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NONPSYCHOTIC DEPRESSION AND RECALL OF INTERRUPTED AND COMPLETED TASKS

by

Joseph Mathew Malancharuvil

A Dissertation Submitted to the Faculty of the Graduate School of Loyola University of Chicago in Partial Fulfillment of the Requirements for the Degree

Doctor of Philosophy

October

1981

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This dissertation is dedicated to the Jesuits of Kerala and Chicago Provinces of the Society of Jesus who have been an integral part of the author's study and life.

VITA

The author, Joseph Mathew Malancharuvil, is the son of Mathai Varghese Malancharuvil and Aleyamma Mathai Malancharuvil. He was born August 1, 1944, in Kerala, India.

He graduated from Padmanabhodayam High School, Mezhuveli, India, in 1959. After completing a pre-university program in Mar Ivanios College, Trivandrum, he pursued three years of humanities in Jesuit Training College, Calicut, India. In 1964, he received the degree of Licentiate in Philosophy from Sacred Heart College of Jesuits, Kodaikanal, India. In 1971, he received the degree of Master of Arts in Psychology from Maharaja Sayaji Rao University of Baroda, India. In 1974, he obtained the degree of Bachelor of Theology from Jnana Deepa Papal Institute of Theology, Pune, India. In September, 1976, he began his graduate studies in clinical psychology at Loyola University of Chicago.

He was granted the Charles Doyle Fellowship in 1977 at Loyola University of Chicago. In 1979 he received a National Institute of Mental Health Fellowship, and, in 1981, he was awarded a Loyola University Dissertation

Fellowship. In 1974, he worked as a member of the Jesuit Provincial Commission for the Evaluation of Jesuit Schools in Kerala, India. In 1975, he was employed as Associate Director and Student Counselor at Socio-religious Center, Calicut, India. In September, 1976, he was granted an assistantship in psychology at Loyola University of Chicago. He worked for the Mayor's Commission of Rehabilitation of Persons in Chicago in 1978 and 1979. He received his clerkship training at Loyola University Student Counselling Center (1977-78) and internship training at Patton State Hospital, Patton, California (1979-81).

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CHAPTER I

INTRODUCTION: STATEMENT OF THE PROBLEM AND HYPOTHESES

The purpose of this study is to examine how non-psychotic depression affects the recall of interrupted and completed tasks. That emotions and mood affect the perception, retention and recall of events is a commonly observed phenomenon. The manner in which depressed patients perceive and process life-events has stimulated considerable thinking, research and theoretical speculation (e.g., Abraham, 1911, 1916, 1924; Beck, 1967; Buchwald, 1977; Ferster, 1973, Freud, 1917; Lewinsohn, 1974; Lloyd & Lishman, 1975; Miller & Seligman, 1973; Nelson & Craighead, 1977; Rado, 1928; Rapaport, 1942). Among the more prominent contemporary theories of depression, three deserve particular mention in relation to the purpose of this study; the cognitive theory of Beck (1967, 1974), Seligman's theory of learned helplessness (1974, 1975), and the behavioristic theory of Peter Lewinsohn (1974). The theories of Beck and Seligman stress the role of cognitive style, particularly pessimistic expectations, in depression. Lewinsohn attributes depressive states to

a low rate of response contingent positive reinforcement. On the other hand, classical psychoanalytic theory explains depression in terms of repressed and introjected anger towards a lost object (Abraham, 1911; Freud, 1917). From these theories, certain predictions can be derived concerning the recall behavior of depressed patients in an experiment that employs negative or positive stimuli. According to cognitive and behavioristic models of depression, depressed patients should concentrate on, and therefore recall more of, the negative material. On the other hand, according to the psychoanalytic position, the depressed patients should demonstrate the effect of repression of the negative, which would express itself in the inability to recall the negative.

The classical Zeigarnik experiment (Zeigarnik, 1927) appears well-suited for such an investigation. In a Zeigarnik experiment, subjects are asked to complete a number of tasks, half of which are interrupted before completion. The subjects are then asked to recall as many of these tasks as they can. The question is whether in a Zeigarnik experiment, where the effects of task-difficulty and order of administration are controlled, depressed patients will recall more interrupted, or failure tasks, or more completed tasks in comparison to normal or non-depressed psychiatric populations. It would appear that,

according to the postulates of cognitive and behavioristic theories, the depressed patients should enhance the Zeigarnik effect, i.e., recall interrupted tasks more than they do completed tasks, while, in accordance with the psychoanalytic position, they should recall fewer interrupted tasks than they do completed tasks. Zeigarnik (1927) observed that when people interpreted interruptions as personal failures, they tended to forget those tasks at the time of recall. However, this finding has not been supported by some of the later researches (Alper, 1948). A recent study by Johnson, Petzel, Hartney & Morgan (1981)[1] reported that depressed students recalled more interrupted tasks than completed tasks than a comparable nondepressed group of students. However, until now psychiatrically diagnosed patients have not been used as subjects in Zeigarnik effect experiments. This study represents an attempt to study how depressed patients recall interrupted and completed tasks in a Zeigarnik-type experiment.

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[1] J. E. Johnson, T. P. Petzel, L. M. Hartney & R. A. Morgan, Recall and Importance Ratings of Completed and Uncompleted Tasks as a Function of Depression. Manuscript accepted for publication in Journal of Cognitive Theory and Research, 1981.

CHAPTER II

REVIEW OF RELEVANT LITERATURE

Theories of Depression: A summarized overview

In the papers of Abraham (1911; 1916; 1924), Freud (1917), and Rado (1928), the most important aspects of psychoanalytic theory of depression are set forth. Abraham reported his clinical observations of depressed patients. He noted their tendency to form intensely ambivalent "object-relations" and he theorized that the hatred aspect of the ambivalence is typically repressed by the depressive patient. Abraham explained the depressed patients' impoverished capacity for love, as well as their anxiety, guilt, self-deprecation, and depressed mood, as consequences of repressed hatred.

In Freud's paper, "Mourning and Melancholia" (1917), he distinguished normal mourning from morbid melancholia. For Freud, both mourning and melancholia stem from an experience of significant "object-loss." Freud observed that for the mourner the world was impoverished, and for the melancholic the ego was impoverished. He observed that depressed patients suffer from dejected mood,

vulnerable self-regard, diminished external interests, inhibited psychomotor abilities, and anticipated punishment. He considered the depressed person as narcissistic and his relationships with others as ambivalent. The sadistic aspect of the ambivalence toward the object is repressed. Freud (1923) wrote: "It is remarkable that the more a man checks his aggressiveness toward the exterior, the more severe - that is aggressive - he becomes in his ego-ideal." (p. 54).

Rado (1923) elaborated on the depressed person's narcissistic cravings and low tolerance of frustration. The depressive's self-esteem is vulnerable to even trivial disappointments. A person prone to depression derives his support primarily from the outside. He concluded that depression is a result of aggression turned inward because narcissistic gratifications are not reinstated.

Subsequent to these "classical" psychoanalytic papers, considerable theoretical material has been written by psychoanalytically oriented authors on depression (Adler, 1959; Adler, K., 1961; Bibring, 1953; Bonime, 1966; Chodoff, 1970; Cohen, Baker, Cohen, Reichmann & Weigert, 1954; Fast, 1967; Jacobson, 1946; 1953; 1971; Klein, 1934; 1940; Salzman, 1970; Sandler & Joffe, 1965; Zetzel, 1953; (1965). However, these clinical speculations have stimulated a relatively limited amount of empirical

research (Becker, 1974).

Cognitive theorists hypothesize that distorted thought processes produce and maintain the affective and behavioral manifestations of depression. Becker (1974) suggests that Beck's (1967) theory namely, that depression is primarily a thought disorder, owes much to Abraham's original formulations of depression. Beck (1967, 1974) maintains that depressed patients distort their thinking through processes such as, arbitrary inference, selective abstraction, over-generalization, magnification and personalization (1970). He argues that these processes help the depressed patients to develop a negative view of the self, the world, and the future. Seligman's (Seligman, 1971; Abramson, Seligman & Teasdale, 1978) theory of learned helplessness is a combination of cognitive theory and behavioristic principles. According to him, motivation to escape a trauma diminishes as one's available responses are perceived to be inadequate to remove the trauma. In learned helplessness, a cognitive expectancy develops that activity and desired results are independent of each other. Both Beck and Seligman emphasize the role of pessimistic expectations in depression. According to them, depressed people see themselves as incompetent losers, and expect few rewards and many punishments. When depressed people actually succeed, they discount their successes as pro-

ducts of chance.

Behavioral theories of depression view depression as a function of reinforcement history. What is crucial is not reinforcement per se, but the subjective experience and interpretation of the reinforcement (Ferster, 1965; 1973; Lewinsohn, 1974). According to Lewinsohn, the chief antecedent condition of depression is lack of social skill which, in turn, creates a social environment of diminished positive reinforcement. Studies by Buchwald (1977), Nelson & Craighead (1977), De Monbruen & Craighead (1977), and Wener & Rehm (1975), support the hypothesis that depressed people recall positive reinforcements with a lower frequency and punishments with a higher frequency than those who are not depressed. Lloyd and Lishman (1975) found that persons who scored highly on Beck Depression Inventory, retrieved unpleasant memories faster than they retrieved pleasant memories. In reflecting on the results, the authors conclude:

> During periods of depression, the recall process might be directed preferentially towards unpleasant experiences which would therefore appear in consciousness more quickly than pleasant experiences. There might also be more mental rehearsal of those memories having negative hedonic tone, since it is a common clinical observation that depressives tend to be preoccupied with unpleasant past events. (p. 179).

The catecholamine hypothesis of depression states that pleasure increases as the supply of catecholamine

available at brain receptor sites increases (Schildkraut, 1965; 1969; 1972; Stein, 1968). It has been observed that depressed people posses relatively small amounts of catecholamines at their brain receptor sites. Costello (1976) believes that depressed people undervalue rewards because of a biochemical deficiency and therefore the frequency or rate of reward-delivery is irrelevant to depression. When the biochemical deficiency is removed, rewards gain in value and depression lifts.

Depression and Recall of Pleasant and Unpleasant Events

Zeller (1951) reviewed 51 studies related to the recall of affectively toned sensory stimuli and found that sixty-three percent of the studies concurred with the psychoanalytic position that pleasant events are recalled more frequently than unpleasant events while contrary results were obtained in 14 percent of the studies. In an experimental study with neurotic subjects, Sharp (1938) found that they recalled ego-threatening words less well than qratifying words. These results could not be replicated, however, by Heathers and Sears (1943). Keet (1948) and Clemes (1964) provided additional experimental evidence that recall was affected by the positive or negative tone of words. Meltzer (1930) demonstrated that college students listed more pleasant than unpleasant memories

immediately after an experience that contained both pleasant and unpleasant aspects and that at a six-week follow-up, the pleasant memories clearly predominated.

Washburn (1926) utilized the recall of pleasant and unpleasant experiences as a test of depressed temperaments. Subjects who recalled greater number of unpleasant experiences were judged by peers and themselves as being of depressed temperaments. Lishman (1972) observed a tendency for an inverse correlation between the recall of pleasant materials and depression. However, when more standardized measures of depression were used, this observation was not confirmed. Lishman's experimental procedure was too difficult for severely depressed patients to master and they did not get tested in the process.

Lloyd and Lishman (1975) conducted an experiment in which depressed patients were asked to recall pleasant or unpleasant experiences from their past-life in response to a standard series of stimulus words. It was observed that, with increasing severity of depression, unpleasant memories were recalled more often and more quickly than were pleasant memories. Teasdale and Fogarty (1979) using a technique of experimentally induced mood, found results similar to those obtained by Lloyd and Lishman (1975).

The Zeigarnik Experiments and Consequent Research

Zeigarnik (1927), in her classical experiments, sought to answer the question: "What is the relation between the status in memory of an activity which has been interrupted before it could be completed and of one which has not been interrupted?" (p. 300) In two independent experiments, it was demonstrated that the interrupted tasks enjoyed a memory advantage of 90% or more over the completed tasks. In two group experiments, the results obtained were essentially similar to the individual experiments. Not only were the interrupted tasks recalled more often, but also "as regards the order of recall they were mentioned first three times as often as were the completed ones." (p. 302).

It should be noted, however, that in all these experiments exceptions were observed. For example, in the first experiment, out of 32 subjects, three remembered completed tasks better and another three remembered the completed and interrupted tasks equally well. In the group experiments, comprising 47 adults and 45 children, seven adults and five children remembered completed tasks more frequently than they remembered interrupted tasks. In subsequent experiments, Zeigarnik noted that the memorial advantage of unfinished tasks was enhanced or diminished by attitudinal factors of the subjects such

as ambition and inferiority. She also observed that such factors as desire to obey instruction, time of interruption, fatigue, and individual differences did affect the manner of recall.

Rosenzweig (1943) compared the recall of subjects in an informal situation (non-stress, i.e., a situation which did not present a threat to self-esteem) with the recall of subjects in a formal situation (stress). Memory in the informal group favored the unfinished tasks; and in the formal group, the memory favored the completed tasks.

Alper (1948) experimentally demonstrated that for a given sample of subjects, unselected for personality factors, there were no statistically significant differences between the incidental recall of completed and uncompleted tasks. She suggested that the discrepancy between her results and those of Zeigarnik (1927) and Rosenzweig (1948) might be attributed to individual differences in responding to the experimental instructions. She further observed:

> To focus one's successes when realistically threatened by failure may be the adjustive mechanism whereby immediate counteraction of failure is possible. To focus on one's successes in the absence of realistic failure-threat may be a non-adjustive, non-integrative reaction symptomatic of low frustration-tolerance and inadequate counteractive mechanisms. The recall of incompleted tasks in an objectively unthreatening situation . . . may be the "good" reaction of the secure, well-adjusted individual. The recall of incompleted tasks in an objectively threatening situation . . . however, may be symptomatic of an over-readiness to admit defeat and of weak counteractive mechanisms. (p. 135)

Glixman (1949) studied the effects of stress (threat to self-esteem) upon the recall of completed and incompleted activities. Specifically he tested two predictions: 1. as stress increases, the recall of incompleted activities decreases; and 2. as stress increases, the recall of completed activities increases. The first prediction was supported, i.e., there was significant decrement of recall of incompleted tasks as stress increased. However, the second prediction was not upheld by data.

In a recent study, Johnson, Petzel, Hartney and Morgan[1] studied the "Recall and Importance Ratings of completed and Uncompleted Tasks as a Function of Depression." Forty undergraduate students were chosen, on the basis of their Beck Depression Inventory scores. After the recall phase of the Zeigarnik experiment, the Subjects were asked to rate each of the tasks in terms of the importance of the skill it tapped for everyday adaptive living. The results were in support of cognitive and behavioral theories of depression. Depressed subjects recalled significantly fewer completed tasks than

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[1]J. E. Johnson, T. P. Petzel, L. M. Hartney & R. A. Morgan, Recall and Importance Ratings of Completed and Uncompleted Tasks as a Function of Depression. Manuscript accepted for publication in Journal of Cognitive Theory and Research, 1981.

incompleted tasks. They also recalled significantly more incompleted tasks and significantly fewer of the completed tasks than nondepressed subjects. The nondepressed subjects rated the completed tasks as more important than incompleted tasks, whereas the depressed subjects saw no differences between tasks. These results support Beck's (1967) cognitive predictions and the behavioristic position that success or failure interacts with mood state influencing recall of specific operant behaviors.

Summary and Evaluation

This chapter provided a summarized overview of the more prominent theories of depression, reviewed a number of studies relating mood and recall, particularly, depression and recall, classical experiments of Zeigarnik, and some of the relevant research that came after her work. It was found that the Zeigarnik effect is not ubiquitous, but has many exceptions, particularly, when personality variables are taken into account.

Studies relating clinical depression to recall of unfinished and completed tasks have been few. Though suggestions were made that psychopathology might characteristically affect the Zeigarnik Effect, no particular psychopathology has been systematically studied through Zeigarnik-type methodology. This methodology might prove to be a fertile experimental tool in testing the validity

of certain predictions derived from different theories of depression. The Zeigarnik effect is readily quantified, experimental procedures can be varied to suit the different needs of research, and replication and cross-validation also can be precise.

The study by Johnson et al. (1981) is a prime example for demonstrating the utility of the Zeigarnik methodology in the study of psychopathology. By grouping subjects at the two extremes of Beck Depression inventory scores, the experimenters were able to demonstrate the validity of certain predictions deduced from cognitive and behavioral theories of depression.

For the purposes of this study, the following hypotheses are formulated:

Null Hypotheses:

H_{01}: Recall Hypothesis

The depressed patients do not differ from nondepressed psychiatric patients in the recall of interrupted versus completed tasks.

H_{02}: Experience Hypothesis

The depressed patients do not differ from nondepressed psychiatric patients in the rating of importance of interrupted versus completed tasks.

If the null hypotheses are rejected, the following alternative hypotheses will be considered:

Recall Hypotheses

H_1: The depressed patients recall more interrupted tasks versus completed tasks.

H_2: The depressed patients recall more interrupted tasks than nondepressed patients.

H_3: The nondepressed patients recall more completed tasks versus interrupted tasks.

H_4: The nondepressed patients recall more completed tasks than depressed patients.

Experience Hypotheses

H_5: The depressed patients rate the interrupted tasks as more important than they do completed tasks.

H_6: The depressed patients rate the interrupted tasks as more important than nondepressed patients rate them.

H_7: The nondepressed patients rate the completed tasks as more important than they do the interrupted tasks.

H_8: The nondepressed patients rate the completed tasks as more important than depressed patients rate them.

H_9: The depressed patients rate the interrupted tasks as less pleasant than they do completed tasks.

H_{10}: The depressed patients rate the interrupted tasks as less pleasant than nondepressed patients rate them.

CHAPTER III

METHOD

Subjects of the Experiment

The experimental groups consisted of 48 psychiatric inpatients, 24 men and 24 women, selected from volunteers at the inpatient clinical facilities of San Bernardino County, California. All patients in the experimental groups carried a current diagnosis of non-psychotic clinical depression. Patients with organic brain syndrome and/or psychotic symptoms were excluded and so were subjects who suffered from serious psychomotor retardation, because the latter could not keep pace with the rest of the group in completing the experimental tasks.

The control groups consisted of 48 psychiatric patients, 24 men and 24 women, selected from among volunteers from the inpatient and outpatient clinical facilities of San Bernardino County, California. All of them carried a psychiatric diagnosis other than depression, psychosis, or organic brain syndrome.

All subjects were psychiatric patients who were in treatment for their illnesses. In general, the recruiting

of the subjects was difficult and particularly, the recruitment of depressed patients. Approximately 29 percent of the original volunteers dropped out of the study during the course of the experiment, because they "felt tired" and/or did "not feel like continuing." Approximately five percent were dropped from the experiment because they were too slow for the rest of the group. There also were problems with the control subjects. A few with the diagnosis of personality disorder, attempted to second-guess the experimenter's next presentation, thought aloud about what the "meaning of the experiment" was, and engaged in other disruptive behavior. Those who did not follow the instructions and violated the standard procedure of the experiment had to be politely excused from the remainder of the experiment. Aside from these exceptions, the subjects were cooperative in performing the required tasks. In the group discussions that ensued data collection, the experimenter attempted to assess the interest and motivation of the subjects. If a serious question arose about the reliability of the subject, his answers were double-checked; if procedural errors were found, the subject was removed from the study. In fact, only two subjects were eliminated.

After all the subjects completed the experiment, and before their protocols were scored, the subjects were

randomly assigned to the validation or cross-validation groups.

Age of the Subjects

The age of the subjects ranged from 19 to 60 years, the majority falling between 25 and 40 years. A two-by-two analysis of variance (Mood X Sex), reported in Table 1 and 2, revealed that there was a significant difference in age between the experimental and control groups in the validation sample ($F(1, 44) = 4.315$, $P < .05$). The women in the control groups were significantly younger than the men in the experimental and control groups. The same tendency was observed in the cross-validation sample.

Educational Level of the Subjects

The educational level of the subjects ranged from eight years to 16 years in school, most of the subjects falling between 10 and 12 years in school. A 2 X 2 analysis of variance yielded no significant differences between the groups, as noted in Tables 3 and 4.

Years in Psychiatric Treatment

The subjects' years in psychiatric treatment ranged from one to three years. A 2 X 2 analysis of variance (Table 5) yielded no significant differences between groups in the validation sample; however, in the cross-

TABLE 1

Age of the Subjects: Summary of Analyses of Variance

2 X 2 (Mood × Sex)

1. Validation Sample, (N, = 48)

Source	df	MS	F
Mood (A)	1	280.33	4.315*
Sex (B)	1	60.75	.935
A X B	1	108.00	1.662
Error	44	64.97	

Bartlett $\chi^2(3) = 4.917$

2. Cross-Validation, (N = 48)

Mood (A)	1	507.00	3.81
Sex (B)	1	176.33	1.32
A X B	1	768.00	5.77*
Error	44	133.14	

Bartlett $\chi^2(3) = 10.281$*

---

*P < .05

TABLE 2

Means and Standard Deviations of Age of Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	33.33	34.08	31.50	26.25
SD	5.41	9.95	6.65	9.34

Cross-Validation Sample

N	12	12	12	12
Mean	34.08	38.25	35.58	23.75
SD	11.97	15.69	10.64	5.46

TABLE 3

Educational Level of the Subjects: Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	3.00	.82
Sex (B)	1	3.00	.82
A X B	1	8.33	2.296
Error	44	3.62	

Bartlett $\chi^2(3) = 1.055$

2. Cross-Validation

Mood (A)	1	6.02	1.201
Sex (B)	1	2.52	.503
A X B	1	3.52	.702
Error	44	5.01	

Bartlett $\chi^2(3) = 7.507$

TABLE 4

Means and Standard Deviations of Educational Level of Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	11.58	12.92	12.92	12.58
SD	1.98	2.11	1.93	1.56

Cross-Validation Sample

N	12	12	12	12
Mean	13.08	12.08	11.83	11.92
SD	2.15	1.88	3.16	1.38

TABLE 5

Years Spent by the Subjects in Psychiatric Treatment

Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	.083	.155
Sex (B)	1	.083	.155
A X B	1	.750	1.394
Error	44	.568	

Bartlett $\chi^2(3) = .521$

2. Cross-Validation

Mood (A)	1	5.333	10.458**
Sex (B)	1	2.083	4.085*
A X B	1	1.333	2.614
Error			

Bartlett $\chi^2(3) = 3.981$

**$P < .01$ *$P < .05$

TABLE 6

Means and Standard Deviations of Years Spent by the Subjects in Psychiatric Treatment

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	1.50	1.67	1.67	1.33
SD	.80	.78	.78	.65

Cross-Validation Sample

N	12	12	12	12
Mean	1.58	2.33	1.25	1.33
SD	.79	.78	.45	.78

validation sample, significant differences were found between the experimental and control groups ($F(1,44) = 10.458$, $P < .01$) and between men and women ($F(1,44) = 4.085$, $P < .05$). As can be seen from Table 6, this was primarily due to the women in the experimental group, who had an average of 2.33 years of psychiatric treatment.

Intelligence of the Subjects

The estimated I.Q. (Shipley Institute of Living Scale) of the subjects ranged from dull normal to superior levels of intelligence. Only subjects who scored a C.Q. (Conceptual Quotient) above 70 were selected for the study. Inspection of Tables 7 and 8 reveals that analysis of I.Q. scores yielded no significant differences between depressed and non-depressed patients. A significant interaction ($F(1,44) = 6.44$, $P < .05$) between mood and sex of the subjects was observed in the validation sample which however, was not cross-validated.

Achievement Motivation of the Subjects

The validation sample yielded significant differences in achievement motivation between men and women ($F(1,44) = 12.305$, $P < .01$) (Table 9). The experimental male group showed significantly higher Mean than the experimental female group, while an opposite trend was observed in the comparisons of male and female control groups. However,

TABLE 7

Intelligence of the Subjects: Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	82.688	.315
Sex (B)	1	58.521	.223
A X B	1	1692.188	6.44*
Error	44	262.748	

Bartlett $\chi^2(3) = 1.103$

2. Cross-Validation

Mood (A)	1	33.33	.101
Sex (B)	1	520.083	1.582
A X B	1	396.75	1.207
Error	44	328.739	

Bartlett $\chi^2(3) = 2.434$

---

*$P < .05$

TABLE 8

Means and Standard Deviations of Intelligence of the Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	102.17	111.83	116.67	103.00
SD	17.21	17.15	17.07	13.00

Cross-Validation Sample

N	12	12	12	12
Mean	103.75	102.92	111.17	98.84
SD	17.90	17.37	22.39	13.84

TABLE 9

Achievement Motivation of the Subjects: Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	117.188	3.483
Sex (B)	1	414.188	12.309*
A X B	1	6.021	.179
Error	44	33.650	

Bartlett $\chi^2(3) = 1.323$

2. Cross-Validation

Mood (A)	1	21.33	.37
Sex (B)	1	120.333	2.097
A X B	1	52.083	.908
Error	44	57.367	

Bartlett $\chi^2(3) = 4.202$

---

*$P < .01$

the cross-validation sample (Table 10) did not yield these differences.

Beck Depression Inventory (BDI)

The mean BDI scores (Table 12) for all groups of this study are relatively high, ranging from a low Mean of 10.75 (which indicates at least mild depressive symptoms) to a high Mean of 20.07. However, a 2 X 2 analysis of variance (Table 11) showed significant differences between the experimental and control groups both in the validation ($F(1,44) = 7.686$, $P < .01$) and cross-validation ($F(1,44) = 4.488$, $P < .05$) samples. Differences between the sexes were not statistically significant.

Depression Adjective Checklist (DACL)

Unexpectedly, the DACL scores did not show any significant differences between experimental and control groups in the validation or the cross-validation samples (Tables 13 & 14). A significant difference between men and women ($F(1,44) = 4.627$, $P < .05$) in the validation sample was not replicated in the cross-validation.

Materials

Shipley Institute of Living Scale

This scale (Shipley, 1940, 1941) was originally known as the Shipley-Hartford Retreat Scale (Shipley). It

TABLE 10

Means and Standard Deviations of Achievement Motivation of the Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	9.17	4.00	13.00	16.42
SD	6.28	4.57	6.28	9.90

Cross-Validation Sample

N	12	12	12	12
Mean	9.17	8.08	9.92	4.67
SD	7.17	8.31	9.21	4.92

TABLE 11

Beck Depression Inventory Scores (BDI) of the Subjects:

Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	638.021	7.686**
Sex (B)	1	25.521	.307
A X B	1	58.521	.705
Error	44	83.009	

Bartlett $\chi^2(3) = 5.803$

2. Cross-Validation

Source	df	MS	F
Mood (A)	1	481.333	4.488*
Sex (B)	1	.333	.003
A X B	1	8.333	.078
Error	44	107.242	

Bartlett $\chi^2(3) = 14.008$**

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*$P < .05$ **$P < .01$

TABLE 12

Means and Standard Deviations of BDI Scores of the Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	20.25	19.50	10.75	14.42
SD	12.03	8.94	5.58	8.73

Cross-Validation Sample

N	12	12	12	12
Mean	20.00	20.67	14.50	13.50
SD	10.39	14.59	9.55	4.10

TABLE 13

Depression Adjective Check List (DACL) Scores of the Subjects: Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	20.021	.514
Sex (B)	1	180.188	4.627*
A X B	1	13.021	.334
Error	44	38.938	

Bartlett $\chi^2(3) = 1.347$

2. Cross-Validation

Mood (A)	1	60.75	1.384
Sex (B)	1	.333	.008
A X B	1	6.750	.154
Error	44	43.905	

Bartlett $\chi^2(3) = 6.173$

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* $P < .05$

TABLE 14

Means and Standard Deviations of Depression Adjective Check List Scores of the Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	8.00	10.83	5.67	10.58
SD	6.97	5.11	5.80	6.88

Cross-Validation Sample

N	12	12	12	12
Mean	10.17	9.25	7.17	7.75
SD	5.51	7.29	8.42	4.09

was originally devised for the purpose of providing a quick, objective, self-administering group test of intellectual impairment. The manual offers an estimate of mental age for total raw scores (vocabulary plus abstraction). It is possible to compute an estimate of the IQ of the person (Standford-Binet Equivalence) from this mental age. This estimated IQ was used in this study to check roughly the comparability of the groups in intellectual ability.

Beck Depression Inventory (BDI)

This inventory consists of 21 categories of depressive symptoms and attitudes. Describing a specific behavioral manifestation of depression, each category consists of a graded series of four self-evaluative statements which are ranked to reflect neutral to maximal severity of the symptom. Numerical values from zero to three are assigned each statement to indicate the degree of severity. A split-half reliability of .93 (Pearson *r* with Spearman Brown Corrections) is reported for the BDI (Beck, 1967). Concurrent validity (Correlations with psychiatric ratings) of .61, 165, .66, and .67, from independent studies are cited by Beck, 1967. According to Becker (1974), Beck's Depression Inventory is probably the best developed and most widely used self-report

depression measure.

Depression Adjective Check List (DACL)

Form B is used in this study. This check list (Lubin, 1967), consisting of 32 adjectives, is expected to measure transient depressive mood. Split-half reliability-coefficients of .88 (males) and .93 (females) are cited (Lubin, 1967). Correlation with BDI ranges from .40 to .66 (Beck, 1967).

Adjective Check List (ACL)

Available since 1952, Adjective check list is an alphabetic list of adjectives from "absentminded" to "zany," to which a subject responds by marking those that are self-descriptive (Gough & Heilburn, 1952). The ACL has been primarily a research instrument which can be scored for 24 variables including 15 needs.

In this study, adjectives which are expected to measure need for Achievement (Ach) were used. The high-scoring subject on Ach is usually seen as intelligent and hard-working, and interested in his intellectual and other endeavors. He is seen as usually succeeding and is determined to do well. He is easily trusting and optimistic. On the other hand, the low-scoring subject on Ach is seen as more skeptical, more dubious about the rewards which

might come from an effort and involvement, and uncertain about risking his labors. He is also seen as withdrawn and dissatisfied with his current status.

Zeigarnik Tasks

The tasks as presented by Mackinnon & Henle (1948) were used. They consist of 20 paper-and-pencil tests which a person of average intelligence with average reading and writing skills can successfully complete. Solving simple codes, writing antonyms of familiar words, simple additions, crossword puzzle, remembering a stanza of a poem are some examples of the tasks. In a Zeigarnik experiment, subjects are administered a number of tasks, half are interrupted before completion, half are allowed to be completed. The subjects are then asked to recall as many tasks as they can remember. The twenty tasks may take up to an hour to complete. The difficulty levels of the tasks vary and so does the time required for the completion of the tasks.

Rating Scales of "Importance" and Pleasantness"

Two rating scales require the subjects to rate the tasks on a five-point scale with five as the highest

rating. One scale rated the tasks' "importance in tapping skills for daily adaptive living". The second scale rates the degree to which the subjects personally liked the tasks.

Experimental Procedure

At the time of recruiting, the subjects were informed that they were being invited to participate voluntarily in a research project approved by the Department of Developmental Disabilities and Mental Health, State of California, and of the Department of Mental Health, County of San Bernardino, California. They were also informed that the purpose of the study was to investigate how emotions affect learning abilities (Appendix A). The potential subjects of the experiment were told that the experiment consisted of paper-and-pencil tests similar to the ones they may have taken in a hospital setting or school. The confidential nature of the records and the ethical obligations of the researcher were explained to the subjects. Subjects who volunteered reviewed and signed an informed consent form and a date was scheduled.

All subjects were tested in small groups, ranging from five to 14 members. The experiments were conducted under similar physical conditions. Each person was seated separately in a manner that precluded any influence upon,

or from, another subject by consultation or observation.

Before the presentation of the experimental tasks, the subjects were administered the Shipley Institute of Living Scale, the Beck Depression Inventory, the Depression Adjective Check list, and the Adjective Check list for achievement Motivation. This was followed by a short period of rest.

After subjects reassembled, they were given the instructions: "I shall give you a series of tasks which you are to complete as rapidly and correctly as possible" (Zeigarnik, 1927, p. 300). The subjects were then given the 20 Zeigarnik Tasks one by one. Of these 20 tasks, ten were interrupted before completion according to a prearranged order which was balanced. Thus, for example, in "Order A", task numbers 2, 5, 7, 8, 10, 13, 14, 16, 17 and 20, and in "Order B", task numbers 1, 3, 4, 6, 9, 11, 12, 15, 18 and 19 were interrupted. Half the number of the subjects in the experimental and control groups was given "Order A", the other half "Order B". Identical procedures were used for the validation and cross-validation groups. When a task was to be interrupted, the experimenter observed the subjects carefully and when most of the subjects completed more than half of the task, he looked at his stop watch, which he carried in his hand during the entire experiment, and said, "Please stop

working now, whether you completed the test or not, let us please proceed to the next." The next task was administered immediately. The same procedures were followed for the completed tasks with the exception that the experimenter made sure, without the subjects being alerted, that all subjects had completed the tasks before they were allowed to proceed to the next.

When administration of all the tasks was completed, all papers were removed from the tables and the subjects were provided with blank sheets of paper. Then the following instruction was given: "Now, please write down what the tasks were upon which you worked. If you have difficulty naming a task, please describe it in a few sentences." After seven minutes, the subjects were requested to draw a heavy line under their last written response. The experimenter then examined each answer sheet to make sure he understood what each subject meant by what he wrote. The papers were removed.

The two rating scales were administered next. After supplying the subjects with the first rating sheet, they were given the following instructions:

> The experimenter will now review each task one by one to refresh your memory. Please indicate the relative importance of the skill used in each of the tasks for daily adaptive living, by placing an "X" in the appropriate column next to the task names. You are rating the importance of each task on a five-point

> scale, ranging from "Very Important" to "Totally Unimportant." Please take your time and answer carefully.

Describing each task in detail, the experimenter then reviewed each task with the group.

After removing the papers, the second rating scale was given to the subjects with the instructions:

> Please rate each of the tasks in terms of how much you personally liked it. Please rate each of them on a five-point scale, ranging from "Liked Very Much" to "Disliked Very Much."

The experimenter reviewed the tasks again one by one, as described earlier.

The subjects were then debriefed about the entire experimental procedure in nontechnical terms and a short discussion followed. The subjects were thanked for their cooperation.

CHAPTER IV

RESULTS

Recall of Completed and Interrupted Tasks

The null hypothesis relating to recall (H_{01}) states that the depressed patients do not differ from nondepressed psychiatric patients in the recall of interrupted versus completed tasks. In order to evaluate this hypothesis, a three-factor analysis of variance was employed with mood (depressed vs. nondepressed) sex and task (completed vs. interrupted) as independent variable and number of tasks recalled as dependent variables. The results of this analysis are presented in Tables 15 and 16. In the validation sample, one observes a significant interaction ($F(1, 44) = 9.85$, $P < .01$) between mood and sex of the subjects. In the depressed groups (experimental groups) the females recalled more completed as well as interrupted tasks than males, in the nondepressed groups (control groups) the females recalled fewer completed and interrupted tasks than males. Both the depressed and nondepressed groups tended to recall more completed tasks than incompleted tasks. In the cross-validation sample, except

TABLE 15

Recall of Interrupted vs. Completed Tasks: Summary of Analyses of Variance

Validation

Source	df	MS	F
Between	47		
Mood (A)	1	3.01	.633
Sex (B)	1	11.34	2.39
A X B	1	46.77	9. 85 **
Error Between	44	4.77	
Within	48		
Task (C)	1	14.26	5.167*
A X C	1	1.26	.46
B X C	1	.10	.04
A X B X C	1	1.25	.45
Error Within	44	2.76	

Cross-Validation

Between	47		
Mood (A)	1	2.66	.72
Sex (B)	1	22.04	5.96*
A X B	1	8.17	2.21
Error Between	44	3.70	
Within	48		
Task (C)	1	1.04	.68
A X C	1	.67	.44
B X C	1	5.04	3.27
A X B X C	1	1.50	.97
Error Within	44	1.54	

* $P < .05$ ** $P < .01$

TABLE 16

Means and Standard Deviations of Recall of Interrupted vs. Completed Tasks

Validation Sample

	Depressed				Nondepressed			
	Male		Female		Male		Female	
	Com.	Inc.	Com.	Inc.	Com.	Inc.	Com.	Inc.
N	12	12	12	12	12	12	12	12
Mean	5.08	4.25	5.5	5.25	6.83	6.00	4.92	3.75
SD	1.66	2.13	2.06	1.58	2.15	1.35	2.14	1.59

Cross-Validation Sample

N	12	12	12	12	12	12	12	12
Mean	5.17	5.00	5.00	4.42	5.67	6.33	4.83	4.08
SD	1.62	2.31	1.35	1.75	1.37	1.25	1.28	1.11

for the control male group, all the other groups showed a nonsignificant tendency ($P > .05$) towards remembering completed tasks more frequently than the interrupted tasks. A significant difference ($F(1, 44) = 5.96$, $P < .05$) was observed between the sexes. All the male groups remembered more completed as well as interrupted tasks than the female groups. None of the findings were cross-validated and consequently, the null hypothesis was sustained. Furthermore, the classical Zeigarnik Effect, i.e., that interrupted tasks enjoy a memorial advantage over completed tasks, was not reflected in the data. On the contrary, an opposite trend was observed.

Implicit in the recall hypothesis of this study is the proposition that the memorial advantage of interrupted tasks over the completed tasks (the Zeigarnik Effect) is different for depressed and nondepressed patients. Zeigarnik measured the Zeigarnik Effect by the ratio of interrupted tasks recalled to the completed tasks recalled IR/CR. In order to increase the comparability, with Zeigarnik's findings, a Zeigarnik Ratio was computed for each subject and multiplied by 100. This ratio IR X 100/ CR is hereafter called the Zeigarnik Quotient (ZQ). The Zeigarnik Quotient was used as the dependent measure in a two-factor analysis of variance with mood and sex as independent variables. The results are presented in

Table 17. There were no significant differences in the validation or cross-validation samples. If a memorial advantage is obtained for the interrupted tasks, the Zeigarnik Quotient means should be significantly above 100; if the completed tasks are remembered more frequently, the means should be significantly below 100. Table 18 shows that none of the means differed significantly as determined by 't' test from 100 (t, $P > .05$). Thus, none of the groups showed a proclivity for recalling more interrupted tasks than completed tasks, or vice-versa. The results are in striking contrast to Zeigarnik's findings (in her group experiments with adults), which yielded a Zeigarnik quotient of 190 (Zeigarnik, 1927).

Ratings of Importance

The subjects rated each of the 20 experimental tasks in terms of its importance to daily adaptive living. The null hypothesis (H_{02}) in this regard states that the depressed patients do not differ from nondepressed psychiatric patients in the rating of interrupted and completed tasks. In order to facilitate comparison with the Zeigarnik Quotient, two scores were computed for the ratings of importance. The first consisted of the ratio of the total rating of interrupted tasks to the total rating of completed tasks multiplied by 100 (100 X RIA/

TABLE 17

Zeigarnik Quotient (ZQ) 100 X IR/CR of the Subjects:

Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	475.650	.116
SEX (B)	1	1253.585	.305
A X B	1	1581.255	.384
Error	44	4116.035	

Bartlett $\chi^2(3) = 3.089$

2. Cross-Validation

Mood (A)	1	1600.830	1.149
Sex (B)	1	4118.108	2.955
A X B	1	1778.768	1.276
Error	44	1393.761	

Bartlett $\chi^2(3) - 1.435$

TABLE 18

Means and Standard Deviations of Zeigarnik Quotient Obtained By the Subjects

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	89.28	110.98	107.06	105.80
SD	48.58	55.80	67.01	80.62
t (difference from 100)	.76	.68	.36	.25

Cross-Validation Sample

N	12	12	12	12
Mean	96.43	90.07	120.14	89.44
SD	34.54	32.54	45.29	35.67
t (difference from 100)	.36	1.06	1.54	1.02

RCA). This score provided information as to how the subject rated the tasks independent of recall; and whether he favored the interrupted or completed task in his ratings. For example, a score above 100 favored the interrupted tasks independent of whether they were remembered or not, while a score below 100 favored the completed tasks regardless whether they were recalled or not. An analysis of variance with this score as dependent variable, and with mood and sex as independent variables revealed no significant differences between groups (Table 19). A t-test was done to check whether the mean differed significantly from 100 (Table 20). The depressed female group of the cross-validation sample favored significantly ($t(11) = 2.52$, $P < .05$) the completed tasks to the interrupted tasks. All the other groups in the validation as well as cross-validation samples rated equally the completed as well as interrupted tasks.

A second score was based on the ratio of the mean ratings of importance of interrupted tasks which were recalled to the mean ratings of completed tasks which were recalled multiplied by 100 (100 R1/RC). This score was computed in order to obtain information as to how the subjects rated the recalled tasks. Again, a score above 100 showed that the subject favored the interrupted tasks in his ratings, and a score below 100 showed that he

TABLE 19

Total Ratings of Importance (Im. 100 X ≥RIA/ ≥RCA)

Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	17.763	.039
Sex (B)	1	82.163	.183
A X B	1	21.87	.049
Error	44	449.853	

Bartlett $\chi^2(3) = 5.021$

2. Cross-Validation

Source	df	MS	F
Mood (A)	1	224.035	.743
Sex (B)	1	84.535	.280
A X B	1	301.502	1.00
Error	44	301.506	

Bartlett $\chi^2(3) = 2.787$

TABLE 20

Means and Standard Deviations of Total Ratings of Importance (Im. 100 X $\leq$ RIA/ $\leq$ RCA)

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	100.60	99.33	100.73	96.77
SD	19.28	16.06	29.34	17.58
t (difference from 100)	.11	.15	.09	.64

Cross-Validation Sample

N	12	12	12	12
Mean	96.07	88.40	95.38	97.73
SD	12.69	16.01	20.84	18.82
t (difference from 100)	1.07	2.51*	.77	.40

*$P < .05$

preferred the completed tasks in his ratings. An analysis of variance, with this score as dependent variable, and mood and sex as independent variables, revealed no significant differences between groups (Table 21). The mean scores of the groups did not differ significantly from 100 as determined by t-tests. Thus, no group favored either the recalled completed tasks or the recalled interrupted tasks in their ratings of importance.

Ratings of Pleasantness

The procedures described above were also used to analyze the data on the ratings of pleasantness. The results are summarized in Tables 22 to 26 and show that the null hypothesis was sustained. The experimental and control groups did not differ significantly from each other. Neither were there any sex differences. The groups did not favor either the completed or interrupted tasks in their ratings of pleasantness.

A significant ($P < .05$) lack of homogeneity of variance among groups was observed with regard to the rating of pleasantness. The Bartlett's Test of Homogeneity of Variance revealed chi squares significant $\chi^2(3) = 8.098$, $P < .05$ for the validation sample and for the cross-validation sample $\chi^2(3) = 15.643$, $P < .01$ for the total rating of pleasantness (Table 23). However, in comparing

TABLE 21

Mean Ratings of Importance of Tasks Recalled ($100\bar{R}I/\bar{R}C$): Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	89.927	.072
Sex (B)	1	883.225	.703
A X B	1	437.417	.348
Error	44	1256.793	

Bartlett $\chi^2(3) = 6.559$

2. Cross-Validation

Mood (A)	1	1422.452	2.105
Sex (B)	1	232.76	.345
A X B	1	1853.81	2.744
Error	44	675.639	

Bartlett $\chi^2(3) = 5.164$

TABLE 22

Means and Standard Deviations of Mean Ratings of Importance of Tasks Recalled ($100\ \bar{RI}/\bar{RC}$)

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	106.58	104.04	109.88	95.27
SD	27.0	24.85	49.79	34.61
t (difference from 100)	.84	.56	.69	.47

Cross-Validation Sample

N	12	12	12	12
Mean	96.43	88.40	94.88	111.72
SD	16.23	24.39	27.19	33.24
t (difference from 100)	.76	1.65	.65	1.22

TABLE 23

Total Rating of Pleasantness (100 RIA/RCA)

Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	.030	.001
Sex (B)	1	106.803	.036
A X B	1	208.333	.070
Error	44	296.510	

Bartlett $\chi^2(3) = 8.098$*

2. Cross-Validation

Mood (A)	1	383.07	.598
Sex (B)	1	332.853	.520
A X B	1	504.403	.788
Error	44	640.487	

Bartlett $\chi^2(3) = 15.643$**

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* $P < .01$ ** $P < .01$

TABLE 24

Means and Standard Deviations of Total Ratings of Pleasantness (100 RIA/RCA)

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	94.46	101.61	98.68	97.49
SD	15.07	25.36	13.20	11.89
t (difference from 100)	1.27	.23	.35	.73

Cross-Validation Sample

N	12	12	12	12
Mean	104.61	92.86	92.48	93.69
SD	41.37	17.19	15.69	17.58
t (difference from 100)	.39	1.44	1.66	1.24

TABLE 25

Mean Ratings of Pleasantness of Tasks Recalled

(100 $\overline{RI}/\overline{RC}$: Summary of Analyses of Variance

1. Validation

Source	df	MS	F
Mood (A)	1	2354.801	2.703
Sex (B)	1	5.468	.006
A X B	1	1052.813	1.209
Error	44		

Bartlett $\chi^2(3) = 9.187$*

2. Cross-Validation

Mood (A)	1	893.550
Sex (B)	1	14.630
A X B	1	1307.297
Error	44	1274.859

Bartlett $\chi^2(3) = 20.688$**

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*$P < .05$ **$P < .01$

TABLE 26

Means and Standard Deviations of Mean Ratings of Plesantness of Tasks Recalled ($100\ \bar{R}I/\bar{R}C$)

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	88.54	98.58	111.92	103.23
SD	28.56	19.15	43.23	20.80
t (difference from 100)	1.39	.26	.95	.54

Cross-Validation Sample

N	12	12	12	12
Mean	107.18	95.64	88.12	97.45
SD	59.18	19.88	17.34	30.02
t (difference from 100)	.42	.76	2.37*	.29

*$P < .05$

the variances of the groups, it was observed that in the validation sample the depressed male group was significantly ($F(11,11) = 2.83$, $P < .05$) more homogeneous than the depressed females, while in the cross-validation sample, a significant and ($F(11,11) = 5.79$, $P < .01$) opposite tendency was observed (Table 24). In the validation sample, the depressed females were less homogeneous than nondepressed males or nondepressed females ($F(11,11) = 3.69$, $P < .05$ and $F(11,11) = 4.55$, $P < .01$, respectively). However, these differences were not observed in the cross-validation sample.

Table 25 shows that in the ratings of the pleasantness of recalled tasks there was a significant lack of homogeneity of variances among the groups ($\chi^2(3) = 9.187$, $P < .05$ for the validation sample and $\chi^2(3) = 20.688$, $P < .01$ for the cross-validation sample). Comparing the variances, it was noted that both, the validation and cross-validation samples, exhibited a consistent tendency for the depressed male groups to be less homogeneous than the depressed or the nondepressed female groups (Table 26). In the cross-validation sample, this tendency was statistically significant ($F(11,11) = 8.86$, $P < .01$ between depressed males and depressed females, and $F(11,11) = 3.89$, $P < .05$ between depressed males and nondepressed females). While in the validation sample the depressed

males demonstrated a tendency to be more homogeneous than nondepressed males ($F(11,11) = 2.29$, $P > .10$), in the cross-validation $F(11,11) = 11.65$, $P < .01$, a significant tendency to the contrary was observed.

The statistical defensibility of the method of computing the Zeigarnik Ratio scores has been questioned. (Marrow, 1938). The Zeigarnik Ratio is computed by dividing the number of interrupted tasks recalled by the number of completed tasks recalled. The mean ratio score for the group is obtained by averaging the individual ratio scores. This procedure leads to a mathematical bias of the mean in favor of the interrupted tasks. Let us suppose, for example, that a subject recalled four interrupted tasks and two completed tasks, and, thus, obtains a Zeigarnik Ratio score of 2.00, while another subject recalled two interrupted tasks and four completed tasks, and a Zeigarnik Ratio score of .50. The mean ratio score for the two subjects, in the manner Zeigarnik computed it, is 1.25 (i.e., (2.00 + .50)/2 = 1.25). This mean clearly indicates that, on the average, more interrupted tasks are recalled than completed ones. This is clearly not the case, since the total number of interrupted tasks recalled (4+2) is equal to the total number of completed tasks recalled (2+4). Thus, it is obvious that, while the Zeignarik Ratio score is quite true for an individual subject, averaging these for the group

produces a mathematical bias in favor of the interrupted tasks.

In order to avoid this mathematical bias inherent in the traditional way of computing the Zeigarnik Ratio scores, the Zeigarnik Ratio scores less than 1.0 (or more precisely, less than 100) obtained in this study were transformed into mathematically unbiased deviation scores by a formula developed by Fox[2] (see Appendix). Data which include the transformed scores were subjected to the same analyses as the untransformed scores. The results are summarized in Tables 27-36.

Neither in the validation nor the cross-validation samples did we find any significant differences between the depressed and non-depressed groups in the manner in which completed and interrupted tasks were recalled (Tables 27 and 28). None of the group-means differed significantly from 100 (t, $P < .05$) indicating an absence of a significant Zeigarnik effect. In the ratings of importance or pleasantness, there were no differences between the depressed and nondepressed groups (Tables 29-36). All the groups rated both completed and interrupted tasks as equally important with the exception that the depressed female group in the cross-validation sample

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[2] J. Fox, Personal communication, July 4, 1981.

TABLE 27

Zeigarnik Quotient (100 IR/CR), Transformed Scores

Summary of Analyses of Variance

Source	df	MS	F
Validation			
Mood (A)	1	148.16	.01
Sex (B)	1	130.65	.01
A X B	1	36435.98	1.90
Error	44	19167.37	
Bartlett $\chi^2(3) = 17.03$*			
Cross-Validation			
Mood (A)	1	4522.53	1.13
Sex (B)	1	5088.61	1.27
A X B	1	6209.39	1.55
Error	44	4018.41	
Bartlett $\chi^2(3) = 6.33$			

*$P < .01$

TABLE 28

Means and Standard Deviations of Zeigarnik Quotient, Transformed Scores

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	45.84	97.64	97.43	39.02
SD	127.98	74.23	75.37	221.58
t (difference from 100)	1.47	.11	.12	.95

Cross Validation Sample

N	12	12	12	12
Mean	75.20	77.36	117.37	74.03
SD	91.39	48.46	48.78	54.72
t (difference from 100)	.94	1.62	-1.23	1.64

Ratio of Total Ratings of Importance (Im. 100 RIA/RCA),

Transformed Ratios: Summary of Analyses of Variance

Source	df	MS	F
Validation			
Mood (A)	1	45.59	.08
Sex (B)	1	45.24	.08
A X B	1	26.14	.05
Error	44	576.91	
Bartlett $\chi^2(3) = 4.55$			
Cross-Validation			
Mood (A)	1	107.25	.16
Sex (B)	1	85.41	.13
A X B	1	872.36	1.29
Error	44	678.16	
Bartlett $\chi^2(3) = 6.94$			

TABLE 30

Means and Standard Deviations of Total Ratings of Importance, Transformed Scores

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	98.49	98.03	98.02	94.60
SD	22.66	17.76	32.56	20.46
t (difference from 100)	.23	.38	.21	.91

Cross Validation Sample

N	12	12	12	12
Mean	94.31	83.12	88.77	94.63
SD	16.07	23.52	36.69	23.56
t (difference from 100)	1.23	2.49*	1.06	.79

*$P < .01$

TABLE 31

Mean Ratings of Importance of Tasks Recalled (100 RI/RC), Transformed Ratios: Summary of Analyses of Variance

Source	df	MS	F
Validation			
Mood (A)	1	1435.09	.59
Sex (B)	1	3148.15	1.29
A X B	1	2278.25	.94
Error	44	2432.06	
Bartlett $\chi^2(3) = 12.95$**			
Cross-Validation			
Mood (A)	1	687.20	.43
Sex (B)	1	288.32	.18
A X B	1	4554.81	2.82
Error	44	1612.82	
Bartlett $\chi^2(3) = 9.93$*			

*$P < .05$ **$P < .01$

TABLE 32

Means and Standard Deviations of Mean Ratings of Importance of Tasks Recalled, Transformed Scores

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	104.45	102.03	107.29	77.32
SD	30.14	27.13	52.17	73.23
t (difference from 100)	-.51	-.26	-.48	1.07

Cross-Validation Sample

N	12	12	12	12
Mean	94.37	79.79	82.45	106.84
SD	19.39	35.24	55.18	42.28
t (difference from 100)	1.01	1.99*	1.10	-.56

*P < .05

TABLE 33

Total Rating of Pleasantness, Transformed Scores:

Summary of Analyses of Variance

Source	df	MS	F
Validation			
Mood (A)	1	9.35	.03
Sex (B)	1	129.59	.36
A X B	1	300.15	.83
Error	44	363.80	
Bartlett $\chi^2(3) = 5.78$			
Cross-Validation			
Mood (A)	1	570.22	.73
Sex (B)	1	500.78	.64
A X B	1	607.05	.77
Error	44	785.75	
Bartlett $\chi^2(3) = 8.69$*			

*$P < .05$

TABLE 34

Means and Standard Deviations of Total Ratings of Pleasantness, Transformed Scores

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	91.99	100.28	97.88	96.16
SD	18.55	26.60	14.11	14.29
t (difference from 100)	1.50	-.04	.52	.93

Cross-Validation Sample

N	12	12	12	12
Mean	103.31	89.74	89.31	89.96
SD	42.18	20.65	19.72	23.42
t (difference from 100)	-.27	1.72	1.88	1.49

TABLE 35

Mean Rating of Pleasantness, Transformed Scores:

Summary of Analyses of Variance

Source	df	MS	F
Validation			
Mood (A)	1	5170.28	3.36
Sex (B)	1	653.65	.42
A X B	1	3026.25	1.96
Error	44	1540.54	
Bartlett $\chi^2(3) = 14.24$*			
Cross-Validation			
Mood (A)	1	1629.37	1.07
Sex (B)	1	.82	.001
A X B	1	1428.77	.94
Error		1525.45	
Bartlett $\chi^2(3) = 13.10$*			

*$P < .01$

TABLE 36

Mean and Standard Deviations of Mean Ratings of Pleasantness of Tasks Recalled, Transformed Scores

Validation Sample

	Depressed		Nondepressed	
	Male	Female	Male	Female
N	12	12	12	12
Mean	73.83	97.09	110.47	101.97
SD	56.86	20.83	44.75	22.19
t (difference from 100)	1.59	.48	-.81	.31

Cross-Validation

N	12	12	12	12
Mean	104.78	93.61	82.21	92.87
SD	60.51	21.64	25.75	36.17
t (difference from 100)	-.27	1.02	2.39*	.68

* $P < .05$

rated the completed tasks as more important than the interrupted tasks ($t(11) = 2.49$, $P < .01$). With regard to the ratings of pleasantness of tasks that were recalled (Table 36), the nondepressed female group in the cross-validation sample significantly preferred the completed tasks to interrupted tasks ($t(11) = 2.39$, $P < .05$), while the opposite tendency was observed for the corresponding group in the validation sample ($t(11) = -.81$, $P > .05$).

In the rating of pleasantness of tasks which were recalled (Table 35), a remarkable lack of homogeneity of variances was observed. The corrected chi squares for both the validation ($\chi^2(3) = 14.24$, $P < .01$) and cross-validation samples ($\chi^2(3) = 13.10$, $P < .01$) were highly significant. In comparing the variances, it was found that in the validation sample, the variance of the experimental male group differed significantly from the variances of the experimental female group ($F(11, 11) = 7.45$, $P < .01$) and the control female group ($F(11, 11) = 6.57$, $P < .01$) and the variance of the experimental female group differed significantly from the variance of the control male group ($F(11, 11) = 4.62$, $P < .01$). In the cross-validation sample, the experimental male group differed significantly from the experimental female group ($F(11, 11) = 7.82$, $P < .01$). Thus, there was a consistent and cross-validated significant difference in variance

between depressed males and females. Thus, the depressed males showed a significantly greater tendency toward more extreme pleasantness ratings than the depressed females.

In order to determine how subject variables, such as age, IQ, and achievement motivation, were related to the Zeigarnik effect, coefficients of correlation between these variables and the Zeigarnik Quotient scores were computed (Table 37). None of the coefficients of correlations were significant ($P > .10$) for the validation or the cross-validation samples.

To increase the comparability of this study with that of Johnson et al (1981), it was thought useful to combine the validation and cross-validation samples on the basis of the subjects' scores on Beck Depression Inventory (BDI) and to select samples which were controlled for level of intelligence and achievement motivation. Subjects who scored higher than 15 on the BDI were selected for the experimental (depressed) groups; subjects who scored less than 10 on the BDI for the control (nondepressed) groups (Table 41). Achievement motivation and IQ were matched for all the groups (Table 41). This procedure yielded 40 subjects. An analysis of variance, with mood, sex, and tasks, as independent variables, and recall as dependent variable, was employed (Table 38). No significant differences were found between the depressed and nondepressed groups ($F(1, 36) = 1.96$, $P > .05$) , or the

TABLE 37

Correlation of Age, IQ, Achievement Motivation and Beck Depression Inventory Scores with Zeigarnik Quotient (Transformed Scores)

	N	Mean	SD	SEM	r	t
Age						
Validation	48	31.29	8.39	1.21	.02	.15
Cross-Validation	48	32.92	12.48	1.80	.07	.48
IQ						
Validation	48	108.31	16.88	2.44	.13	.86
Cross-Validation	48	104.17	18.11	2.61	.04	.25
Achievement Motivation						
Validation	48	8.15	6.55	.95	.10	.68
Cross-Validation	48	7.96	7.60	1.09	.05	.37
Beck Depression Scores						
Validation	48	16.23	9.65	1.39	-.43	3.26*
Cross-Validation	48	17.17	10.53	1.52	.14	.93
Zeigarnik Quotient						
Validation	48	72.60	135.68	19.58		
Cross-Validation	48	85.92	64.03	9.24		

*$P < .01$

TABLE 38

Recall of Completed vs. Interrupted Tasks by Subjects Selected on the Basis of BDI Scores Matched on IQ and Achievement Motivation: Summary of Analysis of Variance

Source	df	MS	F
Mood (A)	1	10.00	1.96
Sex (B)	1	8.65	1.69
A X B	1	2.25	.44
Error Between	36	5.11	
Recall (C)	1	5.20	2.01
A X C	1	3.00	1.16
B X C	1	2.25	.87
A X B X C	1	.25	.09
Error Within	36	2.59	

TABLE 39

Rating of Importance by Subjects Selected on the Basis of BDI Scores and Matched on IQ and Achievement Motivation: Summary of Analysis of Variance

Source	df	MS	F
Mood (A)	39		
Sex (B)	1	.03	.04
A X B	1	2.89	3.75
Error Between	36	.77	
Rating of Importance (C)	1	.50	1.47
A X C	1	.01	.03
B X C	1	.001	.002
A X B X C	1	.89	2.62
Error Within	36	.34	

TABLE 40

Rating of Pleasantness by Subjects Selected on the Basis of BDI Scores and Matched on IQ and Achievement Motivation: Summary of Analysis of Variance

Source	df	MS	F
Mood (A)	1	.15	.23
Sex (B)	1	.23	.36
A X B	1	.77	1.20
Error Between	36	.64	
Rating of Pleasantness	1	.15	.37
A X C	1	.27	.66
B X C	1	.25	.61
A X B X C	1	.04	.10
Error Within	36	.41	

TABLE 41

Means and Standard Deviations of IQ, Achievement and Depression Scores of Subjects for the Matched Groups

	Depressed		Nondepressed	
	Male	Female	Male	Female
IQ				
N	10	10	10	10
Mean	104.3	100.6	107.5	101.6
SD	10.90	11.84	18.65	19.25
Achievement (ACL)				
N	10	10	10	10
Mean	7.4	5.3	8.8	7.1
SD	4.99	3.09	4.91	3.07
Depression (BDI)				
N	10	10	10	10
Mean	22.5	20.9	6.9	8.5
SD	5.10	3.60	3.98	2.91

sexes ($F(1,36) = 1.69$, $P > .05$). The recall of interrupted tasks was not significantly different from the recall of completed tasks $F(1,36) = 2.01$, $P > .05$. Similar analytic procedures were performed with the ratings of importance and the ratings of pleasantness (Tables 39 and 40). There were no significant differences between the groups ($P > .05$).

CHAPTER V

DISCUSSION

The major thrust of this study was to investigate whether nonpsychotic depression affected the recall of interrupted and completed tasks in a systematic and differential manner. The results show clearly that depressed patients do not recall interrupted or completed tasks in a manner different from nondepressed psychiatric patients. The hypothesis derived from cognitive and behavioristic theories that depressed patients are likely to remember more interrupted tasks than completed tasks did not receive support from this study. Neither did the hypothesis derived from the psychoanalytic theory that depressed patients would recall more completed than interrupted tasks.

It was suggested that depressed patients would interpret interruptions of tasks as personal failures, would ruminate about them, and, therefore, remember them more effectively. It was also proposed that, for the same reasons, depressed patients would rate interrupted tasks differently from the way the nondepressed patients did.

The hypothesis derived from the psychoanalytic theory of depression that if depressed patients experience the interrupted tasks (failures) as more unpleasant than completed tasks (successes), they should recall fewer interrupted tasks than completed tasks, because unpleasant experiences will be repressed, was not sustained. This study shows that the depressed patients did not experience the interrupted tasks as less pleasant than the completed tasks. Consequently, the affective tone of the tasks could not influence the recall in a differential manner.

The findings would incline one to a careful analysis of the experimental design of this study for at least two reasons. First, the results failed to support the predictions derived from cognitive, behavioristic, and psychoanalytic, theories of depression. Secondly, they failed to confirm the results of a similar study done by Johnson et al (1981), who found significant differences between depressed and nondepressed subjects in the recall and ratings of interrupted and completed tasks.

The experimental and control groups of this study were selected primarily on the basis of psychiatric diagnosis precisely because they were presumed to be substantially different from an average or "normal" population. Discussion with staff, review of medical charts, and an initial interview with the patients, were used to

guage the accuracy of the diagnosis. On the Beck Depression Inventory, the experimental groups scored significantly higher than the control groups (Tables 11 and 12), with mean scores above 19.5 for the experimental groups and below 14.5 for the control groups. According to Beck, BDI scores above 10 suggest the presence of at least mild levels of clinical depression. It would seem then, that what we may, in fact, be observing in the subjects of this experiment is not presence or absence of depression, but two markedly different degrees of clinically significant depression (a conception which, in itself, may be questionable from clinical and theoretical points of view). A question could be raised whether the results would have been different had another control group been employed, namely, one with a BDI mean score of less than 10. This question was answered by an aposteriori analysis. Twenty nondepressed subjects with a BDI mean score below nine and 20 depressed subjects with a BDI mean score above 20 were selected (Table 41), and subjected to the analyses described above. The results (Tables 38-40) clearly indicated that chosing more extreme scores on the BDI scale as criteria did not alter the original findings.

On the other hand, the study by Johnson et al (1981) did not use psychiatric diagnosis as a criterion.

Extreme scores on the BDI was the sole criteria for selecting depressed and nondepressed subjects. They selected a control group from subjects with BDI scores less than five and an experimental group from subjects who scored higher than 12 and obtained positive results. Their sample consisted entirely of college students who, probably, did not differ from the general college student population, while the sample of this study consisted entirely of psychiatric patients. There is no evidence that the depressed college students suffered from clinically significant depression or received psychiatric treatment. Therefore, the two samples are not comparable. Furthermore, there were methodological differences. Johnson et al, administered their experiment individually. Thus, while in the individual setting it may have been possible to monitor the involvement of each subject in the experimental tasks, it was not possible to ensure, in the group setting, that each group member became involved with the experimental tasks in a way comparable to the individual procedure. Secondly, Johnson et al had instituted a manipulation check to determine whether interruption vs completion of tasks was an effective manipulation of judgment of success. Such a procedure was not adopted by the present study. In view of these striking differences in samples and procedures, it is

surprising to note that these two experimental studies yielded results which are not too far apart. The depressed and nondepressed groups in Johnson et al's study did not differ widely from each other. The mean score for the depressed group was 6.75 (completed tasks) and 7.80 (interrupted tasks); the mean score for the nondepressed group was 7.70 (completed tasks) and 6.65 (interrupted tasks).

It might be argued that the subject variables of age, intelligence, and achievement motivation, which have been shown to influence recall (Zeigarnik, 1927; Atkinson, 1953), were not apriori controlled in this study, and thus, could have affected the experimental results. This is clearly not the case. Firstly, age, intelligence, and achievement motivation, did not correlate with the dependent measure (Table 37). Secondly, the differences between groups in intelligence and achievement motivation were not cross-validated. Finally, when subjects were, in fact, matched on intelligence and achievement, the analysis of the data did not yield significant results (Tables 38-40).

This study provides data which have a significant bearing on the validity of the Beck Depression Inventory and the Depression Adjective Check list. A scale of depression, in order to have more than face validity, must

successfully differentiate between groups of people suffering from depression and normal groups, on the one hand, and between diagnosed depressed patients and patients with a diagnosis other than depression, on the other. In this study, the diagnosed depressed patients scored significantly higher on the BDI than patients with other psychiatric diagnosis. The direction of the differences between the group means were in accordance with the prediction implicit in the scale. Thus, these findings strengthen the validity of the BDI.

The Depression Adjective Check List failed to differentiate between the patient population samples and therefore, the findings raise some question about the validity of this scale. There is no question that the BDI and the DACL do not measure the same phenomenon.

A somewhat serendipitous finding of this study was the absence of the Zeigarnik Effect in all groups. The normal samples of the original experiments by Zeigarnik (1927) consistently demonstrated a very marked recall advantage for the interrupted tasks (a mean Zeigarnik Ratio of 190). The Zeigarnik Ratios obtained for all groups of this study were not significantly different from 100.

In attempting to understand the differences, the question presents itself whether the results were a

consequence of methodological differences. This study departed from Zeigarnik's methodology in the manner of interrupting the subjects at the time of the recall of tasks. The subjects were given seven minutes to recall as a standard procedure, based on pilot testing (Johnson et al, 1981). But Zeigarnik proceeded differently. In her own words:

> ...No time limit was imposed during the subjects' report. A record was kept noting the order of recall. Very often a number of tasks would be mentioned, and then a pause would occur during which the subject tried to remember what other tasks he had had. The quantitative results given below refer to the number of tasks recalled before this pause (Zeigarnik, 1927, P. 300).

It is not clear how Zeigarnik understood and interpreted the "pause" of the subjects. For example, what would she have done in the case of a subject who "paused" before recalling any of the tasks, as happened with one of the subjects of this experiment? Furthermore, the "Pause" could occur for many other reasons than trying to recall more, such as a distracting thought. Zeigarnik's procedure appears open to subjective and nonstandardized intervention on the part of the experimenter which would facilitate the possibility of a Rosenthal effect. The crucial question is: What would have been the effect of setting a fixed time limit to recall in the original experiments of Zeigarnik? Would it have altered her

findings? Is the Zeigarnik Effect an artifact of methodological procedures? Further research is needed to clarify this issue by utilizing a more standarized procedure with normal subjects.

In this connection, one may ask whether the absence of Zeigarnik Effect observed in this study is also a function of methodology. If, for example, a group of subjects, comparable to the original sample of Zeigarnik, exhibited a marked absence of Zeigarnik Effect under the experimental conditions of this study, it would indicate that introducing a standarized time limit for recall does not elicit a recall advantage of the interrupted tasks over the completed tasks. On the other hand, if the same group exhibited a significant Zeigarnik Effect, while the pathological groups did not, it would strongly suggest that psychopathology eliminates the Zeigarnik Effect. Only future research can anser this question.

This study focussed on immediate memory, and so did the case by Johnson et al, and all studies by Zeigarnik cited above. It is quite possible that repression, for example, may not exert its influence immediately, but manifests itself in remote memory. As lapsed time increases between original experience and recall, it is also possible that task-orientation, which is associated with greater recall of interrupted tasks, may give way to more

ego-defensive reactions, which is associated with the recall of completed tasks (Alper, 1948). Whether this is indeed the case can only be answered by future research.

In summary, this study clearly indicates that depressed and nondepressed psychiatric patients do not differ in their recall of interrupted and completed tasks. Neither of the patient groups exhibited a preference for interrupted or completed tasks in the recall or ratings of these tasks. Thus, the predictions derived from cognitive, behavioristic, and psychoanalytic theories of depression were not supported by this study. The remarkable absence of the Zeigarnik Effect exhibited by the pathological groups of this study raises interesting methodological and clinical questions. These are worthwhile avenues for future research.

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APPENDIX A

APPENDIX: A

INFORMED CONSENT

Name _____ Date _____

1. Description of the Project

The purpose of this research project is to obtain information regarding the relationship between emotions and learning.

If you decide to voluntarily participate in this research project, you will be requested to complete a group of paper and pencil tests similar to the tests you may have completed in a school or hospital. The tests should not take you more than two or three hours to complete.

By participating in this research, you will be contributing towards the advancement of scientific knowledge. The results of the study will not become part of your hospital records. In case of publication, only the group results of the study will be published without identifying the individual participants.

If you have any questions concerning this project, please contact Mr. Joseph Malancharuvil at Number 386-8121 Ext. 357 or if you cannot reach him, you may contact Dr. Jack Fox, at 862-8121 Ext. 688.

2. Consent Agreement

I understand the nature of this experimental study. I hereby agree voluntarily to participate in it. I understand that I can withdraw from the project at any time, that I will not be penalized or suffer any other harm because of such a withdrawal, and that my participation will not affect my treatment or any decision about me.

I understand that the research records will be treated in strict confidence by the investigators and that, in case of publication, no one will be able to identify me from published materials.

APPENDIX B

APPENDIX: B

Formula For Transforming The Ratio Scores To Schieve A Balanced Distribution Above And Below The Mean Of 100.[1]

In the Zeigarnik ratio scores, the scores range from 100 to 1,000 when the number of recalled interrupted tasks are equal to or larger than the member of recalled completed tasks (assuming a total of 10 tasks each in the set). The scores range from zero to 100 when the recalled interrupted tasks are equal to or smaller than the recalled completed tasks. If we assume 100 to be the midpoint of the scores -- and there is a good reason for the assumption, as will be shown later --, then the number of possible sequential integer scores below the midpoint is one hundred, while the number of possible sequential interger scores above 100 is 900. This is a marked skewing in the distribution of scores which, when scores are summated and treated statistically, will automatically favor the interrupted tasks even when, in reality, there is no such preference. In order to remedy this mathematical bias, a formula will be developed below which will transform scores smaller than 100 into other scores in

[1]Jack Fox, Personal communication. July 4, 1981

such a manner that the number of possible sequential integer scores below the midpoint will equal the number of possible sequential integer scores above the midpoint, i.e. 900.

The ratio scores (X) are computed by

$$\frac{I}{C} \times 100 \qquad (1)$$

where I = number of interrupted tasks recalled,

C = number of completed tasks recalled.

The deviation of X from the midpoint is expressed by

$$\frac{I}{C} \times 100 \quad - 100 \qquad (2).$$

In essence, the transformation is accomplished by substituting the reciprocal of $\frac{I}{C}$ $(\frac{C}{I})$ in equation (2) and by subtraction of this deviation from the value of the midpoint. This transformation produces a range of scores below the midpoint from -800 to 100, or a total of 900 possible sequential interger scores, a range which is identical to the range of scores above 100. The range of scores is now symmetrical about the midpoint. A mathematical bias no longer exists.

On reflection, it is obvious that there can be only one logical midpoint, namely when I = C. When this is so, equation (1) becomes:

$$\frac{C}{C} \times 100 = 100.$$

Thus, the midpoint of the scores must be 100. A ratio of $\frac{4}{I}$, for example, becomes a score of 400, which represents a deviation of 300 above the midpoint, whereas a ratio of $\frac{1}{4}$ becomes a score of -200, which also represents a deviation of 300 from the midpoint. The deviations are equal in magnitude and the two scores are symmetrical about the midpoint. When $I < C$, the transformed ratio scores (X_T) are computed, as discussed above, by

$$X_T = 100 - \left[\left(\frac{C}{I} \times 100\right) - 100\right] =$$

$$X_T = 200 - \left(\frac{C}{I} \times 100\right) \qquad (3).$$

In the study, ratio scores (X) were computed by equation (1), thus,

$$X = \frac{I}{C} \times 100 \qquad (4).$$

From equation (4), the following is derived:

$$\frac{I}{C} = \frac{X}{100} \qquad (5).$$

From equation (5),

$$\frac{C}{I} = \frac{100}{X} \qquad (6).$$

Substituting from equation (6) in equation (3), equation (3) becomes

$$X_T = 200 - \left(\frac{100}{X} \times 100\right) =$$

$$X_T = 200 - \frac{10,000}{X} \qquad (7).$$

Equation (7) is used to transform X scores below 100 into X_T scores.

APPROVAL SHEET

The dissertation submitted by Joseph Mathew Malancharuvil has been read and approved by the following committee:

Dr. Thomas P. Petzel, Director
Professor, Psychology, Loyola University

Dr. James E. Johnson,
Professor, Psychology, Loyola University

Dr. Alan De Wolfe,
Professor, Psychology, Loyola University

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

12/20/[illegible]
Date

Thomas P. Petzel
Director's Signature