Effects of early visual conditions on stimulation-seeking behavior in young rhesus monkeys, II

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Responding for complex visual stimuli in rhesus monkeys reared under different early visual conditions showed persisting effects of early rearing conditions at later ages. Animals reared for a period after birth without pattern vision showed less stimulation seeking than did a monkey reared with unrestricted access to perceptual stimuli. Limited enrichment provided by a 10-min daily exposure to a laboratory environment of an otherwise visual pattern-restricted animal also appeared to elevate the monkey's stimulation-seeking behavior. Type of stimuli affected rate of responding in all but the younger animals in the restricted group.

Previous research with animals reared with differential early perceptual experience was concerned with the effects of early impoverishment of stimulation upon the reinforcing properties of variation in the environment (Levison et al, 1968). It was found that animals reared in an impoverished visual environment did not show increased stimulation seeking in subsequent periods of perceptual deprivation, whereas animals reared with continuous access to complex visual stimuli showed enhanced stimulation seeking in subsequent periods of perceptual deprivation.

It has been assumed that the consequences of short-term early deprivation (3 months or less) are relatively short lived in terms of effects on later behavior (cf. Griffin & Harlow, 1966). However, social and learning behaviors have principally been studied. Consequently, three of the animals described in the earlier study (Levison et al, 1968) were retested at later ages. In addition, a second group of younger animals reared under similar restriction conditions was added to represent a second age level. A third rearing condition was added, limited exposure to pattern vision, to evaluate whether a limited amount of early pattern experience would affect later stimulation seeking.

SUBJECTS AND REARING CONDITIONS

The Ss were seven male rhesus monkeys in two distinct age groups.

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(Pr, Al, Gol, Pi) 14 months in age. All animals were separated from their mothers within 15 h of birth. Each animal was reared from its first day in a mother surrogate chair, which functionally approximates many of the features of the natural mother monkey (Held & Bauer, 1966; Levison et al, 1968).

Older Group (Group 1)

Fa was reared with unrestricted visual access to the laboratory environment. Is and Hap were reared with restricted access to patterned vision until 139 and 155 days of age, respectively. Restriction was achieved by enclosing the heads of the animals in a translucent chamber containing only a milk bottle. The early rearing histories of these animals have been described elsewhere (Levison et al, 1968).

Younger Group (Group 2)

Al, Gol, and Pi were reared similarly to Is and Hap, with restricted access to patterned vision, until a mean age of 61 days. Pr was reared in a "limited exposure" condition to the same age;

At the beginning of this experiment, the older group (Fa, Is, Hap) averaged 23 months in age, the younger group

Fig. 1. Mean number of visual reinforcements received during a 1-h stimulation-availability period for individual Ss in the older age group (Group 1).

Fig. 2. Mean number of visual reinforcements received during a 1-h stimulation-availability period for individual Ss in the younger age group (Group 2).

he was reared similarly to the restricted-access animals, except that he received 10 min daily of unrestricted viewing of the laboratory.

All Ss (both groups) had prior experience with leverpressing for visual stimulation during the first 3 to 5 months of life. Two other animals, one in the "unrestricted-access" condition and one in the "limited-exposure" condition did not survive to the time of this experiment.

After removal from the chair, all animals were housed individually in cages, except for two of the restricted animals who were housed together for a short time until a cage became available. During this time they were both incompetent motorically and usually were huddled together with each other. The monkeys could see and hear each other, since they were always housed in the same room, but could not interact physically.

PROCEDURE

The monkeys were tested for stimulation seeking in their individual home cages in the colony room. A

portable projection system, including a screen, a motor-driven shutter, and an automatic projector mounted on a platform approximately at eye level for the seated monkey, were used. The screen was mounted in a tunnel which prevented unauthorized viewing by other monkeys. The monkeys could, however, hear each other during test trials and were also able to see those animals in their field of vision. Stimuli were projected from the rear of the screen. The lever was permanently mounted on the cage front adjacent to the viewing area. The tests were programmed and recorded by automatic equipment located in a separate room. No one was permitted in the colony room during the test sessions.

Slide presentation was contingent upon a single leverpress for all conditions. Each presentation was of 10 sec duration. The projector advanced to the next slide at the offset of each stimulus. The animals were tested 1 h daily except for weekends. Prior to formal testing, each monkey

was adapted to the experimental procedures by successive exposure to (1) the apparatus, (2) operation of the shutter exposing a darkened screen contingent upon a leverpress, and (3) operation of the shutter exposing slides (a 4 by 4 checkerboard or a triangle) contingent upon a leverpress. Adaptation required a mean of four daily sessions for the younger group and three for the older group. The animal was considered adapted when he did not become excessively active motorically and vocally under the test conditions.

The experiment included three successive phases represented by three sets of 80 slides each. Set 1 was composed of simple geometric shapes, such as squares, circles, triangles, and checkerboards; Set 2 consisted of complex visual stimuli (examples: landscapes, flowers, and still lifes); and Set 3 consisted of complex stimuli similar to those in Set 2, but also including representations of human figures and 11 "nonthreatening" photographs of nonhuman primates. The mean number of days the older group received each set of slides were: Set 1, 30 days; Set 2, 17 days; Set 3, 11 days. The mean number of days the younger group received each set of slides were: Set 1, 16.5 days; Set 2, 7.7 days; and Set 3, 4.5 days. For comparability, data are presented for each animal for the first 16 days for Set 1, the first 7 days for Set 2, and the first 4 days for Set 3.

RESULTS AND DISCUSSION

The results are presented in Figs. 1 and 2. In Group 1, Fa, the monkey reared without early visual restriction showed higher overall stimulation seeking than did Hap or Is, the early-restricted animals, although Hap's performance for Set 3 slides was high relative to most of the Ss. Fa's low rate in Set 1 is probably a consequence of several recent cage transfers to which he was subjected. All of the Group 1 monkeys showed marked increases in responding for Set 3 slides compared to their own Set 1 and Set 2 performances. In Group 2, Pr, the monkey with an earlier history of brief limited exposures of unrestricted access to the visual environment showed higher overall performance levels than did Pi, Gol, and Al (all reared with early restricted access to pattern vision) on Set 3.

The results for both groups of monkeys support our previous findings (Levison et al, 1968) and extend them well into the juvenile period. The principal finding is that monkeys reared with restricted access to patterned visual stimulation in the period immediately after birth show

relatively less tendency to seek out novel visual stimuli than do monkeys with more pattern experience in the same rearing period. Also, Pr, the limited exposure S, was more responsive in general than all of the animals except Fa and, in particular, was more responsive to the Set 3 stimuli than were the older animals, Is and Hap. Both Fa (except for Set 1) and Pr also showed response decrements with repeated viewings of the stimulus sets, in contrast to the irregularity in the curves of the other animals.

None of the younger group except Pr showed increased responsiveness to Set 3 slides, which included pictures of human and nonhuman primates. These results appear to qualify the findings reported by Sackett (1966), who found that pictures of infant monkeys seem to have an unlearned preponent activating property for socially naive infant monkeys. It would appear that characteristics of the early postnatal rearing environment may contribute to subsequent interest in social stimuli in young monkeys.

It is of particular interest that a brief daily exposure to patterned stimulation during the early rearing

period may compensate for total restriction the rest of the time, as Pr's data suggests. Also, among the early restricted Ss, the older animals show a relatively greater interest in pictures of human and nonhuman animate Ss compared to other patterns. This may be related to relatively advanced sexual maturity in this group. However, Pr's data suggest that early experience is also a factor in the preference. This difference between the age groups also tends to indicate that preference for Set 3 slides was not an order effect.

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A further investigation of familiarization effects on ECS-produced retrograde amnesia*

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The effectiveness of a single posttrial electroconvulsive shock (ECS) in producing retrograde amnesia (RA) of a one-trial passive avoidance response for rats given three trials of 0, 5, 10, 15, 20, or 37.5 sec familiarized (FAM) with the apparatus prior to training was investigated. The results indicate that FAM of up to 37.5 sec duration does not significantly affect ECS-produced RA, all FAM-ECS groups having shorter latencies than the corresponding pseudo-ECS control groups.

According to Lewis, Miller, & Misanin (1968), the emphasis on retrieval rather than storage processes makes the consolidation hypothesis too inflexible to account for the variability of memory storage, especially for recent past events which are not affected by electroconvulsive shock (ECS). In order to investigate the storage phase of memory, Lewis et al employed a one-trial passive

avoidance task and investigated the effects of familiarization (FAM) of the apparatus prior to training on ECS-produced retrograde amnesia (RA). Their results indicated that FAM trials of 37.5-sec duration or longer protected the Ss from RA, whereas Ss receiving FAM trials of 5-sec duration exhibited RA. No duration between 5 and 37.5 sec was investigated.

Of particular theoretical importance is the interval between 5 and 37.5 sec of FAM. If, as Lewis et al suggest, the FAM memory system is a functional system then it should exhibit some of the characteristic time properties of other memory systems. It should be possible to show an increasing FAM effect on ECS-produced RA between time intervals of 5 and 37.5 sec. The

purpose of the present experiment was to investigate the FAM effect on ECS-produced RA between the time intervals of 5 and 37.5 sec.

SUBJECTS

The Ss were 120 female albino rats from Sprague-Dawley, Madison, Wisconsin, approximately 70 days of age. The Ss were housed five to a cage with ad lib food and water.

APPARATUS

The apparatus, a conventional step-down box constructed of plywood, was 16½ in. square and 16 in. high, painted flat gray. A 3½-in.-square Plexiglas platform was centered 3 in. above a grid floor constructed of 3/16-in. brass rods, ½ in. center to center. The grid floor could be charged for 5 sec with 1.6-mA shock from an Applegate constant-current stimulator (Model 250) through a Grason-Stadler scrambler (Model E-1064-GSP). The footshock (FS), ECS, and FAM durations were timed by Hunter decade interval timers. The ECS, 0.5 sec, 40 mA, was administered through alligator earclip electrodes, which were wrapped in surgical gauze and soaked in saline solution.

PROCEDURE

The Ss were assigned randomly to six experimental and six control groups of 10 Ss each. Groups E-0, E-5, E-10, E-15, E-20, and E-37.5 were designated experimental groups and on Day 1 all experimental Ss, except Group E-0, were given three FAM trials of 5, 10, 15, 20, or 37.5 sec duration each at hourly intervals. These trials consisted of placing the S on the platform of the apparatus and allowing it to step down and explore the apparatus for the appropriate amount of time, after which S was removed to the home cage. Groups C-0, C-5, C-10, C-15, C-20, and C-37.5 were designated control groups for their corresponding experimental groups and were treated in the same manner as their experimental counterparts. No FS or ECS was presented during FAM trials.

The training trial occurred on Day 1, 1 h after the third FAM trial. Upon stepping down from the platform, the experimental Ss (all groups) received a 5-sec FS immediately followed by ECS. The control Ss were treated in the same manner except that they received no ECS.

On Days 2-4 all Ss (experimental and control) were given a single retention test trial. Any S remaining on the platform for more than 180 sec was removed and the trial terminated. All Ss were fitted with earclip electrodes on all trials and step-down latencies (SDLs) were recorded on each trial for the 4 days.

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