded rats only because they could not visually locate the stranger. This interpretation is unlikely for two reasons. First, research by McCall, Lester, & Corter (1969) has indicated that avoidance of unfamiliar humans is mediated by olfactory but not visual cues. Second, although the nonblinded rats did spend significantly less time on the side of the open field adjacent to the stranger than would have been expected by chance alone ($t = -2.8640$, $df = 7$, $p < .05$), the blinded rats spent more time on that side than would have been expected by chance alone ($t = 4.1037$, $df = 7$, $p < .05$). Clearly, the difference between the two groups cannot be attributed to random exploration by either group.

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