



LOCATION OF MAXIMAL "KAMIN EFFECT"
WITH RATS

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LOCATION OF MAXIMAL "KAMIN EFFECT" WITH RATS

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INTRODUCTION

Leon J. Kamin was the first to use experimental methods to determine the retention of an avoidance response over short periods of time. He expected to find within the field of conditioning the equivalent of the Ebbinghaus curve of retention. Possibly, if original learning were to be interrupted before response strength had approached a maximal value, partial retention and a retention curve could be demonstrated (Kamin, 1957). What he found was surprisingly divergent from what one would expect if he were to refer to the classical forgetting curve of Ebbinghaus. The degree of transfer from original learning to relearning was a curvilinear function of the retention interval. The amount of retention declined from 0 hr. to 1 hr., then rose from 1 hr. to 19 days. These changes were statistically significant. Other investigators, Denny (1959) and Thomas (1960), have verified the existence of this phenomenon which Denny refers to as the 'Kamin effect'.

The purpose of the present study was to determine the low point or 'trough' in this function. The time intervals used in this study were 0 hr., .5 hr., .75 hr., 1 hr., 1.25 hr., and 1.5 hr. Some experimentation which will be described later was also done with the length of the intertrial interval.

METHOD

Apparatus:

The apparatus was a modified shuttlebox, see Figures 1 and 2. The US was electric shock, with a maximum current flow of 1.7 ma. supplied by a C. J. Applegate Stimulator, Model 228. The CS was an approximately 70-db. buzzer mounted on the outside of the box.

Subjects:

The Ss were 70 naive hooded and grey recessive rats of both sexes, ranging in age from 150 days to 200 days and maintained on an ad lib. feeding schedule. There was approximately an equal number of each sex in each group of 10 animals, one group for each time interval.

Procedure:

The experiment was divided into three basic parts: a learning period, a delay period, and a relearning period.

The learning period was standard avoidance training, with each trial ending either in escape or avoidance. The CS-US interval was 5 sec., and both the CS and US were response-terminated. There were 25 original learning trials in a single session, beginning after a one minute adaptation period. The intertrial interval was 60 sec.

The delay period, or time between learning and relearning, was a different duration for each of the six groups. The groups or periods were 0 hr., .5 hr., .75 hr., 1 hr., 1.25 hr., and 1.5 hr. The animals were placed in their home cages with their cage mates immediately after the learning. The cages were in an adjacent room where the buzzer could not be heard.

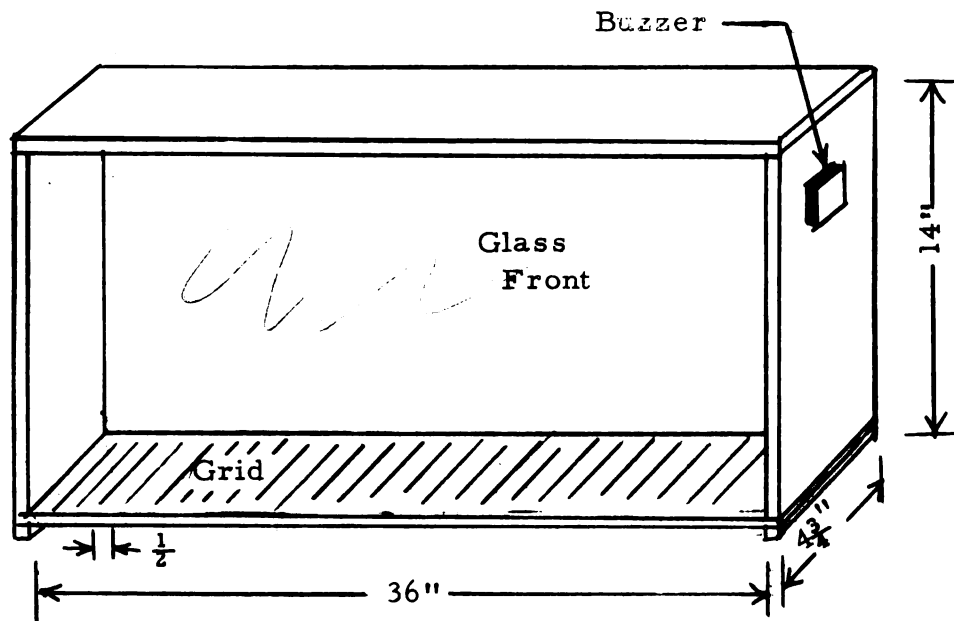


Figure 1. Shuttlebox Apparatus

The relearning period was initiated at the termination of the delay period after a one minute adaptation period. The relearning period consisted of 25 trials presented in the same way as in the learning period. The number of avoidances was noted in the learning and re-learning periods as were exceptionally long latencies (the length of time that it took the animal to reach the safe side of the box after the onset of the US), as well as certain outward signs of anxiety such as tail-raising, urination, and defecation.

The seventh group of ten animals, half males and half females, was run under the procedure described for a delay period of one hour, except in this case the intertrial interval was thirty seconds instead of one minute.

RESULTS

An analysis of variance of the means obtained in the initial learning period yielded an F of .144 which does not reach statistical significance. For the present purposes the Ss may be assumed to be members of a homogeneous population.

The basic relearning data are presented in the uppermost curve of Figure 3. The similarity between the Kamin data and the present data is striking despite differences in delay intervals used. In both cases the low point in the curve is at the 1 hr. interval level. In the present study the rise in performance following the delay period may be seen as early as the 1.25 hr. interval period. In the Kamin study the closest following interval was 6 hrs. which also showed the rise in performance. The lower two curves in Figure 3 constitute another way of presenting the data, i. e., a comparison of the last 10 trials of original learning with the first 10 trials of relearning. These data show that all groups are fairly well matched near the end of original learning and suggest that the 'Kamin effect' occurs in approximately the first 10 trials of the relearning period. The shape of the 10-trial relearning curve is very similar to the 25-trial curve. The means and variances for the groups for both sessions are presented in Table I.

Significant differences were found between the .75 hr. group and the 1 hr. group ($t = 2.46$) and the 1.5 hr. group and the 1 hr. group ($t = 2.98$) at the .05 and .01 levels, respectively. Thus the minimum was found to be between .75 hr. and 1.5 hr., with the lowest point in the curve, representing maximal 'Kamin effect', presumably at the 1 hr. interval.

The 30 sec. intertrial interval group provide data which are mainly suggestive because of being run separately. However, they did learn

Figure 3. Curve for relearning trials showing 'Kamin effect'.

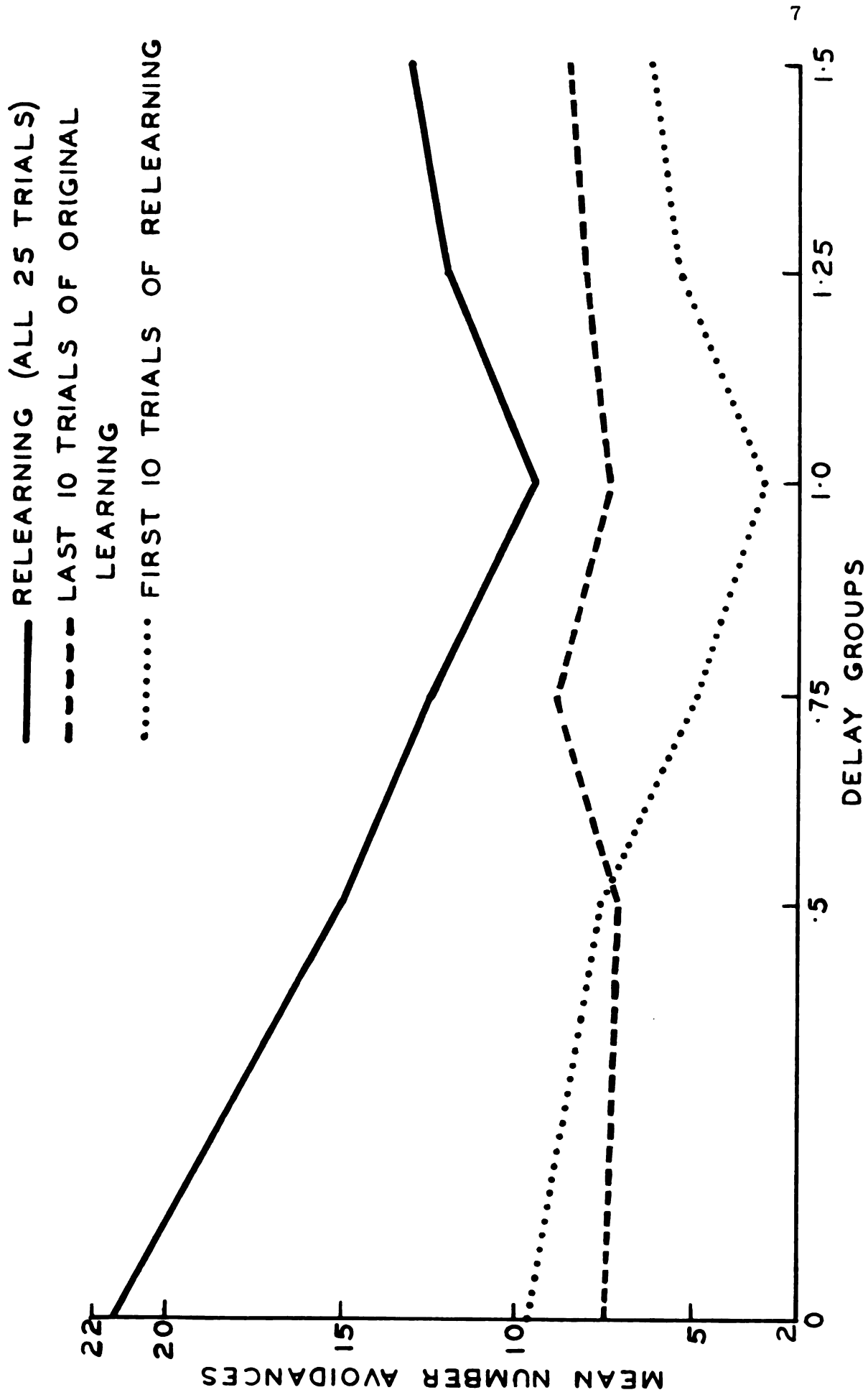


TABLE I

MEANS AND VARIANCES OF AVOIDANCE RESPONSES

Delay Interval in Hours	Mean Number Avoidances for 1st Set of Trials	Mean Number Avoidances for 2nd Set of Trials	Mean Number Avoidances in Last 10 Trials of 1st Session	Mean Number Avoidances in First 10 Trials of 2nd Session	Difference Between 1st and 2nd Sets	Variance for First Session	Variance for Second Session
.0	12.1	21.6	7.3	9.7	9.5	2.51	2.28
.5	11.4	15.0	7.1	7.7	3.6	2.15	2.76
.75	12.9	12.6	8.9	4.9	-.3	2.16	2.37
1.0	11.7	9.6	7.4	3.0	-2.1	2.57	2.81
1.25	12.2	12.1	8.1	5.3	-.1	3.57	2.02
1.5	12.8	13.2	8.4	6.2	1.6	2.23	2.36

less well initially and showed practically no 'Kamin effect' one hour later. The 60 sec. groups made an average of 12.18 avoidances in the initial learning trials while the 30 sec. group made only 6.7. This difference is statistically significant at the .01 level of significance ($t = 3.43$). An average of 12.8 avoidances were made by the 30 sec. group in the relearning trials 1 hr. later compared to 9.6 avoidances for the 60 sec. group. This difference is statistically significant at the .05 level of significance ($t = 2.7$).

In the 30 sec. group in the original learning period the males made a mean of only 4.4 avoidances while the females made a mean of 9.2 avoidances. Apparently females tend not to freeze or make incompatible responses in a high ceiling box and thus their performance does not suffer from the greater anxiety level of massed trials. This apparent sex difference was not found in the groups where the intertrial interval was one minute. However, these findings are compatible with the fact that Denny (1958) failed to find a 'Kamin effect' in females in a high ceiling box with a low shock level.

DISCUSSION

It was found that retention of the avoidance response declined significantly from 0 hr. to 1 hr. and then rose significantly from 1 hr. to 1.5 hr. The 'trough' was found to be between the .75 hr. and the 1.5 hr. intervals, with the lowest point in the curve, for all practical purposes, at the 1 hr. interval level.

In an attempt to interpret his data Kamin postulated two underlying processes, one for each segment of the curve. He attributed the first segment, extending from zero interval to 1 hr., to forgetting. The second segment which extended from 1 hr. to 19 days, including 1 hr., 6 hr., 24 hr. and 19 day intervals, was interpreted as representing an incubation effect, a jelling of the avoidance habit following the initial decrement in retention.

An alternative explanation is quoted below from Thomas (1960).

Denny (1958) reinterpreted Kamin's V-shaped curve in terms of the incubation of anxiety rather than the incubation of an avoidance habit. According to this interpretation, anxiety initially builds up in the interval immediately following the original learning trials to a point where it interferes with the act of shuttling. As observed by Denny, animals when tested one hour later, typically freeze in a second session, and this behavior is incompatible with shuttling. Following a delay of approximately an hour the anxiety begins to dissipate and retention of the avoidance response is clearly apparent after 24 hours. From this point of view, it was predicted that if the anxiety could be kept from building up, the S would no longer show a decrement in performance following an hour delay.

By using counter conditioning, allowing the previously starved animal to eat in his home cage after original learning, and desensitization, leaving the animal in the apparatus during the delay period, Denny was able to inhibit the growth of anxiety during the one hour delay interval. Thus his hypothesis was supported.

Work is being done at the present time at Michigan State University using tranquilizers and chemical decortification in an attempt to block out the 'Kamin effect'. The writer did some preliminary investigation with the use of Stelazine and meprobamate in an attempt to reduce or inhibit the growth of anxiety during the one hour delay period between learning and relearning trials. Anxiety, as measured by the phenomenon of tail-raising, etc., was inhibited using Stelazine in small dosages (.05 mg. to .5 mg. of drug per kg. of animal body weight). In doing this, however, the CR was also inhibited. These results are similar to those reported by Cook and Weidley (1956). It was thought that by the manipulation of dosages of this drug it would be possible both to block the anxiety reaction (fear) and retain the conditioned response. The writer was not able to do this; although, he does admit its possibility.

Thomas (1960) found that he could experimentally manipulate the effects of avoidance learning by varying the dimensions of the shuttlebox. Animals apparently learn less rapidly and exhibit less 'Kamin effect' in a shuttlebox with a low ceiling than they do in the same box with a high ceiling. The present study took advantage of this and used the high ceiling, long runway dimensions to obtain maximal 'Kamin effect'.

Based on his own observations of the animals' behavior the present writer presents the following extension to Denny's interpretation. Let us assume a response generalization factor that is compatible with modern learning theory (Mednick, 1958). If the anxiety builds to a maximum after an hour delay, the total drive state during relearning trials will be the resting level plus the remaining anxiety from the learning trials. Since the total drive level will be greater in the relearning trials, the stimulus (both CS and US) should elicit an augmented anxiety response, which in this case takes the form of freezing, jumping, swaying, and

bounding about. This greater generalization of response caused by increased anxiety will tend to interfere with the specific, partially learned shuttling response.

This same explanation can be used to account for the fact that the thirty-second group learns less well initially and shows practically no "Kamin effect" one hour later. Apparently, thirty seconds does not allow for dissipation of anxiety and consequently the animals make significantly fewer correct responses due to the generalization factor mentioned above. Also since the Ss are so anxious during the learning trials, again as measured by tail-raising, defecation, and urination, they can only become less anxious an hour later by comparison.

SUMMARY

The present study was conducted to determine as precisely as possible the low point or minimum in the retention of an instrumental avoidance response (maximal 'Kamin effect'). Seventy hooded and grey recessive rats, approximately half females and half males, were divided into groups of ten each. Six groups were given 25 shuttlebox trials (the learning period), returned to their home cages with their cage mates (the delay period), and then given 25 more shuttlebox trials (the relearning period). The delay intervals used (delay period) were 0 hr., .5 hr., .75 hr., 1 hr., 1.25 hr. and 1.5 hr. The US was electric shock, the CS was an approximately 70-db buzzer, the CS-US interval was 5 sec. and the intertrial interval was 60 sec. The number of avoidances was noted in each case.

It was found that the retention of the avoidance response declined significantly from 0 hr. to 1 hr. and then rose significantly from 1 hr. to 1.5 hr. The minimum was found for all practical purposes to be between the .75 hr. interval and the 1.5 hr. interval, with the lowest point in the curve, representing maximal 'Kamin effect', presumably at the 1 hr. interval. A possible explanation of the 'Kamin effect' was presented.

Another group of ten animals, half males and half females, was run under the procedure described for a delay period of one hour, except that the intertrial interval was thirty seconds instead of one minute. This group learned less well in the original trials and showed no 'Kamin effect' during relearning.

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