1974

Effects of several levels of white noise induced arousal on rod and frame test performance.

John A. McGrory
University of Windsor

EFFECTS OF SEVERAL LEVELS OF WHITE NOISE INDUCED AROUSAL ON ROD AND FRAME TEST PERFORMANCE

by
John A. McCrory
B.A., St. Francis Xavier University, 1960
M.A., University of Ottawa, 1966

A Dissertation
Submitted to the Faculty of Graduate Studies through the
Department of Psychology in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy at the
University of Windsor

Windsor, Ontario, Canada
1974

Abstract

An experiment was conducted to determine how Rod-and-Frame Test (RFT) performance is affected under several levels of white noise-induced arousal. The study proceeded in two phases. The purpose of Study I was to confirm that white noise did evoke an arousal state, as measured by the palmar sweat procedure, and that a different level of arousal could be induced by different intensities of white noise (63, 75, 85, 91, and 95db). Study II tested the effects of four levels of white noise (63, 75, 85, and 91db) on RFT performance. Ten subjects each were assigned to one control and five experimental groups in Study I. Fifteen subjects each were run in one control and four experimental groups in Study II.

The results demonstrate that white noise does eventuate in arousal. However, increasing levels of white noise produced an irregular pattern of arousal, with highest arousal levels obtained with both low (63db) and high (91db) white noise levels. In Study II, the results indicate that arousal does have a decremental effect on RFT performance. The most significant finding was that the lowest level of arousal led to the highest RFT error and the highest arousal level led to the lowest RFT error, yielding a basically linear relationship. The results support studies by Hill and Feigenbaum (1966),

Feintech (1970), Morf and Howitt (1970), and Chess, Neuringer and Goldstein (1971), who also found that arousal detrimentally affected RFT performance.

Preface

Several persons have directly or indirectly participated in the completion of this dissertation.

Specifically, the writer wishes to express gratitude to Dr. M. E. Morf, who assisted extensively in the conducting of the study. Also, the comments and suggestions of Dr. B. P. Rourke and Dr. G. A. Namikas are greatly appreciated.

The co-operation of numerous summer and intersession psychology professors is also acknowledged, for their assistance in the recruiting of subjects. Finally, the writer is extremely grateful to his wife, Lois Ann, for her help in the typing, recruiting of subjects, and for her forebearance.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Purpose

The main purpose of the study was to investigate the effects of different levels of arousal on the field dependence-independence phenomenon, as measured by the Rod-and-Frame Test. This introductory section will deal with the early investigations of field dependence-independence, some assertions regarding its stability, some experiments conducted affirming or contradicting the stability of the phenomenon, the background on arousal and its measure with the palmar sweat procedure, a review of studies testing the effects of arousal on field dependence-independence, and a statement of the problems and hypotheses under investigation.

Background on Field Dependence-Independence and the Rod-and-Frame Test

In the Witkin, Lewis, Hertzman, Machover, Meissner and Wapner pioneering study (1954) on the relationships between perception and personality, a short history of the two major theoretical approaches influencing research in perception was provided. The first position, according to these authors, held that explanations of perceptual experiences of individuals were to be found in the framework of the field in question. The essence of perception, therefore, was primarily determined by the outer world and not significantly by the personality of the perceiver. The alternate theory or approach emphasized the nature of the stimuli arousing the perception and the functioning of the sense organs and associated neural activity mediating the stimuli. This approach placed more emphasis on the perceiver's participation, but only to a limited degree. The life experiences were not of import, except for the individual's experiences with the specific stimulus.

Adherents of both stances neglected, or at least denigrated rather dramatically, the area of personality. In the Witkin et al. study, the two areas of perception and personality were fused. This appeared to be the inevitable outcome of the chronologically preceeding approaches, i.e., no personality involvement, then minimal involvement and, finally, investigation of the interaction of the two. Witkin saw significance in this development because it led to extensions of existing theories of perception and permitted the inclusion of perceptual techniques as reasonably objective measures of personality.

Specifically, Witkin became interested, through work done during World War II, on projects related to the ability of an individual to detect the upright. It became evident to Witkin that large individual differences found in this ability could not be treated solely in terms of the visual, proprioceptive and "other mechanisms" of the body. Rather, the person as a whole, i.e., his physical-perceptual and psychological processes, would have to be incorporated. Witkin et al. set out, first, to study perceptual processes "under manageable laboratory conditions". Next, individual differences in various modes of perceiving were explored extensively. For example, stability of perception over long periods, self-consistency under varied circumstances, developmental changes and sex differences were included. Finally, personality and perception were compared.

Asch and Witkin (1948) first developed the rod and frame device. This enabled the experimenters to study perception under the aforementioned "manageable laboratory conditions". This device, along with the tilting-room-tilting-chair situation and the rotating-room situation, permitted the study of "all fundamental aspects of perception of the upright, i.e., perception of position of an object within the field, of one's own body, and of the whole field (Witkin et al., 1954, p.9)". Another formulation of the phenomenon provided by Witkin et al. is the following;

> "...perceiving position with relation to the true vertical direction (subjects) differed from one another in relative extent of dependence on the visual field or in relative ability to utilize bodily experiences in over-

coming the influence of the field (p.10)".
Thus, the more field dependent subjects perceived the upright almost exclusively with reference to the visual field. The more field independent subjects, on the other hand, located the upright almost entirely from information of bodily position virtually oblivious of the surrounding field.

In the literature field dependence-independence is generally measured by either the Rod-and-Frame Test (RFT) or the Embedded Figures Test (EFT), with the former much more prevalent. The reason for the more extensive use of the RFT over other measures of field dependence-independence may be associated with Witkin's initial works, which were to evaluate individuals' ability to determine verticality. The rod-and-frame apparatus began as an obvious device to measure this ability and thereby enjoyed a headstart over other measures, such as the EFT. Additionally, Shipman and Heath (1967), citing Elliott (1961), indicated that much of what the EFT measured was "intelligence". Elliott stated the following;

> "When field dependence is measured by the EFT, it tends to be significantly related with any measure of ability, and to share more variance with quantitative-spatial tests (about 30%) than with the verbal tests (about 10%). When field dependence

> is measured by the RFT, it tends to have slight negative relationships with ability measures (Elliott, 1961, p.28)".

Elliott continued to say that the RFT is a "'purer', less multifactorial" measure of field dependence than "any EFT (p.34)". Shipman and Heath supported Elliott stating that research on Witkin's dimension of field dependence-independence "is probably better based on the Rod-and-Frame (p.2)". For the purpose of the research to be outlined in this paper, therefore, the RFT will be used.

In the course of the Witkin et al. discussion of some of the studies they conducted which preceeded their major 1954 formulation, the authors stated that, "in a variety of ways, the evidence suggested that each person tended in diferent orientation situations to exhibit a characteristic way of perceiving, which was not readily subject to change (p.10)". Additionally, Witkin et al. intended in their 1954 work to study two important problems, the first of which was "the extent of perceptual self-consistency" among people and the second, how perception differs among people.

Relative to the first problem, Witkin et al. reported (1954, p.72) test-retest correlations for males over a three-year period of .84 for the RFT and .89 for the tilting-room-tilting-chair test. Correlations for females were .66 and .89 respectively. This longitudinal study was actually conducted by Bauman (1951). Additionally, Witkin et al. reported that;

> "With few exceptions, the test-retest correlations are of about the same magnitude as corresponding uncorrected odd-even correlations. This indicated that performance over a period of time is about as stable as performance from trial to trial within the same test. Together, these results provide striking evidence of marked stability in the individual's manner of perception (p.72)".

In a later work, Witkin, Dyk, Faterson, Goodenough and Karp (1962) mentioned again Bauman's (1951) work and reported a study conducted by Fliegel (1955) on 17-year-old high-school seniors, who were retested three years later, providing test-retest correlations which were "extremely high, suggesting striking stability in mode of field approach over periods ranging from 1 to 3 years (p.369)".

Obviously, the stability over time of the phenomenon of field dependence is impressive. However, stability can also be measured in terms of the phenomenon's sensitivity or imperviousness to environmental and/or internal situations, such as drugs, alcohol ingestion, stress, or special training.

Experimental Studies of Stability of RFT Performance

(1) Studies Supporting Stability

Franks (1956) found no significant differences in RFT performance among subjects given an amphetamine (dexedrine), a barbiturate (sodium amytal), a placebo, or nothing. Pollack, Kahn, Karp and Fink (1960) studied the effects of tranquilizers, an anti-depressant, and either electric or inhalant convulsive therapy on RFT performance. No significant differences were found on the before-, during-, or after-treatment scores for the drug-treatment groups although, inexplicably, the convulsive subjects showed a decrease in RFT performance. Witkin et al. indicate that, "in general, the results...are consistent in suggesting that mode of field approach tends to remain stable with changes in psychological state induced by various kinds of drugs although apparently not by convulsive seizures (p.371)".

Relative to special training, Witkin (1948) was unable to obtain changes in field approach as a function of training: specifically, discussions of orientation problems and practical demonstrations. Witkin et al. (1962) mentioned an attempt to modify field dependence with alcohol which failed, but gave no reference, in which alcoholics showed no significant change in RFT or Body-Adjustment-Test (BAT) performance following consumption of alcohol. A significant decrease, however, was found in EFT scores. Witkin believed this was due to a decrement in attention maintenance and speed due to the alcohol and not a change in the mode of perception. Karp, Witkin and Goodenough (1956) also reported that alcohol ingestion provided the same results, that of no change in RFT or BAT scores, but a decrease in EFT performance. These authors noted that "it is reasonable to conclude that alcohol ingestion does not affect perceptual field dependence (p.264)". Karp and Konstadt (1965) compared performances of alcoholics with different lengths of alcoholic histories and found that the length of drinking did not affect performances on the BAT, RFT, or EFT. It was found, however, that field dependence increased with age and was greater among alcoholics than their matched controls at any age. Karp, Witkin and Goodenough (1966) examined the effect of a cessation of drinking on the same three measures. Drinking alcoholics did not differ significantly from alcoholics sober for at least 15 months. The authors concluded that there was evidence for the stability of field dependence "over various phases of the alcoholismic cycle".

(2) Studies Not Supporting Stability

At the conclusion of the introduction of his 1954 text, Witkin indicated the need for more research in two specific areas; the first was the "extent of perceptual self-consistency" and the second, perceptual differences among people.

The former, the consistency of perceptual patterns within people, was later studied to a considerable degree, as outlined above, with the consensus that field dependency was essentially stable. It was in 1961, in a study conducted by Elliott, that the results of these studies, relative to the stability hypothesis, were first challenged.

Morf and Howitt (1970) saw two interpretations arising from the work on field dependence. The first, essentially Witkin's, was that field dependence was a "cognitive or perceptual style" and, as such, was characterized by "generality" across virtually all human operations, perceptual, intellectual, motivational, defensive, and social. Additionally, field dependency was stable over time. The alternative hypothesis outlined by Morf and Howitt was Elliott's, viz., that situational determinants are paramount in determining the level of field dependence. Elliott stated the following;

> "...the field dependent person does not always act dependently. It may be more accurate to state that he reacts with disruption and ineffectiveness in the face of strange or unstructured stimulus configurations, such disruption leading to conforming behaviour only when there is available something obvious to conform to, like a luminous frame, or a confident confederate (p.28)".

Elliott used studies by Linton (1955), Gross (1959), and Block (1957) to support his disruption hypothesis. Linton reported that design dependence (EFT) related positively with increases in reported autokinetic movement in the presence of influence exerted by a confederate. Gross found she was able to increase the frame dependence (RFT) of all subjects by introducing a bogus "distorting lens" between them and the RFT apparatus. Also, Gross made changes in instructions which led subjects to expect more available alternatives, making them increasingly "uncertain" of RFT judgments. High frame dependent subjects tended to view themselves as feeling "uncertain" significantly more often than frame independent subjects. The latter saw themselves as "expectant". Block indirectly supported Gross. He found that groups differing significantly in degrees of frame dependence did not differ in degree of yielding in an Asch-like conformity task. However, they were significantly different ($p<.001$) in the degree of self-rated confidence with which they made their judgments.

Thus, two main interpretations of field dependence-independence emanated, Witkin's cognitive style and Elliott's disruption hypothesis. Morf and Howitt suggested that these two are not "mutually exclusive" but may rather "emerge as part of the same comprehensive and detailed explanation of field-dependence (p.703)". The latter authors stated that the disruption hypothesis may contribute to making the comprehensive explanation of field dependence "more molecular" and "lead to a focussing on the processes and on the immediate antecedents of the cognitive style of field-dependence (p.703)".

Witkin, Dyk, Faterson, Goodenough and Karp (1962) reported one study by Davis, McCourt and Solomon (1958) in which no significant effect was found on EFT performance for subjects maintained for extended periods in a sensory-isolation situation. However, Jacobson (1968) reported Goldstein and Chotlos' (1966) contrary findings. The latter found significant decreases in field dependence, using the RFT measure, during a 3 month period of hospitalization and treatment. Jacobson (1966) showed that 1 hour of moderate sensory deprivation resulted in significant reductions of field dependence, as measured by the RFT, in college students, both male and female.

Jacobson (1968) attempted to synthesize his 1966 findings with those of Goldstein and Chotlos by providing sensory deprivation to hospitalized alcoholics. His results showed a significant reduction in field dependence as a function of the sensory deprivation.

Jacobson also reported supporting evidence by Astrup (1967), in which young, male gold miners significantly improved their RFT performance following a 2½ hour shift underground. Jacobson believed his and the other studies reported put into question the Witkin et al. (1962) contention that "perceptual field dependence was a stable and unalterable characteristic".

Despite the Witkin et al. (1962) and Karp, Witkin and Goodenough (1965) contentions that alcohol ingestion did not modify field dependence, Kristofferson (1968) found precisely the opposite. Using nonalcoholic, male university students, Kristofferson randomly assigned the subjects into an alcohol-administered experimental group and a non-alcohol control group. Neither group was found to differ significantly on pretest RFT scores. A significant increase in field dependence was found ($p < .01$) for the experimental group on the posttest, while no significant change was found for the controls. Kristofferson contended that her study "shows that field dependence is unstable in the sense that it can be changed by alcohol (p.390)".

The general area of field dependence is marked by disagreement along at least the dimension of its stability and sensitivity-imperviousness to internal states and external stimulation. The Witkin et al. position is that the phenomenon is stable, both over time and with regard to its apparent insensitivity to internal and external stimulation. On the other hand, Elliott, Jacobson and Kristofferson have all shown that field dependence is less stable than contended.

Background on Arousal and the Palmar Sweat Procedure

Epstein (1972) relied on Woodworth and Schlossberg (1954) for a definition of arousal: "a concept that refers to the level of excitation of an individual along a dimension that varies from relaxed sleep to emotional excitement". This is obviously a very complex and broad concept. A state of arousal involves virtually the whole organism, autonomic functioning, voluntary musculature and neural activity. Bindra (1959) argues that because the various levels of arousal are manifested in these three areas, it may be possible to employ physiological measures to estimate the degree of arousal present.

Davis and Buchwald (1957) exposed a variety of pictures to human subjects while simultaneously measuring several autonomic and somatic changes. The various measures showed, in some cases, a monophasic decrease, in others an increase and in still others a diphasic change. The authors concluded that all of the several autonomic-somatic functions do not covary. However, Davis (1957) later sought to determine if some of the functions do vary together under certain circumstances. He decided that, under conditions of simple sensory stimulation, mild exercise and viewing pictures, any new stimulation produces an increase in sweat gland (palmar) and muscular activity (extensor digit) more consistently and clearly than in other functions.

Bindra maintains that "the presentation of a simple stimulus increases level of arousal" and that the increase "is roughly proportional to the intensity of the stimulus". Arousal is also a function of "novelty" of the stimulus, with adaptation following repeated presentations.

Noise and white noise have been utilized extensively to produce arousal (Davis, Buchwald & Frankmann, 1955; Berlyne & Lewis, 1963; Oltman, 1964; Shipman & Heath, 1967). Berlyne, Borsa, Hamacher and Koenig (1966, p.1) supported the assumption that white noise increases arousal with several arguments, which include:

a) neuroanatomical and neurophysiological evidence that all exteroceptive stimulation activates the reticular activating system,

b) the finding that continuous white noise causes skin resistance to drop significantly over a period of 15-20 min. in conditions that would otherwise leave skin resistance virtually unchanged (Berlyne & Lewis, 1963),

c) the finding that sound increases muscular tension (Davis,1948).

White noise appears appropriate as an arousal agent in a study of RFT performance because it can be ongoing throughout the RFT trials.

The palmar sweat procedure is suitable for measuring arousal for several reasons. First, Davis (1957) found that any new stimulation produces an increase in palmar sweating and muscular activity. Other objective arousal measures, such as pulse rate, finger volume and respiration rate varied in different ways with different types of stimulation. Second, the latency period for palmar sweat change after presentation of an unexpected stimulus is approximately 2.0 sec. (Bindra, 1959). Third, administration of the palmar sweat procedure is simple, fast, and relatively unthreatening. Fourth, Light (1951), who reviewed the history and development of the palmar sweat measure, has shown it to be valid through comparisons of "normal" and "anxiety neurotics" in therapy and has demonstrated a decrease of palmar sweat with therapy. Finally, Gladstone (1949) showed that palmar sweat measures decreased under relaxing conditions (soft music) and increased under "stress" situations.

Studies of Effects of Arousal Manipulation on RFT Performance

The area dealing specifically with the effects of arousal manipulation of RFT performance is also replete with inconsistency. A review of the literature in this area indicated conflict between those reporting that arousal impairs RFT performance and those finding that arousal improves RFT performance. Other studies reported no relationship.

Oltman (1964) employed white noise at 100 decibels (db) to induce arousal and found that RFT performance was significantly improved. He cited Easterbrook's (1959) hypothesis that arousal reduces responsiveness to peripheral cues, which Callaway (1959) labelled "narrowed attention". Essentially, a subject responding less to peripheral cues will be less attentive to cues derived from the field and should thereby be less field dependent. As support, Oltman referred to Callaway's study in which the author found that drug-induced arousal (amobarbital and methamphetamine) facilitated performance on "one type of embedded figures test".

On the other side, Hill and Feigenbaum (1966) found that threatened self-esteem through subject-deprecating feedback on social judgments impaired performance on the RFT, with subjects moving toward the field dependent direction.

Feintech (1970) tested subjects on the RFT under three experimental conditions; a test-retest condition, a high drive and a low drive condition. The high drive was attained with random electric shocks. His conclusion was that "increasing drive level leads to greater tendency to rely on the surrounding visual field", and vice versa.

Morf and Howitt (1970) experimentally induced arousal using unsolvable anagrams and their results gave tentative support to the hypothesis that "within a narrow range of intermediate arousal or disruption levels the greater the physiologically measured disruption, the greater the decremental effect on RFT performance (p.707)".

Chess, Neuringer and Goldstein (1971) simultaneously measured arousal levels, using skin resistance and heart rate, over a seven week period of RFT testing. Their results showed that RFT performance improved as arousal level decreased.

Studies finding no relation between arousal and RFT performance include Vaught and Bremer (1969) and Chess (1970) The former study employed a 60-cycle massage vibrator to create arousal. No effect on RFT responding was found. Unfortunately, and like Oltman's study, no objective measure of arousal was used to confirm whether or not an arousal state was attained. Chess' study, a precursor to that of Chess, Neuringer and Goldstein (1971), also found that arousal was not related to changes in RFT scores. Employing an EFT, Kraidman (1959) tested individuals before and after ostensibly stress-provoking heart surgery and found no changes.

The area of the effects of arousal on RFT performance is, therefore, also quite unclear, as was the broader area of the stability of RFT performance reviewed above. However, the weight of evidence would support the contention that arousal does impair RFT functioning. This position is taken because the major study to the contrary, Oltman's, did not employ objective physiological arousal measures. Also, as mentioned above, the Vaught and Bremer study, in which no relationship was found, also did not utilize any objective measures of arousal. In summary, the evidence is in favor of probable decremental RFT effects under arousal because, a) more studies indicate this direction than the contrary and, b) those of the contrary have design shortcomings.

Problem

Several questions arise from the review of the literature. First, is RFT performance, as a measure of field-dependence-independence, a stable phenomenon or not? Second, and more specifically, does physiological arousal affect RFT performance? Third, what effects do different levels of arousal have on RFT performance? Fourth, is there a curvilinear relationship between different levels of arousal and RFT performance, as suggested by Hebb's (1955) hypothesis of an inverted-U relationship between arousal and performance?

Hypotheses

1) An arousal state, as measured by palmar sweat, is induced by white noise.

2) Increased levels of white noise increase the level of arousal.

3) Arousal has a decremental effect on RFT performance.

4) A curvilinear relationship obtains between different levels of arousal and RFT performance.

CHAPTER II

METHODOLOGY AND PROCEDURE

Subjects

Sixty subjects were drawn from a population of female college students and hospital staff and assigned to Study I of the experiment. Seventy-five subjects were later drawn from these groups and assigned to Study II. Study I consisted of five experimental groups and one control group; Study II, of four experimental groups and one control group. The subjects were randomly assigned to each of these conditions.

Apparatus

The apparatus consisted of a Lehigh Valley Electronics white noise generator, Model 112-05, a Marietta Apparatus Company Rod and Frame Test, Model 18-10, a Photovolt Corporation Densicord Recording Electrophoresis Densitometer, Model 542, with attached integrator, and an audiometer. The dimensions of the RFT were 42.75 in. per side luminous frame and a 40.50 in. luminous rod. A standard metal laboratory stool was used to seat each subject during RFT testing. In addition, a totally darkened room was used for the conducting of RFT trials. The ambient noise in this room was consistently 42db.

Materials required for the palmar sweat measure include a ferric chloride and acetone solution, a 5% tannic acid solution prepared in distilled water and filtered, Dietzgen No.198M mimeograph paper, a dietic weigh scale, rubbing alcohol, cottonswabs and a plate glass surface. The procedures to implement the palmar sweat measure were as those outlined by Mowrer (1953, p.599) and Solley and Stagner (1956) and as specified in detail below, except for the use of rubbing alcohol as a cleaning agent rather than ether.

Procedure

The study consists of two experiments, referred to as Study I and Study II. Study I involved the establishment of the relationship, if any, between white noise and arousal. Study II investigated the effect of several levels of arousal on RFT performance.

(1) Study I

Following the random assignment of the 60 subjects of Study I to one of six conditions, each subject was given a cursory explanation of the experimenter's purpose. Specifically, they were told that the amount of perspiration on their right and left index fingers were to be measured. This was the only information provided. Subjects were then given the first palmar sweat measure of their preferred-hand index finger. Following this, the non-preferred-hand index finger was prepared. Fifteen seconds prior to the second palmar sweat measure the appropriate level of white noise was introduced. Subjects were next asked to complete an adjectival rating scale designed to assess subjective impressions and feelings. The rating scale consisted of 10 adjective continua, five of which were meaningful, along with five "fillers" (see Appendix B). The former five included "anxious-calm", "tense-relaxed", "insecure-secure", "certain-uncertain", and "unaroused-stimulated". A 7-point rating scale was used. Following completion of the rating scale, each subject was thanked for her participation and given a more detailed explanation of the experiment.

The administration of the palmar sweat procedure essentially consisted of swabbing some of the ferric chloride and acetone solution on the subject's preferred-hand index finger, after it had been cleansed with alcohol. After allowing the finger to dry for 30 sec., the subject placed the finger on a small piece of mimeograph paper, treated with the tannic acid solution, on a small dietic scale, holding a constant 8 oz. pressure for 2 min. The more profuse the sweating, the more ferric chloride and acetone solution was deposited on the paper, causing it to darken. The print was then read, on a densitometer (Mowrer, 1953), by the amount of light impedance in microampere output change of a photoelectric circuit containing a microammeter. The attached integrator gave an objective count of the amount of light impedance. Each subject's prints were read twice and if the integrator varied slightly in its reading, the mean of the two measures was used.

(2) Study II

Seventy-five subjects were randomly assigned to a control or one of four experimental conditions, 15 per cell. Each subject was then told they were to participate in a study involving the perception of the vertical. Detailed and verbatim instructions are provided in Appendix A. Next, the first 8 of 16 RFT trials were administered, following the procedure outlined by Witkin et al. (1954, p.25), with the exception that the subjects adjusted the rod by means of a remote device and the subjects' chair. After the first set of RFT trials the room's lights were turned on. The subject was informed that everything would be repeated, except that "noise" would be "introduced". Each subject was told that if the noise was found to be "too unpleasant" to interrupt the experiment. The appropriate decibel level of noise was turned on, the lights extinguished and the second set of 8 RFT trials administered. The total between-sets pause consumed less than 1 minute.

The control groups of Studies I and II received the same treatment as the experimental groups, except, of course, for the actual noise introductions.

As outlined by Witkin et al. (1954, p.25), the subject's stool was placed 7 feet from the RFT. The frame tilt was set, as also specified, at 28 degrees and the rod at 20 degrees. The eight trials of each RFT set were given in the following sequence: frame, LLRRLLRR; rod, LRRLLRRL; where L and R stand for left and right of the subject looking at the rod-frame configuration. The RFT scores were the sums of absolute degree deviations from zero.

CHAPTER III

PRESENTATION AND ANALYSIS OF RESULTS

Methods of Analysis

The data of Study I were analyzed by means of a 6 (control and 5 levels of white noise) x 2 ("without" and "with" white noise) analysis of variance with repeated measures on the second factor, an analysis of covariance, and Newman-Keuls tests. In addition, the five meaningful continua of the subjective adjectival ratings of Study I were analyzed by means of a 6 (control and 5 levels of white noise) x 5 (adjectival continua) analysis of variance with repeated measures and Newman-Keuls tests.

Study I consisted of five levels of white noise (63, 75, 85, 91, and 95db), each defining 15 sone intervals, a control group and the "without" and "with" white noise conditions, hereinafter referred to as No White Noise (NWN) and White Noise (WN). The analysis of covariance was calculated to statistically eliminate any differences in the WN condition attributable to factors other than the presence of white noise. The WN condition was the variate and the NWN condition the covariate. From this analysis the adjusted WN means were derived.

In Study II, only four levels of white noise were used

(63, 75, 85, and 91db), along with a control and the NWN and WN conditions. The highest noise level (95db) used in Study I was dropped in Study II for two reasons. The first was because of the possible damaging physiological effects on subjects exposed to such a level for the considerably longer experimental period involved in Study II. The second was due to the fact that the data from Study I indicated the second highest level of white noise (91db) produced the highest level of arousal, making the 95db level less critical.

The data of Study II were analyzed by a 5 (control and 4 levels of white noise) x 2 (NWN and WN) x 8 (number of trials) analysis of variance with repeated measures on the second and third factors, Newman-Keuls tests, and a sign test.

Results

(1) Study I

Table 1 contains the means and standard deviations for the palmar sweat data of Study I, under the NWN and WN conditions, and the adjusted WN means from the analysis of covariance. Data from this table are plotted in Figures 1 and 2. Figure 2 provides the same information as Figure 1 but displays the groups arranged on the horizontal axis according to their level of arousal, from lowest to highest. This is provided in order to assist in making meaningful comparisons. Inspection of Table 1 indicates that in four of five cases the experimental groups' means for the sweat measure increased with

TABLE 1

PALMAR SWEAT MEASURES OF CONTROL AND EXPERIMENTAL GROUPS, WITHOUT (NWN) AND WITH (WN) WHITE NOISE

Group	Without		With		Adjusted WN
	M	SD	M	SD	M
Control	31.40	24.48	36.65*	34.62*	50.30
II (63db)	46.40	41.25	79.85	48.34	80.82
III (75")	40.70	18.11	38.50	26.60	44.45
IV (85")	32.30	28.99	42.70	31.69	56.00
V (91")	71.70	49.09	95.20	47.14	74.04
VI (95")	62.05	34.48	70.60	41.68	57.88

* also without

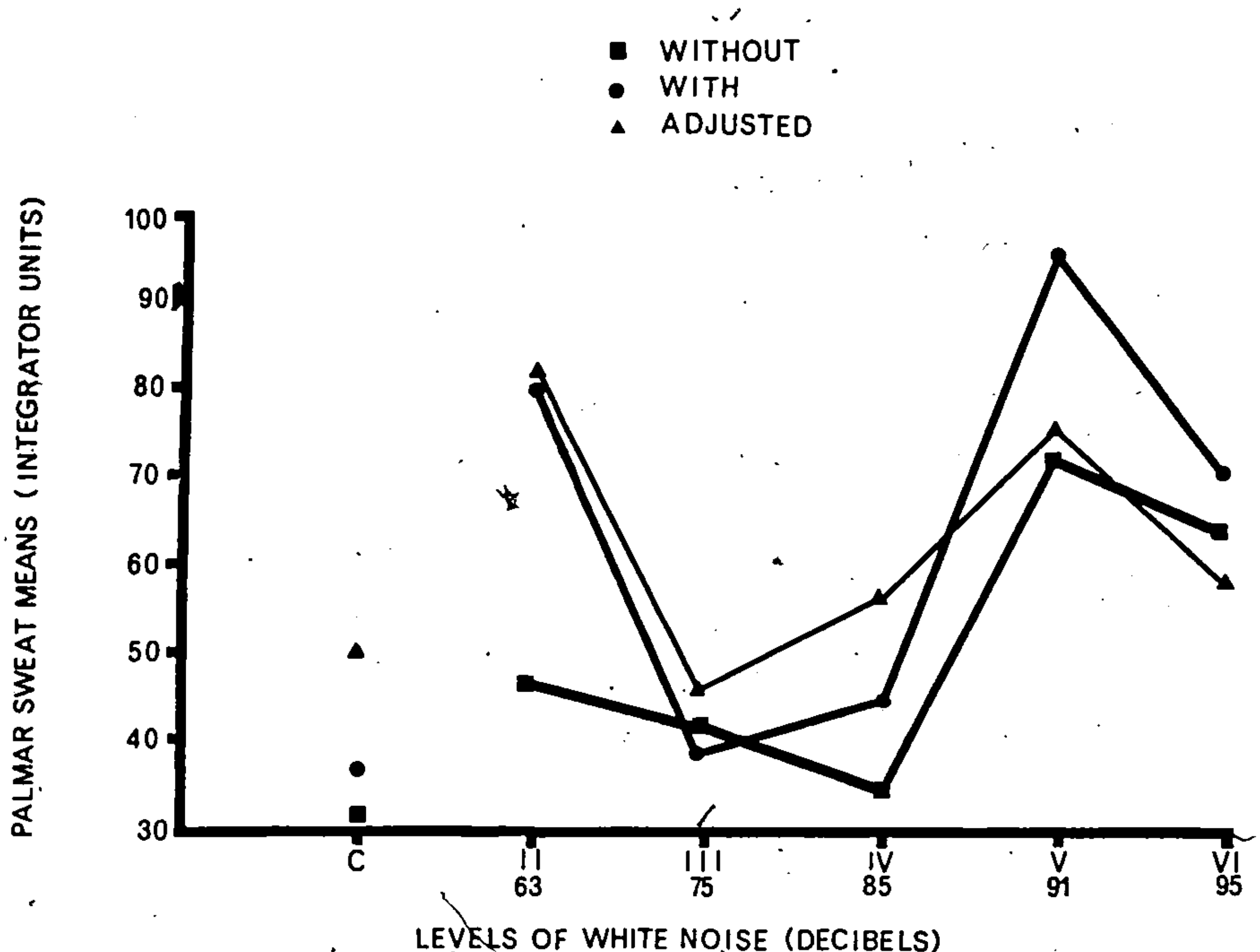

FIG. 1. Mean palmar sweat integrator units of Control and Experimental Groups and adjusted white noise means.

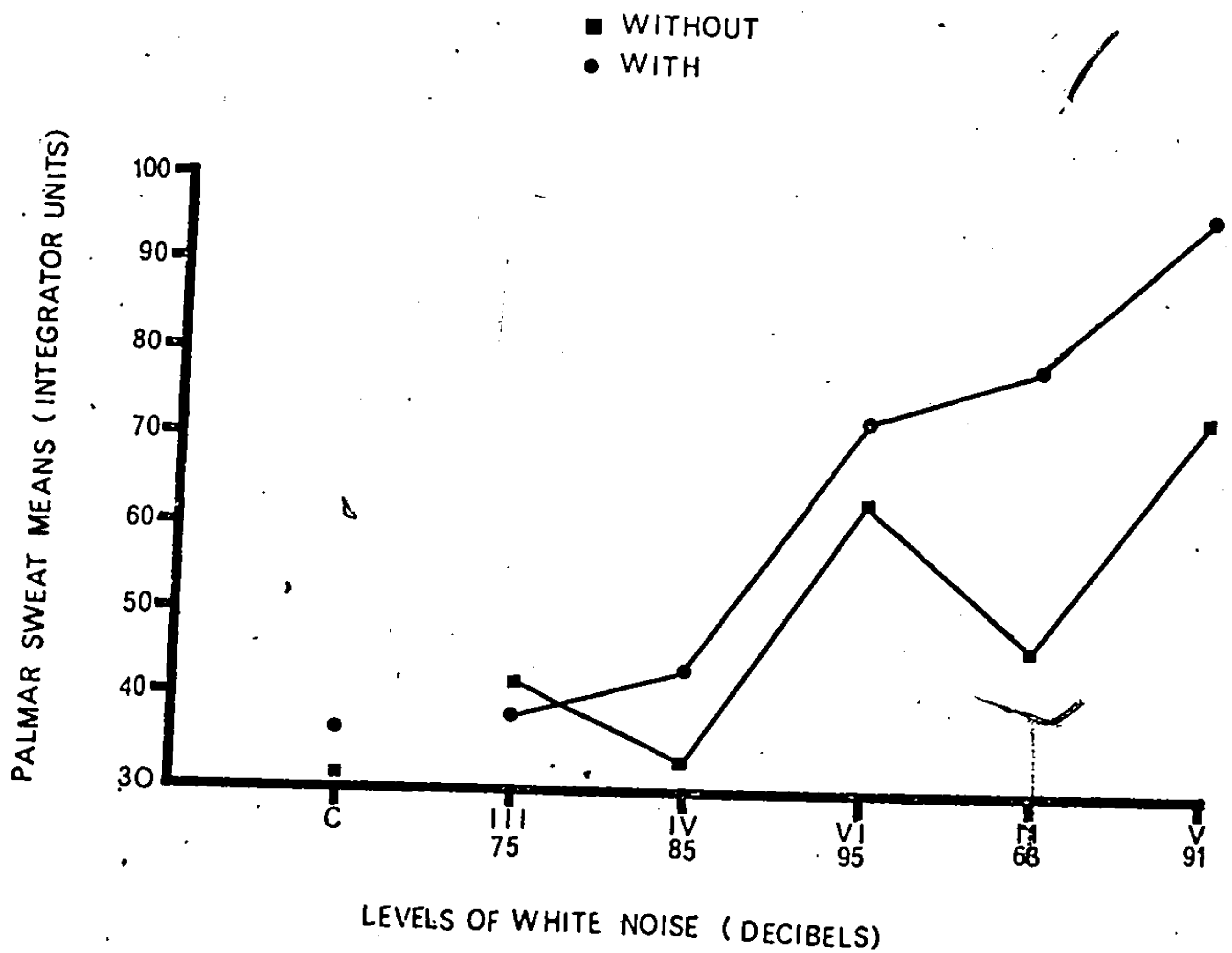

FIG. 2. Mean palmar sweat integrator units of Control and Experimental Groups in ascending order of arousal.

the presentation of each successive level of white noise, relative to the NWN conditions, as was expected. Group III (75db), however, showed a slight but unexpected decrease in palmar sweat under the WN condition. This was probably a chance fluctuation. The other four groups all showed substantial increases, in particular, Groups II and V. The increase on the WN condition for Group II was quite high, indicating the lowest level of white noise had a considerable arousal effect. Plausible reasons for this will be discussed in the following chapter. These results indicate that a linear relationship does not exist between increasing levels of white noise and increasing arousal. Rather, the relationship appears irregular.

In the analysis of variance, presented in Table 2, the differences between the arousal groups due to the different levels of white noise is significant ($p<.05$). Newman-Keuls tests of the palmar sweat WN data showed Group V significantly ($p<.01$) more aroused by their particular level of white noise than were Groups III and IV by their respective levels. Group V also differed, at the same level of confidence, from the Control group. As can be seen in Table 2, the arousal measures on the WN condition were significantly higher ($p<.001$) than those under the NWN condition.

The analysis of covariance results, summarized in Table 3, indicated the experimental treatments differed

TABLE 2

ANALYSIS OF VARIANCE OF PALMAR SWEAT MEASURES OF CONTROL AND EXPERIMENTAL GROUPS WITHOUT (NWN) AND WITH (WN) WHITE NOISE

Source	df	MS	F	P
Between Subjects (Ss)	59			
Levels of White Noise (LWN)	5	7884.58	2.97	<.05
Subject within group error (a)	54	2651.31		
Within Ss	60			
NWN and WN	1	5128.66	14.17	<.001
LWN x NWN and WN	5	854.08	2.36	
NWN and WN x Ss within error (b)	54	361.87		

TABLE 3

ANALYSIS OF COVARIANCE OF PALMAR SWEAT MEASURES

Source	df	MS	F	P
Total	58			
Error	53	1635.41		
Levels of White Noise	5	5678.35	3.47	<.01

significantly ($p<.01$) when the NWN measure is held constant. The analysis of covariance thus shows the experimental treatments to differ at a higher level of probability than the analysis of variance.

The subjective adjectival seven-point rating scales consisted of 10 continua, five of which were meaningful, five of which were fillers. The five meaningful continua were comprised of "anxious-calm", "tense-relaxed", "insecure-secure", "certain-uncertain", and "unaroused-stimulated". The latter two continua were reversed prior to their analysis in order to attain consistency in direction. As a result, a rating of 1 represented the highest arousal and 7, the lowest. A summary of the analysis of variance on these data is contained in Table 4. The main effect for the control and five levels of noise was not significant. The main effect for the second factor of this analysis, the five meaningful continua, was significant ($p<.001$), indicating the five subjective measures were viewed by subjects as being quite different. The "insecure-secure" continuum had the highest mean rating, 5.78. The "anxious-calm" mean was 5.00, followed by the "tense-relaxed" mean of 4.98, the "uncertain-certain" mean of 4.20 and the "stimulated-unaroused" mean of 3.65. Newman-Keuls tests showed each of these means differed significantly ($p<.01$) from the other.

The data from Study I indicated that white noise

TABLE 4

ANALYSIS OF VARIANCE OF SUBJECTIVE ADJECTIVAL RATINGS

Source	df	MS	F	P
Between Subjects (Ss)	59			
Levels of White Noise (LWN)	5	11.74	1.94	
Subject within group error (a)	54	6.04		
Within Ss	240			
Subjective Continua (SC)	4	40.40	29.70	<.001
LWN x SC	20	1.65	1.21	
SC x Ss within error (b)	216	1.36		

does eventuate in arousal. Additionally, the levels of white noise have differential effects on arousal, i.e., a low level of white noise (63db) can evoke almost as high a level of arousal as a much higher noise level (91db). The lack of significant differences between the control and white noise levels on the subjective ratings would suggest that either the groups subjectively felt no more arousal with white noise or, that objective and subjective measures of one's arousal level do not correlate too highly, i.e. that one could be aroused according to an objective measure, but not be aware of this arousal. Nevertheless, a consistent difference between Group VI (95db) and the Control group was apparent. Group VI scored lower, in the arousal direction, than the Control group on each of the five continua of import.

(2) Study II

The RFT degree error means and standard deviations of Study II are presented in Table 5. By observation, one can see minimal differences between the mean NWN RFT scores of the 4 experimental groups. However, the Control group NWN mean is considerably higher, as is its standard deviation. This was probably due to chance factors in the assignment of subjects to groups. The Control group was comprised of subjects more heterogeneous in RFT error than were the experimental

TABLE 5

RFT DEGREE ERRORS OF CONTROL AND EXPERIMENTAL GROUPS WITHOUT AND WITH WHITE NOISE

Group	Without		With	
	M	SD	M	SD
Control	71.06	65.57	68.73*	61.23*
II (63db)	53.26	55.53	54.40	44.43
III (75db)	55.00	49.07	65.60	63.40
IV (85db)	53.26	51.63	59.60	40.31
V (91db)	52.80	50.56	53.26	52.15

* also without

groups.

The analysis of variance for the effects of various levels of white noise on RFT performance is presented in Table 6. No significant differences were found between the NWN and WN conditions and RFT error scores, nor between the several levels of white noise and RFT performance. However, each increased their error on the WN set of RFT trials, while the Control group's error dropped slightly on the second RFT set. Some 47 of the 75 subjects increased their error on the WN RFT set, so a sign test (McNemar, 1955) was applied using the number of differences in the predicted direction between the NWN and WN RFT scores. The differences were found significant ($p<.05$), indicating that white noise does increase error.

The 8 RFT trials, the third factor of the RFT analysis of variance, were significantly different ($p<.001$). On both sets of RFT trials, the 4th, 7th, and 8th trials had considerably more error than the other trials. In the NWN RFT set, the most errors occurred on Trials 8, followed by Trials 7 and 4. The reverse was true on the second RFT set. Trial 2 had the fewest errors of both sets.

Newman-Keuls tests indicated a significant difference ($p<.01$) between Trials 8 and Trials 2, 1, 5, 6, and 3 on the NWN condition and between Trials 8 and Trials 2, 3, 6, 5, and 1 on the WN condition. For the NWN condition for Trial 7, significant differences ($p<.01$) occurred between Trial 7 and Trials

TABLE 6

ANALYSIS OF VARIANCE OF RFT DEGREE ERRORS OF CONTROL AND EXPERIMENTAL GROUPS WITHOUT (NWN) AND WITH (WN) WHITE NOISE

Source	df	MS		P
Between Subjects (Ss)	74			
Levels of White Noise (LWN)	4	177.12	.24	
Subject within group error (a)	70	724.02		
Within Ss	1125			
NWN and WN	1	49.20	.68	
LWN x NWN and WN	4	25.06	.35	
NWN and WN x Ss within error (b)	70	71.39		
RFT Trials (RFT)	7	196.06	7.79	<.001
LWN x RFT	28	18.56	.73	
RFT x Ss within error (c)	490	25.14		
NWN and WN x RFT	7	14.41	1.21	
LWN x NWN and WN x RFT	28	8.08	.68	
NWN and WN x RFT x Ss within error	490	11.87		

2, 1, 5, and 6. For the WN condition, Trial 7 differed at the .01 level of confidence from Trials 2, 3, 6, 5, and 1. Trial 4 differed significantly ($p<.01$) from Trials 2, 1, and 5 under the NWN condition and between Trial 4 and Trials 2, 3, 6, 5, and 1 for the WN condition. Additional differences at the .01 level occurred between Trials 2 and 3, Trials 2 and 6, and between Trials 2 and 5 under the NWN condition. Finally, under the WN condition, additional significant differences ($p<.01$) occurred between Trials 1 and 2.

Figure 3 combines the palmar sweat data of Study I and the RFT data of Study II, both transformed to T scores in order to facilitate visual presentation. Figure 4, using the same T scores, is presented with the groups on the horizontal axis arranged in order of ascending levels of arousal. This more clearly illustrates the linear trend of the relationship between arousal and RFT error.

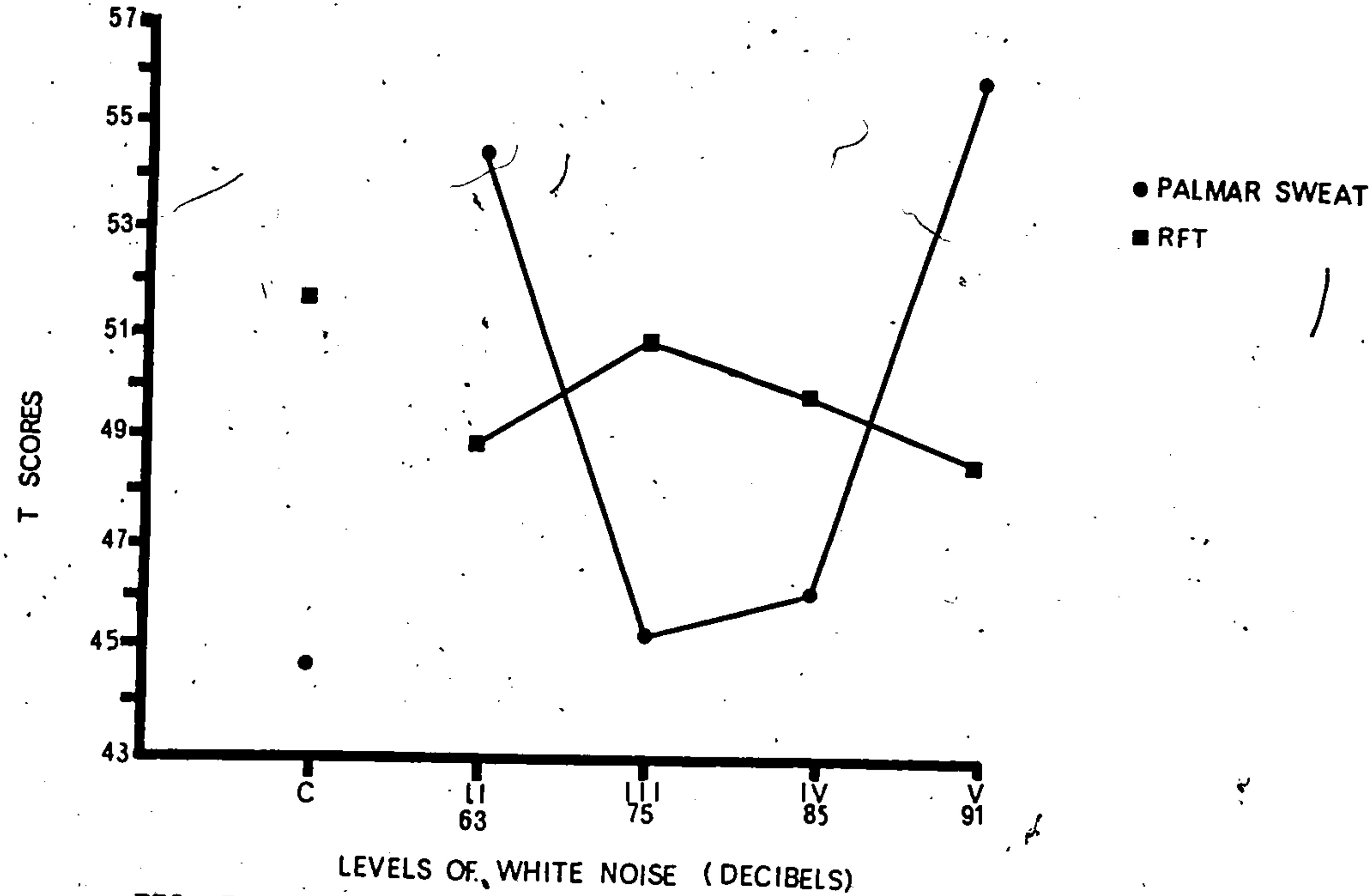

FIG. 3. With white noise palmar sweat T score means and with white noise RFT T score means of Control and Experimental Groups.

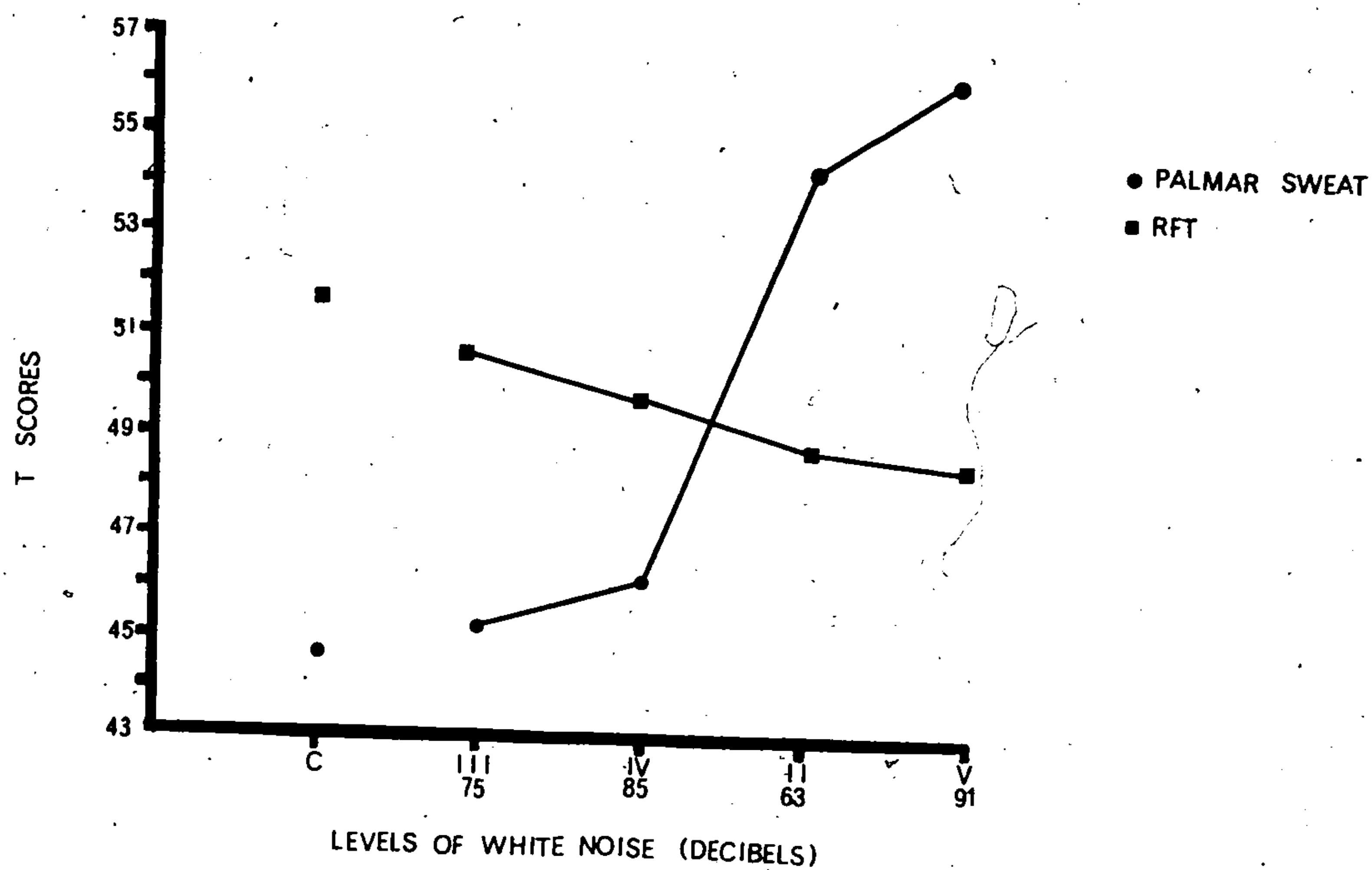

FIG. 4. With white noise mean palmar sweat T scores and with white noise mean RFT T scores of Control and Experimental Groups in ascending order of arousal.

CHAPTER IV

DISCUSSION

The present study was conducted in two phases. The first, Study I, was designed to determine if white noise evoked an arousal state and if increasing intensities of white noise led to corresponding increases in the level of arousal. The primary purpose of Study II was to determine if and how arousal might affect RFT performance.

Witkin, Lewis, Hertzman, Machover, Meissner and Wapner (1954) and Witkin, Dyk, Faterson, Goodenough and Karp (1962), with support from Franks (1956) and Pollack, Kahn, Karp and Fink (1960), strongly contended that field dependence was extremely stable, both relative to time and to various internal states and external stimulation. Other authors presented results indicating field dependence was affected by alcohol consumption (Kristofferson, 1968), sensory deprivation (Jacobson, 1968), and convulsive therapy (Pollack, Kahn, Karp & Fink, 1960). Additionally, authors such as Hill and Feigenbaum (1966), Feintech (1970), and Chess, Neuringer and Goldstein (1970) found that RFT performance was detrimentally affected by arousal, while Vaught and Bremer (1969) and Chess (1970) found no relation between arousal and RFT functioning. Finally, Oltman (1964) found white noise-induced arousal improved RFT performance.

The results to be discussed in this chapter indicate that RFT performance is detrimentally affected by arousal. More interestingly, the results suggest that various levels arousal have quite an unexpected effect on RFT performance. This latter finding is probably the most significant of the study. It suggested that low levels of arousal have a greater decremental effect on RFT performance than do higher states of arousal. In fact, there is a possibility that rather extreme arousal levels may actually have an incremental influence on RFT functioning, as Oltman (1964) reported.

The results of Studies I and II will be individually discussed below and synthesized at the conclusion of the chapter.

(1) Study I

It is clear from the data in Table 2 that white noise increases the arousal level, as measured by the palmar sweat procedure. These findings are consistent with the results of previous studies, e.g., Berlyne and Lewis, (1963), and Shipman and Heath, (1967), and predictable in view of the relatively intense levels of noise utilized. Bindra (1959), in a "generalization", indicated that in using auditory stimuli (tones, white noise), the arousal increase is only "roughly" proportional to the stimulus intensity. This was not the case in Study I of this experiment. As the level of white noise increased from 63db to 95db, at 15 sone intervals, the increase in arousal was somewhat irregular. This irregularity is contrary to the results of Davis, Buchwald and Frankmann's (1955) study. These authors used a 1000 cycles per second (cps) tone at intensities of 70, 90, and 120db and measured arousal by means of muscle-action potential and galvanic skin responses (GSR). The former measure did not differ between the 70 and 90db levels but did increase dramatically between 90 and 120db. The GSR increased slightly between 70 and 90db and then increased as sharply as the muscle-action potential responses. However, one of the reasons the 70db 1000cps tone in the above study was found less arousing than the 63db stimulus of the present study may be the difference in quality of the two stimuli. White noise is a less clearly defined, more novel and noxious stimulus than is a 1000cps tone. The latter is very prominent in music and is thereby much less novel than white noise. Both the novelty and noxious quality of a stimulus are two important factors in evoking arousal (Bindra, p.230 and p.238). As a result, it is not suprising the 63db level in the present study eventuated in more arousal than did the 70db 1000cps tone in the Davis et al. study.

The most obvious deviation, therefore, from Bindra's hypothesized "roughly" proportional relationship was found in

Group II (63db), which registered the second highest level of arousal. This was contrary to expectations, not only because it was the lowest level of stimulus intensity, but also because habituation has been reported to occur more rapidly at the lower intensities of sound than the higher (Davis, Buchwald & Frankmann, 1955). It was assumed that if habituation did occur it would have been manifested in lower palmar sweat readings at the 63db level.

There are at least two plausible explanations for the high level of arousal found with Group II. First, the increment of this stimulus, 63db, over the level of noise consistently present in the laboratory, 42db, was not large. Thus, this increase may not have been sufficient for the subjects to discriminate between the white noise stimulus and the surrounding noise. The lack of a clear differentiation may have led to some confusion, uncertainty and increased anxiety due to the ambiguity of the stimulation. This would, in turn, elevate the arousal measure (Bindra, p.242).

The second and perhaps less likely explanation may be that the low intensity of the stimulus for Group II may have been perceived by many subjects in this group as not representing the "true" experimental condition, but, rather, as something of a precursor to the "real" condition, which they may have anticipated anxiously. In other words, the low stimulus intensity may have been viewed ominously and been, thereby, more arousing. Many subjects in Study I quickly recognized that the second palmar sweat measure would be conducted under a slightly different condition. For the subjects in other groups, the relatively higher noise levels represented that altered condition, whereas those in Group II may have perceived the 63db condition as not sufficiently intense to define an experimental condition.

In summary, the highest level of arousal was found in Group V (91db). It was assumed the highest level would occur with the group experiencing the highest noise intensity, Group VI (95db). The lowest arousal level occurred, as expected, with the Control group. Group III was second lowest, followed by Group IV, Group VI, and Groups II and V. The overall pattern presented, therefore, is a rather irregular one, with both Groups II and VI deviating somewhat from the expected order. However, this may be an accurate representation of what effects various white noise levels have in inducing arousal. Some support for this contention is found in Study II, in which the two highest arousal levels of Study I, Groups II and V, behaved similarly under the same levels of noise on the RFT.

The subjective rating data, outlined in Table 4, proved somewhat suprising. It appears that subjects generally are inaccurate in the monitoring and estimation of their level of arousal, or, are reluctant to reveal an arousal state. Two additional explanations for the lack of significance of group differences are possible. First, some subjects may have viewed some of the meaningful continua as connoting something psychologically unhealthy and/or demeaning, such as "anxious", "tense", and "insecure". As a result, they may have scored their feelings in the opposite, more "healthy" direction. Observation of the subjective data supports this, as the two highest continua are the "insecure-secure" and "anxious-calm" continua, both of which were scored in the healthier directions. It is also possible that this finding represents an attempt by the subjects to reassure the experimenter that the conditions to which they had been exposed were not unpleasant or aversive. Nevertheless, Group VI, which was exposed to the highest noise level (95db), did rate their feelings of arousal higher than the Control group on each of the five meaningful continua. This suggests that the 95db condition did evoke a subjective feeling of arousal, which was expected in view of its intensity. Ninety-five decibels is close to the "discomfort" level of 110-120db reported by Silverman, Harrison and Lane (1946).

In conclusion, the results of Study I indicate that white noise does evoke arousal and that varying intensities of white noise appear to have differential arousal effects, with the lower and higher intensities seemingly more effective in creating arousal than moderate levels. Also, the data from the subjective ratings of arousal suggest that, generally, subjects are either unaware of their objectively-measured arousal or, are reticent to betray such a state.

(2) Study II

The analysis of variance of the results of Study II, RFT performance and four levels of white noise, showed no significant differences for either the increasing white noise levels or the NWN-WN conditions. Individual differences on the RFT, much like the palmar sweat measures, are extremely large and have occurred in similar studies, e.g., Morf and Howitt (1970). Individual total scores on the WN RFT eight-trial set, for example, range from five degrees to 267 degrees. As these individual differences are represented as error variance in the analysis of variance, the experimental effects may have been neutralized. However, the data did show consistent increases of RFT error for all experimental groups on the WN set of trials. The Control group decreased slightly on the second set, as might be expected from the increased familiarity with the apparatus and the lack of any noise intrusion. The sign test, however, of the differences within-subjects on the NWN and WN RFT sets of trials, was significant, indicating that white noise has a decremental effect of RFT performance. This supports the previous findings of Hill and Feigenbaum (1966), Feintech (1970), and Chess, Neuringer and Goldstein (1971).

The error increase on RFT WN trials may be explained by Broadbent's (1958) theory that noise creates brief interruptions in the intake of information from a task at which an individual is working. These "internal blinks", as Broadbent refers to them, occur after the stimulus input has entered the nervous system, but before the input is analyzed. The "internal blinks" could either be a short but complete block in the analysis of all stimulus input, or a temporary shift of the input analyzer to some sense not used in the task.

The third factor of the analysis of variance, the eight RFT trials, had a significant effect. Trials 8, 7, and 4 on both sets were highest in error. On the first set, the most errors occurred on Trial 8, followed by Trials 7 and 4, in decreasing order. This pattern was reversed on the second set, wherein Trial 4 was highest in error, followed by Trials 7 and 8. This was not unexpected in view of Singleton's (1953) findings of a deterioration in performance over even the first few minutes of a perceptual-motor task. The optimal performances occurred on Trial 2 of both sets.

These data might suggest that reactive inhibition and/or boredom were operating at both the end and middle of each set. Perhaps what is seen here is something analogous to the oscillation of inhibition to which Hull refers (1943, p.319). One of Hull's postulates suggested that the excitatory potential relative to a particular response is not stable, but rather varies in strength from trial to trial depending on the oscillating inhibitory factor associated with the response. This may explain to some degree the inconsistency and unevenness evident in performances over the eight RFT trials. On both RFT sets the best performances occurred on Trial 2, followed by considerably increased error on Trial 4, slight improvement relatively on Trials 5 and 6, followed in turn by performance decrements on Trials 7 and 8. Boredom, of course, cannot be discounted. Several subjects inquired as to why they had been asked to repeat the RFT procedure so often.

Witkin's purpose in having eight trials per set prior to a rest was ostensibly to increase reliability. However, the increased errors seen in this study on Trials 7 and 8 may work to the contrary. Perhaps a more reliable measure of field dependence-independence could be obtained by reducing the number of trials per set to six, or using reinforcement to increase involvement. Six may be the optimal number, combining the benefits of several measures and excluding the negative elements which intrude as the task persists. A pre-experimental reduction of trials in this study to six may have considerably reduced the error variance and perhaps would have permitted an experimental effect to emerge at a significant level in the analysis of variance. It is of interest that Oltman (1964), who found that RFT performance improved slightly but significantly under white noise (100db), used only four trials per set.

Although the differences between the experimental groups' RFT T scores were not statistically significant, perhaps the most important finding of this study is illustrated in Figures 3 and 4, which suggest that high levels of arousal led to the least decrement in RFT performance and low-to-moderate levels the most. The habituation factor was first considered as a possible explanation for the differential effects of Groups II and V and Groups III and IV on RFT error. It was thought that perhaps habituation was operating with one pair of these groups but not the other, thereby accounting for the differences. This did not prove very fruitful for the following reasons, however. A breakdown of the RFT scores over the eight WN trials showed both Groups II and V and Groups III and IV improving very slightly, in terms of reducing error, on the last four trials of the set as compared to the first four, despite the consistently poor performances mentioned above on Trials 7 and 8. In the case of Groups II and V, the error was reduced only a total of 43 degrees, from 829 on the first four to 786 degrees on the second four. Groups III and IV reduced their error a total of 26 degrees, from 952 to 926. Had habituation to the white noise occurred to any measure, with a concomitant reduction in its interference, one might have expected more pronounced decreases. Contributing here to these slight reductions also is the increased familiarity the subjects had with the apparatus, particularly when the trials in question are actually Trials 9-12 and 13-16.

One explanation for the higher RFT error with the two least aroused groups, as compared to the most highly aroused groups, could well be that given by Davies and Tune (1969). These authors reported that white noise increases the expenditure of effort required in task performance by adding slightly but significantly to "the cost of mental work", e.g., Ryan, Cottrell and Bitterman (1950), Corso (1952), Helper (1957) and Wilkinson (1960). Davies and Tune also reported studies by Boggs and Simon (1968) and Davies (1968). Boggs and Simon developed these findings of increased effort outlay into a theory, supported by Davies, which hypothesized that when subjects are exposed to noise they tend to "draw upon unused perceptual capacity and thereby maintain their performance level, despite the noise distraction (Boggs & Simon, p.148)". Davies stated that, "the short-term effects of noise suggest that it acts as a stressor which increases the effort required to maintain adequate levels of efficiency on tasks requiring continuous attention.(p.215)". Boggs and Simon (p.152) spoke of this response to noise as the subject drawing upon a "reserve capacity" that is not being utilized at the time, and the subject by so doing, "may be able to maintain task performance at a constant high level". The authors referred to this increased effort as a "compensatory mechanism".

If such is the case, it could be expected that the higher levels of arousal but lower RFT error seen with Groups II and V may have been the result of these groups mustering greater efforts to "maintain task performance", which they did essentially. Groups III and IV, on the other hand, may not have been sufficiently aroused to have resorted to increased effort and, as a result, their performances showed a decrease. Additionally, the above contention is supported by the poor performances found on the WN RFT Trials 7 and 8. A small degree of habituation to the white noise may have occurred, thereby slightly reducing arousal, which may have accounted for the increased error on Trials 7 and 8. In other words, the habituation may have reduced arousal to a low-to-moderate level, which led to increased errors on the last two trials.

The consistency of the trend in the RFT data is impressive and lends support to the hypothesis forwarded by Boggs and Simon and by Davies. The data show the highest arousal level from Study I had the lowest RFT error; the second highest arousal, the second lowest RFT error; the third highest arousal level, the second highest RFT error; and the lowest arousal level, the highest RFT error.

To summarize, the RFT data show, first, that white noise-induced arousal impairs RFT performance, supporting previous findings. Arousal impairs RFT performance in an unexpected way, however. The arousal hypothesis of Hebb (1955) and Malmo (1959) would predict that increasing levels of arousal would improve RFT performance up to an optimal level, whereafter performance would deteriorate as arousal increased to more extreme levels. As can be clearly seen in Figure 4, however, white noise-induced arousal and RFT performance have an almost linear relationship. The failure of the arousal hypothesis is not completely unexpected. Despite its considerable acceptance, the inverted-U hypothesis is supported, according to Davies and Tune (p.225), by "remarkedly little evidence" in studies of arousal.

Generally, arousal increases RFT error, but increasing levels of arousal may induce subjects to strive harder to compensate for the debilitating effects of the noise, thereby maintaining their level of performance, minimizing their error and, indeed, perhaps even decreasing their error as compared to pre-experimental measures. This may have been the case in Oltman's study (1964). His 100db level of white noise produced a significant improvement in RFT performance. One obvious implication for future research from this finding would be to replicate Oltman's work, adding white noise levels above and below his 100db level. Following the trend observed in the present study, 100db and more of white noise may actually improve RFT performance. A perusal of Figure 4 shows this a definite possibility. If such were the case, it could be concluded that RFT performance is detrimentally affected by moderate levels of arousal, less so by increasing levels, and, as arousal continues to increase, short of obvious limits, RFT performance is improved.

In conclusion, these RFT data may help to resolve the debate concerning the effects of arousal on RFT performance. It may be that the disagreement found in the studies reviewed earlier can be plausibly explained by the results of the present study. The position taken by those supporting the contention that RFT error increases under conditions of arousal, i.e., Hill and Feigenbaum (1966), Feintech (1970), Morf and Howitt (1970), Chess, Neuringer and Goldstein (1971), are supported. Oltman's results to the contrary are also indirectly supported. Finally, one study finding arousal had no effect on RFT error, Vaught and Bremer (1969), may be at least partially explained by the fact that the large individual differences in RFT performance are represented as error variance in an analysis of variance, and, as a result, tend to diminish experimental effects.

CHAPTER V

SUMMARY AND CONCLUSIONS

The study was conducted in two phases, referred to as Studies I and II.. In Study I an attempt was made to establish that white noise would induce arousal, and that increasing levels of white noise had the effect of increasing arousal. The purpose of Study II was to test the effects of the various levels of arousal on Rod-and-Frame Test (RFT) performance.

The hypotheses under investigation were as follows:

Hypothesis 1. An arousal state, as measured by palmar sweat, is induced by white noise. This was supported.

Hypothesis 2. Increased levels of white noise increase the level of arousal. This hypothesis was not supported. An irregular relationship between white noise levels and arousal was found. Various levels of white noise have differential effects on arousal. In this study, for example, the lowest level of white noise (63db) used evoked the second highest level of arousal. Of the six groups used in Study I, the Control group was lowest on the arousal measure, followed by Group III (75db), Group IV (85db), Group VI (95db), Group II (63db), and Group V (91db).

Hypothesis 3. Arousal has a decremental effect on RFT performance. This hypothesis was supported. Although the analysis of variance failed to indicate significant differences between RFT error with and without white noise, a sign test of the number of subjects whose error increased on the second RFT measure with white noise (WN) was significant.

<u>Hypothesis 4.</u> A curvilinear relationship obtains between different levels of arousal and RFT performance. This hypothesis was not supported. On the contrary, a partial linear relationship between arousal and RFT performance was found. Quite interestingly, the results showed that the highest level of arousal had the smallest RFT error increment; the second highest level of arousal, the second smallest error increase; the third lowest arousal level, the second highest RFT error; and, the lowest arousal level, the highest RFT error.

This study generates several problems that warrant further investigation:

(1) The number of RFT trials should be reduced from eight per set to six, in order to avoid the large increase in errors found in this study on Trials 7 and 8.

(2) Investigation of the effects of even higher levels of arousal on RFT performance might confirm the suggestion from this study that the progression of decreased error with increased arousal might continue to the point where RFT performance is even slightly improved under extreme

arousal conditions.

(3) Future studies of RFT performance should rely on statistical analyses other than the analysis of variance. Individual differences found on RFT performances are quite extreme and can often negate any experimental effect.

Appendix A

"This experiment simply involves a person's ability to discriminate the vertical, to tell when something is straight up-and-down, the way a stone would fall.

I am going to ask you to sit on this stool and control this rod with this switch. You can move the rod either way by moving this switch one way or the other. I am going to turn off the lights and move the rod and the frame in different directions. I would like you to move the rod back, when I say so, to the position you think is straight up-and-down, the way a stone would fall. When you think it is straight, just leave the switch alone and in 10 seconds, if you haven't moved it again, I'll know you have stopped moving the rod. After you have moved the rod I would ask you to turn around on your stool and face the back of the room, so your back is to me. I will take a reading and re-position the rod and frame and then tell you to turn around again and straighten the rod once again. Any questions? Would you like to test the switch before we start? Please keep your feet on the floor, facing in either direction".

After the first set of RFT trials and lights are turned on;

"Any problems? O.K., I would like to see how you do this after some noise is introduced. When you have positioned the rod, leave it, turn around and wait for me to ask you to try it again. If the noise is too unpleasant, tell me and I'll stop it. Any questions?"

APPENDIX B

For each pair of adjectives circle the number that best corresponds to your feeling right now.

(1) Anxious Calm

1 2 3 4 5 6 7

(2) Uninterested Interested

1 2 3 4 5 6 7

(3) Painful Painless

1 2 3 4 5 6 7

(4) Tense Relaxed

1 2 3 4 5 6 7

(5) Confused Clarity

1 2 3 4 5 6 7

(6) Insecure Secure

1 2 3 4 5 6 7

(7) Certain Uncertain

1 2 3 4 5 6 7

(8) Unamused Amused

1 2 3 4 5 6 7

(9) Sad Happy

1 2 3 4 5 6 7

(10) Unaroused Aroused

1 2 3 4 5 6 7

Code no. ____________
Age ____________
Year ____________
Program ____________

BIBLIOGRAPHY

Asch, S. E., & Witkin, H.A. Studies in space orientation: II. Perception of the upright with displaced visual fields. Journal of Experimental Psychology, 1948, 38, 455-457.

Astrup, A.M. Sensory deprivation in the underground mining environment. Changes in performance on the Witkin Rod-and-Frame Test. Unpublished honours thesis, 1967, University of Witwaterstand, Johannesburg, South Africa.

Bauman, G. The stability of the individual's mode of perception, and perception-personality relationships, Unpublished Ph.D. dissertation, New York University, 1951.

Berlyne, D.E. & Lewis, J. L. Effects of heightened arousal on human exploratory behavior, Canadian Journal of Psychology, 1963, 17, 398-411.

Berlyne, D.E., Borsa, D.M., Hamacher, J.H. and Koenig, I.D.V. Paired-Associate Learning and the Timing of Arousal. Journal of Experimental Psychology, 72, No. 1, July, 1966, 1-6.

Bindra, D. Motivation: A Systematic Reinterpretation. The Ronald Press Co., New York, 1959.

Block, J.A. A study of affective responses in a lie detection situation. Journal of Abnormal and Social Psychology, 1957, 55, 11-15.

Boggs, D.H. & Simon, J.R. Differential effect of noise on tasks of varying complexity. Journal of Applied Psychology, 1968, 52, 148-153.

Broadbent, D.E. Some effects of noise on visual performance. Quarterly Journal of Experimental Psychology, 1954, 6, 1-5.

Callaway, E. The influence of amobarbital (amylobarbitone) and methanphetamine on the focus of attention. Journal of Mental Science, 1959, 105, 382-392.

Chess, S.D. The relationship between arousal level and rod and frame test performance. Dissertation Abstracts International, 1970, June, Vol. 30 (12-B), 5684.

Chess, S.B., Neuringer, C. & Goldstein, G. Arousal and field dependency in alcoholics. Journal of General Psychology, 1971, 85, 93-102.

Corso, J.F. The effects of noise on human behavior. U.S. Air Force Wright Air Development Center tech. rep., No. 53-81.

Davies, D.R. Physiological and psychological effects of exposure to high intensity noise. Applied Acoustics, 1968, 1, 215-233.

Davies, D.R. & Tune, G.S. Human Vigilance Performance, New York: American Elsevier, 1969.

Davis, R.C. Motor effects of strong auditory stimuli, Journal of Experimental Psychology, 1948, 38, 257-75.

Davis, R.C., Buchwald, A.M., & Frankman, R.W. Autonomic and muscular responses, and their relation to simple stimuli. Psychological Monograph, 1955, 69, No. 20 (Whole No. 405).

Davis, R.C. Response patterns. Trans. New York Academy of Science, 1957, 19, 731-39.

Davis, R.C. & Buchwald, A.M. An exploration of somatic response patterns: stimulus and sex differences. Journal of Comparative Physiological Psychology, 1957, 50, 44-52.

Davis, J.M., McCourt, W.F. & Solomon, P. Sensory deprivation: (1) Effects of social contact, (2) Effects of random visual stimulation. Paper read at the American Psychiatric Meeting, Philadelphia, 1958.

Easterbrook, J.A. The effect of emotion on cue utilization and the organization of behavior. Psychological Review, 1959, 66, 183-201.

Elliott, R. Interrelationships among measures of field-dependence, ability, and personality traits. Journal of Abnormal and Social Psychology, 1961, 63, 27-37.

Epstein, S. The Nature of anxiety with emphasis upon its relationship to xpectancy in Anxiety, Current Trends in Theory and Research, Vol. II, edit. by Charles D. Spielberger, Academy Press, N.Y. 1972.

Feintech, E.R. Judgments of verticality in the rod-and-frame test as a function of drive level. Dissertation Abstracts International, 1970, Vol. 30 (7-B), 3370-1.

Fliegel, Z.V. Stability and change in perceptual performance of a late adolescent group in relation to personality variables. Unpublished doctoral dissertation. New School for Social Research, 1955.

Franks, C.M. Differences determinee par le personalite dans le perception visuelle de la verticalite. Revue de Psychologie Appliquee, 1956, 6, 235-246.

Gladstone, R. An investigation of the relationship between palmar sweating and emotion as measured by a group test of palmar sweating. Unpublished doctor's dissertation, Univ. of Illinois, 1949.

Goldstein, G. & Chotlos, J.W. Stability of field dependence in chronic alcoholic patients. Journal of Abnormal Psychology, 1966,71, 420.

Gross, F. The role of set in the perception of the upright. Journal of Personality, 1969, 27, 95-103.

Hebb, D.O. Drives and the C.N.S. (conceptual nervous system). Psychological Review, 1955, 62, 243-253.

Helper, M.M. The effects of noise on work output and physiological activation. U.S. Army Med, res. Lab. Rep., No. 270, 1957.

Hill, E. & Feigenbaum, K.D. Altering field dependence through stress. Perceptual and Motor Skills, 1966, 23, 1200.

Hull, C.L. Principles of Behavior. New York:Appleton-Century-Crofts, 1943.

Jacobson, G.R. Effect of brief sensory deprivation on field dependence. Journal of Abnormal Psychology, 1966, 71, 115-118.

Jacobson, G.R. Reduction of field dependence in chronic alcoholic patients. Journal of Abnormal Psychology, 1968, 73, 547-549.

Karp, S.A., Witkin H.A. & Goodenough, D. Alcoholism and Psychological Differentiation; The Effect of Alcohol on Field Dependence. Journal of Abnormal Psychology, 1965, 70, 262-265.

Karp, S.A. & Konstadt, N.L. Alcoholism and psychological differentiation: Long range effect of heavy drinking. Journal of Nervous & Mental Disorders, 1965, 240, 412-416.

Karp, S.A., Witkin, H.A. & Goodenough, D.R. Alcoholism and psychological differentiation: Effect of acheivement of sobriety on field dependence. Quarterly Journal of Studies in Alcoholism, 1966, 27, 580-585.

Kraidman, E. Developmental analysis of conceptual and perceptual functioning under stress and non-stress conditions. Unpublished doctoral dissertation, Clark University, 1959.

Kristofferson, M.W. Effect of alcohol on perceptual field dependence. Journal of Abnormal Psychology, 1968, 73, 387.

Light, B. Tension changes in patients undergoing psychotherapy. Unpublished doctoral dissertation, Univ. of Illinois, 1951.

Linton, H.B. Dependence on external influence: correlates in perception, attitudes, and judgements. Journal of Abnormal and Social Psychology, 1955, 51, 502-507.

Malmo, R.B. Activation: a neuropsychological dimension. Psychol. Rev., 1959, 66, 367-386.

Morf, M.E. & Howitt, R. Rod-and-Frame test performance as a function of momentary arousal. Perceptual and Motor Skills, 1970, 31, 703-708.

Mowrer, O.H. Psychotherapy, Theory and Research, Ronald Press, New York, 1953.

Oltman, P.K. Field dependence and arousal. Perceptual and Motor Skills, 1964, 19, 441.

Pollack, M., Kahn, R.L., Karp, E. & Fink, M. Individual differences in the perception of the upright in hospitalized psychiatric patients. Paper read at Eastern Psychological Association, New York, April, 1960.

Ryan, T.A., Cottrell, C.L., & Bitterman, M.E. Muscular tension as an index of effort; the effect of glare and other disturbances in visual work. Amer. J. Psychol., 1950, 63, 317-341.

Shipman, W.G. & Heath, H.A. What Does The Rod-And-Frame Measure? Paper read at the annual meeting of the Midwestern Psychological Association, Chicago, May, 1967.

Singleton, W.T. Deterioration of performance on a short-term perceptual-motor task. In: Fatigue, W.F. Floyd & A.T. Welford (Editors), London, Lewis, 1953, Pp. 163-172.

Silverman, S.R., Harrison, C.E., & Lane, H.S. Tolerance for pure tones and speech in normal and hard-of-hearing ears. OSRD Report 6303, Central Institute for the Deaf, St. Louis, 1946, (PB L 58239).

Solley, C.M. & Stagner, R. Effects of magnitude of temporal barriers, type of goal, and perception of self. Journal of Experimental Psychology, 1956, 51, 1.

Vaught, G.M. & Bremer, B. RFT Stability or failure to arouse? Perceptual and Motor Skills, 1969, 28, 378.

Witkin, H.A. The effect of training and of structural aids on performance in three tests of space orientation, Civil Aeronautics Administration, Division of Research, Report No. 80, 1948, Washington, D.C.

Witkin, H.A., Lewis, H.B., Hertzman, M., Machover, K., Meissner, B.P., & Wapner, S. Personality through perception. New York: Harper, 1954.

Witkin, H.A., Dyk, R.B., Faterson, H.F., Goodenough, D.R., & Karp, S.A. Psychological Differentiation. New York: Wiley, 1962.

Wilkinson, R.T. Effects of sleep deprivation on performance and muscle tension. In: The Nature of Sleep, G.E.W. Wolstenholme and M. O'Connor (Editors). Boston, Little, Brown & Co., 1960.

Woodworth, R.S., Schlossberg, H. Experimental Psychology, New York: Holt, Rinehart & Winston, 1954.

Vita Auctoris

1939	- Born in Ottawa, Ontario, Canada, to Arthur and Edna McCrory.
1957	- Completed high school at Regiopolis College, Kingston, Ontario, Canada.
1960	- Graduated with the degree of B.A., St. Francis Xavier University, Antigonish, Nova Scotia, Canada.
1966	- Graduated with the degree of M.A. in Psychology, University of Ottawa, Ottawa, Ontario, Canada.
1969-1974	- Registered as a full-time graduate student in the Ph.D. program in Clinical Psychology, University of Windsor, Windsor, Ontario, Canada.