The effects of differential early rearing upon discrimination learning in monkeys^{1,2}

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Behavioral discrimination tests were performed on 14-16 month-old male rhesus monkeys, reared from the age of 2 to 4 months under four different conditions of perceptual and social enrichment. Results show no differences between any of the groups in the learning of a discrimination task, consisting of a two-dimensional four-choice match-to-sample problem, similar in make-up to the PATA-K, used by Strong (1965).

Differential early rearing has been shown in a number of studies to be an important independent variable. Among others, differences among differentially reared animals have included those in performance of discrimination tasks. Studies by Krech, Rosenzweig, & Bennett (1962) and by Hymovitch (1952) showed that animals reared in the more "enriched" environments performed better on a variety of problems. Reynolds (1963) found that rats reared in isolation exhibited a significantly poorer discrimination than rats reared with social companions. A change to a social environment improved the performance of the formerly isolated Ss. But a change to an isolated environment did not affect the performance of the socially reared animals. Stern, Winokur, Eisenstein, Taylor, & Sly (1960) determined that animals reared in groups explored more and were less "fearful" than animals reared in isolation.

The study reported here sought to determine the effects of differential early rearing upon the learning of a two-dimensional, four-choice match-to-sample task in rhesus monkeys.

Subjects

Twenty-four male rhesus monkeys (*Macaca mulatta*), varying in age from 2 to 4 months at the time of arrival from their natural habitats, were used as Ss. The animals were randomly assigned to one of the four following conditions. (1) Strict Isolation: Ss were housed individually; visual and tactual contact with other animals was not permitted; N=6. (2) Partial Isolation: Ss were housed individually; visual and moderate tactual contact were permitted; N=6. (3) Social Environment: Ss were housed in pairs; visual and tactual contact between cages was also permitted; N=6. (4) Enriched Social Environment: Ss were housed in pairs; in addition, play objects were available in the cages. Colored panels and rotating colored lights were affixed to the walls surrounding the cages; N=6. All animals were provided fresh fruit and a balanced biscuit diet twice daily. Animals used in the positive reinforcement task were reduced to 90 percent

of their normal body weights and maintained at that level for the duration of the experiment.

Apparatus

The test apparatus consisted of a performance cage, 24 x 36 x 36 in. high. Four plastic pushbuttons were arranged horizontally and mounted flush in an opaque plastic performance panel. Four in. above the top line formed by the pushbuttons, a sample inline digital display unit (IDD) projected symbols through a clear space in the performance panel. For the negatively reinforced Ss, the bottom grid and the sides of the apparatus could be electrified. The apparatus was fully automatic.

Procedure

Half of the animals in each group were assigned to a match-to-sample task involving positive reinforcement, and half of them to the same task involving negative reinforcement (avoidance). The experimental contingencies were programmed as follows: A 2-sec 1000-cps tone signalled onset of each discrete trial; at the end of the tone, the sample IDD and the pushbutton IDDs presented various combinations of four symbols: □, △, ○, and +. Under the negative condition, the animals received shock if they did not match the sample IDD by pushing the appropriate button within 3 sec. The shock was adjusted for the individual S (2 to 12 mA range), lasted for 0.5 sec, and was administered with a 3-sec shock-shock interval. Under the positive condition, a correct match was reinforced by a 0.3-g banana pellet. Intertrial intervals were 15 sec for the negatively and 5 sec for the positively reinforced Ss. All animals were given approach training until they had learned to depress the pushbuttons, and then they received 50 trials per day for a period of three months, excepting weekends.

Because of the inherent difficulty of a four-choice, two-dimensional match-to-sample task for rhesus monkeys, the experimental contingencies were presented sequentially as follows: After approach training, the brightness of the sample IDD and the corresponding correct response button were kept at 100 percent. The brightness of the incorrect buttons was increased from 0 to 100 percent in 10 phases. An animal was permitted to progress from one phase to the next when it responded correctly on 90 percent of the 50 daily trials.

Results

All of the animals were given about 3000 trials. The raw data consisted of (1) average latencies for

each trial, (2) levels of discrimination reached by each animal after 1000, 2000, and 3000 trials, expressed as number of phases, and (3) average number of trials per phase. The data were analyzed separately for positively and negatively reinforced Ss. None of the group differences, using the Mann-Whitney U test, suggested by Siegel (1956), were statistically significant. A comparison of differences between the positively and negatively reinforced Ss also failed to reach statistical significance, although the performance of the positively reinforced Ss was slightly better than that of the negatively reinforced Ss.

Discussion

The failure to obtain significant differences in the learning of a discrimination task in monkeys reared differentially may be due to the fact that, indeed, such differences do not exist. It may very well be that specific types of effects, such as social isolation, are apparent only in later social behavior, particularly in primates, such as were used here. From observations via closed-circuit TV, it was readily apparent that differences in social behavior existed between our groups. Technically speaking, there was ample opportunity for differential learning abilities to be demonstrated by the various groups of Ss. The experiment described here has been continued beyond its original scope. Even at this date, some 6000 trials later, no differential learning ability is apparent. From these observations it may be tentatively concluded that simple discrimination learning capabilities of primates appear to be less subject to the effects

of differential early social experience than those of lower organisms, as reported by Hymovitch (1952), Krech, Rosenzweig, & Bennett (1962), and Reynolds (1963). All of these investigators used rats as Ss.

If these results are considered from the viewpoint of greater central nervous system plasticity in primates, it is evident that such plasticity favors the primate Ss reared in the more "impoverished" conditions.

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Notes

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2. A more detailed report is available from the authors upon request.