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Digit series and response lists in learning of extraverts and introverts

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DIGIT SERIES AND RESPONSE LISTS IN LEARNING OF EXTRAVERTS AND INTROVERTS.

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CHAPTER I

Introduction

Recently there has been an emphasis and upsurge in the literature relating personality differences and their effects on learning tasks. This contemporary trend has been enhanced by recent research efforts of physiological psychologists and neurophysiologists who have provided data about arousal and consolidation of memory traces. Also, recent short term memory studies have provided personality researchers with a method to investigate immediate reproduction of stimulus materials, and to measure the rate of forgetting materials (i. e. the fading or decaying of a neural trace).

Deutsch (1967) states that the concept of memory trace assumes that the perception of a stimulus leaves a distinct neural aftereffect or trace. Immediately after the exposure, the trace begins to fade and will decay gradually unless it is restored by repetition of the stimulus or by rehearsal.

A dual-trace consolidation theory was proposed by Hebb (1949). His theory postulates that "when an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased." Thus a transient reverberatory trace of a sensory message is preserved through the consolidation process in which a

permanent structural change gradually takes place.

Walker (1958) presented a theory of arousal and trace consolidation which maintains that in learning situations under conditions of low arousal a typical forgetting pattern results. The immediate recall is excellent but the recall ability decreases rapidly with time. High arousal learning, on the other hand, shows a marked reminiscence effect: poor immediate recall but strong permanent memory. The poor immediate recall for high arousal learning is accounted for on the basis of the assumption of the relative unavailability of an actively consolidation neural trace. In addition it was predicted that the greater consolidation of high arousal learning also results in stronger permanent memory. Several investigators (Kleinsmith and Kaplan, 1963, 1964; Kleinsmith, Kaplan and Tarte, 1963; Walker and Tarte, 1963) have demonstrated this predicted relationship between arousal and learning. Their studies provide evidence which shows that arousal is a critical variable in the retention of verbal material. Their results have been interpreted as supporting Walker's theory of consolidation of neural traces.
In addition it was predicted that the greater consolidation of high arousal learning also results in stronger permanent memory. Several investigators (Kleinsmith and Kaplan, 1963, 1964; Kleinsmith, Kaplan and Tarte, 1963; Walker and Tarte, 1963) have demonstrated this predicted relationship between arousal and learning. Their studies provide evidence which shows that arousal is a critical variable in the retention of verbal material. Their results have been interpreted as supporting Walker's theory of consolidation of neural traces. The poor immediate recall for high arousal learning is accounted for by

making the assumption that actively consolidating neural traces are relatively unavailable for recall until the consolidating process has ceased.

Eysenck (1963, 1964, 1967) has presented a theory of personality which places major emphasis on the dimensions of introversion-extraversion and neuroticism. On the basis of evidence from EEG recordings, evoked potentials, CFF and drug studies, he has argued that introverts can be characterized as more highly cortically aroused than extraverts. Extraverts on the other hand are characterized by low cortical arousal. From this it would follow that introverts should show stronger consolidation, and accordingly greater reminiscence. We would predict that extraverts would perform better on tasks when only a short interval elasped between learning and reproduction, but introverts would perform in a superior manner with a lengthy rest pause intervening. Evidence has since accumulated showing the superiority of extraverts in learning tasks with immediate recall of material.

Howarth (1963) investigating digit span found no significant differences between extraverts and introverts in size of the span, but ability to hold the information over a longer period proved to be greater in the extraverts. The extraverts had a mean score of 14.0 exconds. In a study of serial learning and digit span, Jensen (1964) found a significantly high correlation of extraversion to these learning tasks. McLaughlin and Eysenck (1967) related the accumulating evidence of extraverts superiority in learning tasks to Walker's theory of consolidation. Their study found that extra-

verts were superior in acquisition of a paired-associate task. Howarth and Eysenck (1968) and McLaughlin (1968) have further confirmed this result. The evidence for the predicted superiority of recall in introverts after a retention interval was supported by Howarth and Eysenck while not substantiated in the results of McLaughlin.

In finding that extraverts are superior in the acquisition of paired-associate learning tasks further studies are warranted to determine what aspects of this learning task leads to the extraverts superiority. Underlying learning tasks is the ability of the individual to retain information. The momentary retention of stimulus inputs allowing for further processing, encoding or consolidating is often termed short-term memory. Beyond being able to retain the information for brief periods of time, it is necessary in paired-associate learning to: (1) differentiate the stimulus members; (2) differentiate and integrate the response members; and (3) form an associative connection between the stimulus and response members.

One of the essential features of the anticipation method of paired-associate learning is that each attempted anticipatory response (performance measurement) be followed immediately by the presentation of the correct response presentation. Consequently the subject must in effect be simultaneously learning what he has not yet learned, and demonstrating what he has learned on previous trials. As a result, the measurement of his performance becomes contaminated by the co-occurrence of additional learning which is not observed until his performance on the next trial is obtained.

The design of this study utilizes the response learning procedure whereby each trial begins with the presentation of the entire list of stimulus items (the digit series and response lists) for a designated time period. The performance of the subjects is measured by the number of correct items recalled. With the immediate recall, an index of short-term memory can be easily obtained and with the retention intervals, a measure of long term memory and the amount of consolidation taken place can be assessed.

The first part of the study replicated Howarth's digit series repetition experiment (1963) making some major change in the experimental procedures. In Howarth's design, the subject's base span of apprehension was first established (the number of digits in sequence which were correctly repeated beginning with the four digit series). Numbers were progressively increased by one digit each time until the subject failed twice in succession at a given span. The time duration of the subject's base span of apprehension was extended beginning with a five second delay between presentation and reproduction, and increasing in five second steps until two incorrect attempts were made. The rate of verbal presentation of the digits was controlled by an electronic metronome set at two beats per second. During the interim period the individual was to await the signal (a tap on the shoulder) to make the reproduction of the digits. Instructions were given to the subjects not to repeat the digit series to themselves during the retention intervals.

In the present study the digit series from the Wechsler Adult Intelligence Scale Test were presented to the five groups on a tape

recorder. The digits were presented at a rate of one per second. During the five retention intervals (3, 6, 9, 12, and 18 seconds) the subjects responded to short answer questions to minimize the practice effects. An electronic buzzer was sounded to signal the reproduction of the digits.

The second phase of the experiment consisted of the four response lists to determine whether extraverts are superior in the acquisition process and poorer after lengthy retention intervals (1, 6, 15, and 30 minutes) compared to introverts. The four lists containing 50 stimulus items are composed of names of United States cities; animals; adverbs, verbs, and adjectives; and common nouns.

It is predicted from previous experimental data of Eysenck and Howarth (1963) and McLaughlin (1968) that the extraverts will excell in the acquisition of the response lists. It is also predicted that the introverts will excell in recall performance of response lists with the lengthy rest period (retention intervals). The study will attempt to confirm the results obtained by Howarth and Eysenck on paired-associate learning using response learning tasks.

CHAPTER II

Method

Subjects.

The Ss were 114 undergraduate students from three general psychology classes at Southern Illinois University-Edwardsville, Illinois. Six Ss were excluded due to high lie scores on the Eysenck Personality Inventory. One S was eliminated for failure to complete the Eysenck Personality Inventory. A total of 107 Ss consisted of 49 females and 58 males.

Materials.

1. An electric timer and buzzer system were used in the experiment.

2. The digit series test from the Wechsler Adult Intelligence Test was presented to the five groups. The digit series were recorded on a Wollensak tape recorder that was located on a table at the rear-center of the testing room. The six sets of digits, beginning with the 4 digit series, were given at a rate of one per second.

3. Response learning tasks were composed of 4 different black and white slides containing lists of stimulus words. The slides contained 5 columns with 10 words in each column. The first list contained the names of 50 United States cities randomly selected from an atlas; the second list contained 50 verbs, adverbs, and adjectives;

the third list contained the names of 50 animals; and the fourth list contained 50 common nouns. The nouns, adverbs, and verbs were taken from the Lorge Thorndike list of common words. The slides were projected on the screen by a Kodak Carousal projector.

4. Ten black and white slides containing five different line lengths per slide and ten black and white slides containing varying number of dots and digit symbol copying-task exercise were utilized during the retention intervals.

5. The Eysenck Personality Inventory was administered at the end of the testing session to each Ss. On the basis of scores the Ss were put into one of four groups: low neurotic-extraverts; high neurotic-extraverts; low neurotic-introverts; and high neurotic-introverts. The Ss scoring above 11 on the neuroticism scale were considered high neurotics and those Ss scoring 13 or above on the introversion-extraversion scale were considered extraverts. The mean for the 107 EPI scores on the extraversion-introversion scale was 13.24. The mean for the neuroticism scale was 10.97. The EPI was tested on 1931 British Ss and the mean for the extraversion-introversion scale was 12.08 and for the neuroticisim scale, the mean was 9.04. The means of the 107 Ss were used as the cut-off points in the present study since differences have been obtained with American Ss. On a test-retest reliability with British Ss on both scores with times elasping between one month and one year the reliability varies between .82 and .97.

Procedure.

Five individual groups of Ss consisting of 17-25 Ss reported to

the laboratory on one of five consecutive days of the week. The Ss were seated at desks facing the screen at the front of the room. Instructions were read to the Ss by E: "You have been asked to come here today to help participate in an experiment on perception. Your answers will be significant to us only in our final evaluation of the results for the total group of Ss. Let me say that this experiment will not be considered as an indication of your intelligence or your ability. Are there any questions?"

"The first part of the experiment is called the digit series. You are going to hear some numbers presented on the tape recorder. After each series of numbers we want you to write down the numbers you heard presented."

"Please place your pencil or pen on your desk. After a series has been given, pick up your pencil and write down your answer in your booklet. When you are finished with your answer, replace your pen or pencil on your desk."

"Your answer booklet contains 13 small pages and 2 large pages of paper. When you complete your answer on the first page fold it over and turn your booklet over. You will write your second answer on the back of the first page." Demonstration.

"Are there any questions?" The tape recorder was turned on.

"I am going to say some more numbers. Listen carefully, and when I am through write them down right after me. Remember do not begin writing down the numbers until after the whole series has been presented. Let's begin with a practice series. The number series is 5-8-2. (Pause) You should have written down the number 5-8-2 on

your answer sheet. Now fold over the first sheet of your answer booklet and listen for the next series. (Pause) The next series is:

"6-4-3-9" "5-9-1-7-4-2-8"

"4-2-7-3-1" "5-8-1-9-2-6-4-7"

"6-1-9-4-7-3" "2-7-5-8-6-2-5-8-4".

The Ss completed the first stage of the digit series task and were instructed: "Again you are going to hear some more numbers only this time after each series there will be a short answer type question. When the buzzer sounds write down the numbers you heard before the question. For example: the series is 1-6-4-3, what is the 2nd letter in the alphabet? (Pause) You should have written down the letter B and when the buzzer sounded written down the numbers 1, 6, 4, 3. Remember, answer the question first and then when the buzzer sounds write down the numbers presented before the question. If you are unsure of the answer make a guess or estimate to the best of your ability. When the buzzer sounds try to write down as many of the numbers as you remember." Retention intervals after the 4 and 5 digit series were 3 sec., 6 sec., 9 sec., 12 sec., and 18 sec.. The Ss were asked to answer short questions to minimize the effects of practicing during the retention intervals. The tape recorder was turned on.

"Now this time I'm going to say some more numbers only after each series there will be a question. Mark down the answer to the question in your booklet. When the buzzer sounds write down the numbers you heard before the question. Let's begin with the series:

"6-2-9-4 name the 4th letter after F"

"3-2-7-9 name the 5th letter after S"

"1-5-2-8 name the 6th letter before Y"

"5-3-9-4 name the 9th letter before L"

"6-1-8-4 name the 8th letter before R"

"8-1-2-9-3 name the 3rd letter after P"

"9-4-3-7-6 name the 3rd letter after P"

"7-2-4-8-5 name the 3rd letter after K"

"4-7-3-9-1 name the 8th letter before V"

"5-1-9-6-8 name the 7th letter before N".

After the digit span repetition task instructions were given for the response learning task. "The next part of the experiment is the response learning task. A list of items will be projected on the screen in front of you. You will have time to study the list. Try to learn as many of the items as you can in the time alotted. When the slide is removed write down as many of the items as you can remember. Don't begin writing until after the slide is flashed off the screen." (Lights dimmed) All groups were presented the first 3 lists. On the 4th list, each group was assigned one of the following retention intervals: 0 sec., 1 min., 5 min., 15 min., and 30 min.. The group with the 0 sec. retention interval had an immediate recall of the items in the 4th list. The other four groups received these instructions: "The 4th list will be presented the same as the other lists only after the study period some other slides will be projected onto the screen. Some of the slides will contain various numbers of dots. Other slides will contain a series of lines. With the dot slides, count the number of dots on the screen and write down your

answer in your booklet. With the slides containing the lines, estimate the length of each line to the nearest foot and inch and write down as many of the response items from the 4th list that you can remember. Do not write down any of the items until the buzzer sounds." The group with the 30 min. retention intervals also was instructed after completing 20 min. of dot and line estimating, "Take out the number sheet from the desk shelf. Read the directions at the top of the page and fill in as many of the items as possible. Work as rapidly as possible. When the buzzer sounds write down as many of the items from the 4th response list as you can recall."

The black and white slides containing the dots and numbers were used for the four groups up to 20 min.. Each slide was projected for 1 min.. The 30 min. retention interval groups spent the remaining 10 min. of their intervals on the digit symbol exercise. Following the response learning task the Ss completed the Eysenck Personality Inventory and a data sheet: "Take out the Eysenck Personality Invertory from your desk shelf. Put your name on the IBM answer sheet and read the directions on the front cover of the EPI booklet. Do not skip any item; work as quickly as you can. (Pause) Now fill in the data sheet with your name and address. That completes your participation in this experiment."

CHAPTER III

Results

In the digit series task with no retention intervals using a criterion of the longest series correctly repeated up to where the Ss made two errors was analyzed for the effects of introversion-extraversion and neuroticism. The Ss with scores of 13 or larger were placed into the extravert group; and those Ss with scores less than 13 were considered introverts. All Ss scoring 11 or more were placed in the high neuroticism group; Ss with scores less than 11 were placed in the low neuroticism group. The 107 Ss were placed into four groups on the basis of their scores of extraversion-introversion and high and low neuroticism scales (HN-E, LN-E, HN-I, LN-I). The means and the standard deviations are given in Table 1. The summary of the analysis of variance of this data presented in Table 2 yielded no significant differences for E or N or the interactions.

The 107 Ss had a mean of 6.92 and a standard deviation of 1.11 on the digit span task without retention intervals. A product moment correlation of r= .08 resulted in comparing extraversion to the number of digit series recalled. A product moment correlation comparing the 107 Ss scores of N (neuroticism) to the number of digit series recalled yielded a correlation of r= .04. The mean of the 107 scores of N (neuroticism) was 10.66 and the standard deviation was 4.41.

The EPI scores on the introversion-extraversion scale ranging from 1 - 19 were further analyzed to compare the extreme scores of

TABLE 1

Means and SDs of Digit Series With No Retention Intervals of Four Personality Groups

	High Neurotic Extravert	High Neurotic Introvert	Low Neurotic Extravert	Low Neurotic Introvert
N	29	29	36	13
Males	12	16	21	6
Females	17	13	15	7
$\overline{X}$	6.90	6.83	7.03	6.85
SD	5.31	5.45	7.16	6.81

TABLE 2

Summary of Analysis of Variance of Extraversion-Introversion and Neuroticism Scores on Digit Series Task With No Retention Intervals

Source of Variation	SS	df	MS	F
Neuroticism	.27	1	.27	.211
Introversion-Extraversion	.53	1	.53	.414
Interaction	.27	1	.27	.211
Within Cell	131.51	103	1.28	

extraversion-introversion to the number of digit series recalled. The Ss with scores of 11 - 15 were excluded from this sample; extraverts had scores of 16 - 19 and introverts had scores of 1 - 10. Neuroticism scores were not considered in this analysis. The means and the standard deviations are given in Table 3. A t test comparing the means of the extreme extraverts and introverts on the digit series task was completed. As given in Table 3, it is seen that the extraverts had a mean number of recalled digits of 6.85 compared to 6.64 digits for the introverts. ($t = 1.24$, $df = 56$, $p => .01$)

Extreme scores of neuroticism (N) were compared to the number of digit series recalled without any retention intervals. N scores of 14 - 19 were considered high neurotics; scores of 1 - 8 were considered low neurotics. The means and the standard deviations for this sample are found in Table 4. Comparing the HN mean of 6.88 to the LN mean of 7.02 resulted in no significant findings. ($t = 1.55$, $df = 56$, $p > .01$)

The data of the digit series task with the retention intervals of 3, 6, 9, 12, and 15 seconds was analyzed. A criterion of the score totaling the number of seconds was calculated for each correct digit series recalled in the different intervals for the 4 and 5 digit series. The Ss were placed into the two personality groups of extraversion-introversion on the basis of scores on the EPI. Neuroticism (N) scores were not considered. The results of the t tests comparing the scores of introversion-extraversion to the scores on the 4 and 5 digit series tasks did not yield significant results. ($t = .14$, $df = 56$, $p > .01$ for the 4 digit series) and ($t = .14$, $df = 56$, $p > .01$ for the 5 digit series) The extraverts retained the digits over a period of 6.65

TABLE 3

Means and SDs of Extreme Scores of Introversion-Extraversion on Digit Series No Retention Intervals

	Introverts	Extraverts
N	26	32
$\bar{X}$	6.64	6.85
SD	1.21	.98

TABLE 4

Means and SDs of Neuroticism Scores on Digit Series No Retention Intervals

	High Neuroticism	Low Neuroticism
N	30	36
$\bar{X}$	6.88	7.02
SD	1.26	1.18

seconds compared to 5.16 seconds of the introverts for the 4 digit series. With the 5 digit series, the extraverts retained the digits for an average of 4.82 seconds compared to 5.19 seconds of the introverts.

The 107 Ss had a mean of 5.08 and a standard deviation of 3.89 for the 4 digit series and a mean of 3.20 and a standard deviation of 3.50 on the 5 digit series task. A product moment correlation comparing the scores of the Ss on the 4 and 5 digit series resulted in r= .37. Comparing the 107 Ss scores of introversion-extraversion (E) to the number of digits recalled on the 4 digit series task with retention intervals yielded a correlation of .15. The 107 Ss scores of (E) compared to the number of digits recalled on the 5 digit series yielded a correlation of .04. The 107 scored of N (neuroticism) compared to the number of digits recalled on the 4 digits series task yielded a correlation of -.09 and -.12 on the 5 digit series.

On the response lists of cities (List I); verbs, adverbs, adjectives (List II); animals (List III); the 107 Ss were placed in the four personality groups to compare the effects of extraversion-introversion and neuroticism. The means and the standard deviations for the three lists are given in Tables 5, 6, and 7. A summary of the analysis of variance found in Table 8 yielded no significant differences for extraversion-introversion or the neuroticism interactions.

The mean and the standard deviations for the 107 Ss resulted in the following: List I: $\overline{X}$ = 18.22 and SD = 4.42; List II: $\overline{X}$ = 17.54 and SD = 4.31; and List III: $\overline{X}$ = 23.90 and SD = 4.96. Product moment correlations comparing the number of items recalled to extraversion scores yielded the following correlations: List I: r = .06:

List II: r = .12; and List III: r = .21. Inter-list correlations were: List I and List II: r = .44: List I and List III: r = .43; List II and List III: r = .39.

Neuroticism scores compared to the number of items recalled on the lists yielded correlations of: List I: r = -.02; List II: r = -.04; and List III: r = -.01.

The fourth response list data was analyzed using a product moment correlation for both the E scale and the N scale. The number of items recalled on the list for each retention interval (0 min., 1 min., 5 min., 15 min., and 30 min.) was compared to the extraversion-introversion score and the neuroticism score. The scores resulted in the following correlations: 0 min.: r = -.27; 1 min.: r = -.21; 5 min.: r = .28; 15 min.: r = .07; and 30 min.: r = -.10. For the N score the correlations were: 0 min.: r = -.56; 1 min.: r = -.09; 5 min.: r = .03; 15 min.: r = .02: and 30 min.: r = -.32. The 0 min. retention interval relating to the N score resulted in a significant negative correlation. The amount of neuroticism is inversely proportional to the amount of material recalled. The Ss that scored low on the N scale tended to recall more items on List IV compared to those Ss with high N score who recalled fewer items.

TABLE 5

Means and SDs of Four Personality Groups and Response List I: Cities

	High Neurotic Extravert	High Neurotic Introvert	Low Neurotic Extravert	Low Neurotic Introvert
N	29	29	36	13
$\bar{X}$	18.14	17.97	18.17	19.23
SD	5.31	5.45	6.81	7.16

TABLE 6

Means and SDs of Four Personality Groups on Response List II: Verbs, Adverbs, Adjectives

N	29	29	36	13
$\bar{X}$	17.44	17.51	17.36	18.33
SD	4.26	4.03	4.41	5.32

TABLE 7

Means and SDs of Four Personality Groups on Response List III: Animals

N	29	29	36	13
$\bar{X}$	24.06	23.58	24.27	23.15
SD	4.25	5.18	5.21	4.46

TABLE 8

Summary of Analysis of Variance Tables For

Response Lists I, II, and III

Cities

Source of Variation	df	SS	MS	F
Introversion-Extraversion	1	91.21	91.21	.557
Neuroticism	1	5.34	5.34	.266
Interaction	1	70.14	70.14	.49
Within Cell	103	2160.91	20.98	

Verbs, Adverbs, Adjectives

Introversion-Extraversion	1	9.33	9.33	.463
Neuroticism	1	12.53	12.53	.623
Interaction	1	2.40	2.40	.119
Within Cell	103	2075.33	20.15	

Animals

Introversion-Extraversion	1	.533	.533	.02096
Neuroticism	1	17.07	17.07	.6715
Interaction	1	2.67	2.67	.105
Within Cell	103	25.42		

CHAPTER IV

Discussion

The results of this study using groups with the response learning approach did not provide any data to support the previous experimental findings on learning differences of introverts and extraverts.

In the digit series experiment which replicated the Howarth (1963) study, the results support his initial finding. Extraverts and introverts were approximately equal in the size of the digit span recalled.

Results of the retention intervals on the digit series task did not concur with Howarth's results. The extraverts in the present study retained the digits for a mean of 6.65 seconds compared to 14.0 seconds in the Howarth study.

In this study digits were presented verbally on a tape recorder located in the back of the room to the five groups of subjects. Howarth's design incorporated the individual presentation with the experimenter repeating the digits timed by use of the metronome. In his study there was an auditory stimulus and a visual stimulus. The subject heard the numbers and also faced the experimenter during the administration of the numbers. Recall of the digits in Howarth's study was verbal compared to the written reproduction in the present study. The different methods of sensory input and recall methods could attribute to the differences in the two findings. The additional visual stimulus of the items could facilitate learning and be a contributing

factor to the increased retention period. The double presentation of the stimulus item may be hypothesized as to increase the duration of the stimulus trace and thus permit recall after a longer time span.

A further study could investigate the types of presentation methods in the digit series task comparing the auditory versus auditory-visual with groups and individuals. The results would confirm either Howarth's findings of extravert's superiority in retaining digits over a longer time span or the present study's results that no differences exist between introverts and extraverts in the retention span.

The auditory-visual variable is present in the paired-associate method of learning. The studies using this method found significant differences in acquisition rates of extraverts and introverts. The subject views the stimulus item and then verbalizes the anticipated stimulus pair. His response is visually reinforced when the memory drum rotates. The visual presentation of the item accompanied by the auditory repetition may be a crucial variable in the learning differences between extraverts and introverts.

Howarth's study did not use any task to prevent the subject from rehearsing the digits during the retention intervals. The present study had subjects answering short questions to eliminate practice effects. This also may be hypothesized as a variable attributing to the differences in results. Howarth's subjects could use the retention intervals to practice the numbers and thus have a longer span for the retention of the digits.

The individual presentation of the digits compared to a group presentation also may account for another performance variable. In-

dividual testing could have facilitated better performance rates due to the one-to-one contact with the experimenter. In the group testing the one-to-one contact was eliminated and it could be hypothesized that the subjects were not as anxious and consequently their performance scores were lower than those subjects in Howarth's study.

The response lists were not effective in establishing the superiority of extraverts in the acquisition process as predicted. Both groups recalled similar amounts of material on the three lists. The three different types of stimulus items failed to elicit any differences in learning rates.

Further statistical analysis could be carried out to investigate any differences in extreme EPI scores between extraverts and introverts. The analysis of variance and product moment correlations comparing the 107 subjects failed to demonstrate any significant findings.

The correlations of EPI scores and the number of nouns recalled on the fourth response list did not result in the typical forgetting curve. There was no meaningful findings in the correlations completed.

A significant correlation ($r = -.56$) was obtained relating the amount of N (neuroticism) to the number of nouns recalled with immediate recall. The amount of anxiety (neuroticism) is inversely proportional to the amount of material recalled. Low anxious subjects tend to have better short term memory compared to the highly anxious individuals. This trend begins to appear at the 30 minute retention interval however, the correlation ($r = -.32$) is not high enough to be significant. These findings would not support the Yerkes-Dodson Law which predicts that high anxious subjects would be superior in per-

formance compared to low anxious subjects in an easy learning task. This result indicates that low anxious subjects tend to recall a greater amount of material. Since this result is not related to the introversion-extraversion concept, the experimenter is unable to explain the nature of this finding.

CHAPTER V

Summary

Psychologists have in recent years been interested in and explored personality dimensions in relationship to learning and short-long term memory. Research findings of physiological psychologists and neurophysiologists have provided data concerning arousal and consolidation of memory traces while short term memory studies have provided methods for investigating immediate reproduction of a stimulus item.

Deutsch (1967) proposed that the concept of memory trace assumes that the perception of a stimulus leaves a distinct neural aftereffect or trace. In addition Hebb (1949) proposed a theory of consolidation that postulates when a cell A is near enough to excite a cell B and does this repeatedly, some growth process or metabolic change takes place in one or both cells. Further Walker's (1958) theory of arousal and trace consolidation states that in learning situations under conditions of low arousal a typical forgetting pattern results which implies immediate recall is excellent but recall ability gradually diminishes with time. In addition high arousal learning shows a marked reminiscence effect; poor immediate recall but strong permanent memory. Several studies have supported Walker's theory demonstrating the relationship between arousal and learning (Kleinsmith and Kaplan, 1963, 1964; Kleinsmith, Kaplan and Tarte, 1963; and

Walker and Tarte, 1963).

Eysenck has proposed a theory of personality types (introversion-extraversion) related to learning and consolidation of material. On the basis of evidence from EEG recordings, evoked potentials, CFF and drug studies, he has argued that introverts can be characterized as more highly cortically aroused than extraverts. From this we would predict that extraverts would perform better on tasks when only a short interval elasped between learning and reproduction, but introverts would perform in a superior manner with a lengthy rest pause intervening.

Several investigators have demonstrated the superiority of extraverts in the acquisition of paired-associate learning tasks (Jensen, 1964; McLaughlin and Eysenck, 1967; Howarth and Eysenck, 1968; and McLaughlin, 1968). The predicted superiority of recall of introverts after a lengthy retention interval has not been substantiated in all studies.

Further investigation is warranted to determine what aspects of the paired-associate learning task leads to the extraverts superiority. The design of this study incorporated the response learning procedure. With immediate recall, an index of short term memory can be obtained and with the retention intervals a measure of long term memory and the amount of consolidation taken place can be assessed. This procedure eliminated the contamination of measurement of performance in the paired-associate method which assesses both previous learning and new learning on each trial.

The first phase of the study replicated Howarth's (1963) digit series experiment making some modifications in procedures. The digit

series was presented to a group of subjects on a tape recorder and the recall method was manual. The second phase of the study consisted of four response lists, each composed of 50 stimulus items containing the names of United States cities; adverbs, verbs and adjectives; animals; and nouns. The subjects were tested for immediate recall on all lists and on the fourth list for recall after retention intervals of 1, 5, 15, and 30 minutes.

One hundred and seven general psychology students from Southern Illinois University, Edwardsville, Illinois were placed in one of the five groups that were tested on one of the five consecutive days of the week. At the conclusion of the digit deries and response learning tasks, subjects completed the Eysenck Personality Inventory.

An analysis of variance comparing EPI scores of extraversion-introversion and high-low neuroticism to the number of digit series recalled did not demonstrate any significant findings. Also there were no differences among the four personality groups in the amount of digits recalled with the various retention intervals on the digit series task. Product moment correlations comparing the extreme scores in extraversion-introversion to the number of digits recalled was not significant. Similarly an analyis of variance of the four personality groups comparing EPI scores to the number of items recalled on the four response lists did not demonstrate any findings. A product moment correlation comparing the extraversion-introversion scores to the amount of nouns recalled with the various retention intervals on the fourth list did not reveal any findings. A significant correlation, $r=-.56$ comparing neuroticism was inversely proportional to the number of items recalled. This trend became apparent ($r=-.32$) at the 30 minute reten-

tion interval however, the result was not statistically significant.

The results of this study did not support the original predictions that extraverts are superior in the acquisition process and introverts perform better after a lengthy retention interval intervenes. The response learning method, the presentation of material to groups and the different methods of presenting the stimulus items may account for the differences that resulted.

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