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NOTE

1. Traupmann, K. L., Wong, P. T. P., & Amsel, A. Durability of persistence as a function of number of partially reinforced trials. Submitted for publication, 1970.

The incentive value of complexity*

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A free-selection procedure was employed to examine complexity as an incentive. Twenty-four hungry rats were given a choice in a double alley between food and a goal area containing objects of differing complexities. This setting provided the animals an alternative response, i.e., to choose the food alley, but instead they frequently chose the complexity alley. This frequency increased when the complexity of the stimuli was high and decreased with a corresponding decrease in complexity. These results were interpreted as implicating complexity as a positive incentive.

Although a variety of experiments have demonstrated that stimulus change, complexity, or novelty can reinforce instrumental behavior (cf. Fowler, 1965), few have allowed the Ss a choice between these rewards and a more conventional reinforcer, such as food. A typical procedure employed in an examination of the effects of novelty is to allow animals experience with a goal, change the goal in some way, and then compare the second running latencies with the first (e.g., Fowler, 1967). Other measures which have been used include performance in extinction (Hommel & Altman, 1966), length of exposure to objects

(Butler, 1954), and spontaneous alternation (Montgomery, 1952).

Welker (1957) has proposed that behaviors usually labeled as exploration may in actuality be escape behavior generated by fear of novelty. He suggested free-choice procedures to examine the "purer" effects of novelty. Therefore, the animal could choose either to avoid or expose himself to the novel stimuli. Analyses of incentives have frequently employed the choice or selection procedure to measure the differential effects of various incentives (e.g., Logan, 1965). Although several experiments have used the choice method to examine behavioral effects of novelty, most have allowed choices between two goals differing in novelty values (Dember, 1956), which offers somewhat the same dilemma for the animal as animals forced into a novel setting.

Two subsequent experiments have allowed Ss a true free selection. Timberlake & Birch (1967) found that Ss who had a choice to leave a start area containing food to a complex spacious area had significantly shorter latencies than animals with a less complex and spacious area. Cohen & Stettner (1968) reported that thirsty rats who had been given experience running to water in a straight alley would stop to examine a novel alley located adjacent to the straight alley. However, the examination time by the rats was an inverse function of the distance the novel alley was placed from the water-baited goal area. Since these investigations allowed the animal access to both the novel area and food or water on the same trial, a design was employed in a previous experiment (Wilson & Taylor, 1969) which allowed the Ss to choose between an area housing complex objects and a goal previously containing food. Using this procedure, complexity was found to have differential effects upon choice behavior of satiated and food-deprived animals (Wilson & Taylor, 1969) and Ss receiving various experiences with the initially food-baited goal (Taylor, 1970).

The present experiment extends the free-selection method and represents an effort to demonstrate the incentive value of complexity by allowing hungry rats a choice between food and a goal area containing objects of differing complexities.

SUBJECTS

The Ss were 24 female hooded rats of the Sprague-Dawley strain bred and reared in the University of New Mexico laboratory. The animals, approximately 100 days old at the beginning of experimentation, were housed in individual cages with water freely available. The rats were randomly assigned to either a high-then-low complexity (Hi-Lo) or a low-then-high complexity (Lo-Hi) condition.

APPARATUS

A double-alley maze described in detail elsewhere (Logan, 1960) was used. The startbox was situated so as to allow access to either of the two black alleys. A light was located at the entrance of each alley whose presence for half the Ss in each group or absence for the other half represented the SD for the food alley. A black metal blocking door, 4 x 5 in., that could be situated at the entrance of either alley was employed on forced-choice trials. The low-complexity stimulus arrangement was one of a variety of objects found around the lab, placed on the black metal insert. The objects, e.g., a flashlight, a block of wood, or paper,

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Fig. 1. The percentage of novel turns for free-choice trials.

were never presented twice to the same animal.

Start- and goalbox entry latencies were recorded by Standard Electric timers connected to a photoelectric relay-beam unit. Goalbox entry times began 1 ft from the front of the goal chamber and terminated as the rat entered that area.

PROCEDURE

Pretraining

All Ss were gentled and adapted to a 23-h food-deprivation schedule for 7 days prior to the beginning of experimentation. The animals were magazine trained in both of the alleys for each of 4 pretraining days.

Acquisition

The rats were given three spaced trials per day randomly sequenced between the two alleys for 26 days. On the first and third trials of each day, a blocking door was positioned to force the animals to a goalbox containing three 45-mg Noyes pellets. To insure adequate discrimination training, the second trial consisted of a free-choice trial between the food rewarded alley and an empty alley.

Free-choice Testing

After the training trials, the food reinforcement was reduced to one pellet and a complex stimulus introduced in the other alley. The Ss were given three free-choice trials each on Days 1-12. The Hi-Lo group encountered a different, highly complex stimulus on each trial, while the Lo-Hi Ss' stimulus arrangement was one of low complexity.

Reversal

The complexity conditions were

reversed for the two groups and the animals given three free-choice trials on each of Days 13-18.

RESULTS

The choice data of the Ss for the free-selection trials is shown in Fig. 1. At the termination of the acquisition phase, the animals were choosing the food alley on nearly every choice trial, approximately 90%.

With the introduction of the complex stimuli, the animal's preference remained for the food alley. Initially (Days 1-4), the Hi-Lo rats preferred the food goal more than did the Group Lo-Hi Ss ($\chi^2 = 2.72$, $df = 1$, $p < .10$). The subsequent choice behavior prior to reversal revealed the Lo-Hi rats to prefer the food alley at a mildly increasing rate, while the Hi-Lo began to exhibit an increased selection rate for the complex stimuli, the differences between the groups being statistically reliable ($\chi^2 = 24.36$, $df = 1$, $p < .001$). After complexity conditions were reversed on Days 13-18, the animal's preference behavior subsequently reversed ($\chi^2 = 7.36$, $df = 1$, $p < .01$).

DISCUSSION

The present experiment demonstrates that complexity can serve as an incentive for food-deprived animals. The selection situation offered here provided the animals an alternative response, i.e., to choose the food alley, but instead they frequently chose the complexity alley. This frequency increased when the complexity of the stimuli was high and decreased with a corresponding decrease in complexity.

Finer analysis of the choice data reveals findings which offer additional support for the incentive value of complexity. The early choice behavior for the highly complex stimuli of the Hi-Lo Ss was low, but slowly evolved into a preference for the complexity goal. This behavior is consistent with hypotheses (e.g., Welker, 1957; Lester, 1969) that propose that the initial response to a highly "novel" object is fear that gives way to exploration after a short period of exposure. The present results suggest a related conclusion. The highly complex stimuli serve originally as a low incentive (possibly even as a negative incentive) which gradually becomes a high positive incentive capable of competing with food for hungry rats.

A final demonstration of the incentive value of complexity occurs when the complexity conditions were reversed. Almost immediately there is a corresponding reversal in the choice performance of the animals. These results indicate that the response to complexity is not escape, but that complexity can serve as a positive incentive for hungry rats.

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