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.

REFERENCES

- LEVISON, C. A., LEVISON, P. K., & NORTON, H. P. Effects of early visual conditions on stimulation-seeking behavior in infant rhesus monkeys. *Psychonomic Science*, 1968, 11, 101-102.
- GRIFFIN, G. A., & HARLOW, H. F. Effects of three months of total social deprivation on social adjustment and learning in the rhesus monkey. *Child Development*, 1966, 37, 533-547.
- HELD, R., & BAUER, J. A., JR. Visually guided reaching in infant monkeys after restricted rearing. *Science*, 1967, 155, 718-720.
- SACKETT, G. P. Monkeys reared in isolation with pictures as visual input: Evidence for an innate releasing mechanism. *Science*, 1966, 154, 1468-1493.

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

RICHARD A. GALOSY† and RICHARD W. THOMPSON
Western Washington State College, Bellingham, Wash. 98225

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.

*This paper is based upon a Master's thesis submitted to the Graduate School of Western Washington State College. The authors wish to thank Drs. Louis Lippman and B. L. Kintz for their helpful comments.

†Requests for reprints should be sent to Richard A. Galosy, Behavioral Sciences, Hostos Community College of the City University of New York, 260 East 161 Street, Bronx, New York 10451.

Table 1
Mean Reciprocal SDL (1/SDL) Across Days for Each FAM Group and Condition

FAM	Condition	Days			
		1	2	3	4
0	E	.7043	1.2008	1.4300	.5739
	C	.6526	.2085	.2405	.1184
5	E	1.3813	1.0472	.6953	.4715
	C	1.3796	.6705	.0961	.1441
10	E	1.2121	1.2499	.4281	.2770
	C	1.3064	.2691	.1119	.0457
15	E	1.2495	.7583	.3394	.2267
	C	1.1002	.1400	.0677	.1123
20	E	1.6075	1.2054	.4491	.6841
	C	1.6476	.4042	.0565	.1016
37.5	E	.8449	.5610	.0814	.2142
	C	1.0001	.0935	.0700	.0430

RESULTS

The SDLs for each trial for each S were transformed to reciprocals (1/latency) for analysis. A summary of the results is presented in Table 1. To assess acquisition, an analysis of variance was performed using the data from Days 1 and 2 only. The analysis resulted in a significant ECS effect ($F = 6.091$, $df = 1/108$, $p < .05$), days effect ($F = 30.84$, $df = 1/108$, $p < .05$), and ECS by Days interaction ($F = 14.625$, $df = 1/108$, $p < .05$). Subsequent analysis of the interaction by t test indicated that experimental and control groups did not differ on Day 1 ($p > .05$) but did on Day 2 ($t = 2.99$, $df = 108$, $p < .05$). There was no difference between Days 1 and 2 for experimental Ss ($p > .05$), but Day 1 to Day 2 difference was significant for the control Ss ($t = 8.77$,

$df = 108$, $p < .05$). There was no effect for FAM, nor did it interact with other variables in the analysis. Mean reciprocal SDL for all days for the experimental and control Ss shown in the ECS by Days interaction are presented in Fig. 1.

To investigate retention, an analysis of variance was performed using data from Days 2 through 4 only. The analysis resulted in a significant ECS effect ($F = 27.98$, $df = 1/108$, $p < .05$), days effect ($F = 17.35$, $df = 2/216$, $p < .05$), and ECS by Days interaction ($F = 3.85$, $df = 2/216$, $p < .05$). The interaction is presented in Fig. 1.

Subsequent analysis of this interaction by analysis of variance indicated no change for control Ss from Day 2 to Day 4 ($p > .05$) but a significant decrease in mean reciprocal SDL from Day 2 to Day 4 for experimental Ss ($F = 4.03$, $df = 2/18$, $p < .05$). The decrease in experimental reciprocal SDLs resulted in no differences between experimental and control groups on Day 4 ($p > .05$). There was no significant effect of FAM and it did not interact with other variables in this analysis.

DISCUSSION

Lewis, Miller, & Misanin (1968, 1969) have suggested that the FAM procedure elaborates a functional memory system which attenuates the RA effect of a single posttrial ECS. The results of the present experiment suggest that FAM does not influence ECS-produced RA if the FAM duration is 37.5 sec or less, a finding contrary to those of Lewis et al (1968).

A consistent finding in ECS experiments is that the more RA is produced the sooner the ECS is given after training (Chorover & Schiller, 1965; McGaugh, 1966). This finding is consistent with hypotheses that memory formation develops over time, a process which has been described as consolidation (McGaugh, 1966). The

FAM procedure investigated in the present study had none of the characteristics which have been found to be part of other memory systems.

It is possible that the 37.5-sec FAM was not of sufficient duration to allow FAM to have an effect; however, even if this were the case, FAM should have shown some trend which indicated that it was in a developing stage. No such evidence was found in the present experiment.

Lewis et al (1968) did not investigate the retention of the response. However, previous studies that have investigated the effect of ECS on the long-term retention of a one-trial passive avoidance response have generally found that as the retention interval increases the Ss given ECS begin to perform more like Ss not given ECS. Several retention intervals have been investigated and the results range from a few days (Zinkin & Miller, 1967; Riddell, 1969; Thompson, Enter, & Russell, 1967) to several weeks (Luttges & McGaugh, 1967; King & Glasser, 1969). The results of the present study are consistent with the general trend of retention which has been reported in these previous studies. This may be taken as additional evidence that the ECS treatment in the present study did produce behavior similar to that reported in previous experiments which have not employed the FAM procedure and supports the conclusion that FAM durations of 37.5 sec or less do not affect ECS-produced RA.

REFERENCES

- CHOROVER, S. L., & SCHILLER, P. H. Short-term retrograde amnesia in rats. *Journal of Comparative & Physiological Psychology*, 1965, 59, 73-78.
- KING, R. A., & GLASSER, R. L. Permanence of ECS induced retrograde amnesia. Paper presented at Western Psychological Association, Vancouver, B.C., 1969.
- LEWIS, D. J., MILLER, R. R., & MISANIN, J. R. Control of retrograde amnesia. *Journal of Comparative & Physiological Psychology*, 1968, 66, 48-52.
- LEWIS, D. J., MILLER, R. R., & MISANIN, J. R. Selective amnesia in rats produced by electroconvulsive shock. *Journal of Comparative & Physiological Psychology*, 1969, 69, 136-140.
- LUTTGES, M. W., & MCGAUGH, J. L. Permanence of retrograde amnesia produced by electroconvulsive shock. *Science*, 1967, 156, 408-410.
- MCGAUGH, J. L. Time-dependent processes in memory storage. *Science*, 1966, 153, 1351-1358.
- RIDDELL, W. I. Effect of electroconvulsive shock: Permanence or temporary retrograde amnesia. *Journal of Comparative & Physiological Psychology*, 1969, 67, 140-144.
- THOMPSON, R. W., ENTER, R., & RUSSELL, N. Effect of electroconvulsive shock (ECS) on retention of a passive avoidance in rats. *Psychological Reports*, 1967, 21, 150-152.
- ZINKIN, S., & MILLER, A. J. Recovery of memory after amnesia induced by electroconvulsive shock. *Science*, 1967, 155, 102-103.

Fig. 1. Mean reciprocal SDL (1/SDL) for Days 1-4 for experimental and control groups combined over familiarization periods; the ECS by Days interactions.