THE ROLE OF FEEDBACK AND TYPE OF INFORMATION ON SYSTOLIC BLOOD PRESSURE ESTIMATION

By

SARAH MARLENE WEISS

Bachelor of Arts

Allegheny College

Meadville, Pennsylvania

1976

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1979

THE ROLE OF FEEDBACK AND TYPE OF INFORMATION

ON SYSTOLIC BLOOD PRESSURE ESTIMATION

Thesis Approved:

Larry Hochhaus
Thesis Adviser

Charles J. Mueller

James M. Price

Norman N. Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to express my appreciation to my major adviser, Dr. Larry Hochhaus, for his helpful suggestions and emotional support during the last several months. Dr. Jim Price was a valuable asset regarding the design and statistical analysis of the study. Also, I would like to thank Dr. Philip Murphy for his confidence in my ability as a graduate student in terms of my acceptance into Oklahoma State University. Finally, I would like to thank my mother, Sarah P. Weiss, for her continual support of my academic efforts.

TABLE OF CONTENTS

TABLE

Table Page

FIGURE

Figure Page

CHAPTER I

INTRODUCTION

The last decade has been dominated by research dealing with human control of physiological processes. The biofeedback literature demonstrates that it is possible to gain control of processes that were at one time thought to be involuntary. These developments have led other researchers to question how estimation and discrimination of physiological processes fit into the biofeedback process. Specifically, the interest has developed into determining if subjects can control and estimate the present state of the internal processes or accurately discriminate state X from state non-X.

The role of feedback within these three areas has been contradictory. External feedback is inherent to biofeedback; however, some evidence has questioned its effectiveness in estimation and discrimination. Probably the most appealing explanation of the negative effects of feedback on discrimination ability is offered by McNicol (1975). McNicol has stated that knowledge of results (feedback) can be detrimental to learning under some circumstances. Difficulty in learning could result because the feedback serves only to add more noise to the system. Similarly, Diekhoff (1976) has suggested that, in terms of discrimination of bodily states, external feedback may be out of phase with internal feedback mechanisms. This discrepancy amy cause difficulty in schematic formation.

The three areas of control, estimation and discrimination have been emphasized frequently in studying blood pressure. Biofeedback studies have shown successful control of blood pressure (e.g., Shapiro, Tursky, Gershon, & Stern, 1969; Shapiro, 1973). However, other studies dealing with blood pressure estimation have questioned the role of feedback (e.g., Shapiro, Redmond, McDonald, & Gaylor, 1975). Additionally, researchers such as Luborsky, Brady, McClintock, Kron, Bortnichak and Levitz (1976) and the Shapiro group have listed personality factors such as field dependency as being conducive to estimation accuracy.

The problem that has emerged from the literature has been one of specifying the difference between the physiological processes involved in control, estimation, and discrimination of bodily states. Secondly, examining the role of feedback in these areas appears critical to our understanding of the three processes. Finally, in dealing with specific tasks such as the role of feedback in blood pressure estimation, interest has continued concerning the nature of relevant personality characteristics that assist in improving blood pressure estimation accuracy.

CHAPTER II

REVIEW OF THE LITERATURE

Biofeedback: Research and Theory

The essential procedure of biofeedback learning involves turning internal signals into externalized information that can be perceived and, thereby, acted upon (Brown, 1974). It can be said that there are three main objectives in biofeedback training: awareness, control, and transfer. The theory of biofeedback is based on a combination of biology and cybernetics (Astor, 1977). Cybernetics introduced the feedback concept; information repeatedly cycles through an automated system for self-correction, improvement, or perfection. The feedback of biological information, in theory, gives the ability to detect internal changes and, consequently, to make appropriate alterations.

There are several advantages of biofeedback research. As already mentioned it can act to enhance "wholistic" human behavior (Astor, 1977). Secondly, biofeedback research can lead to control at will of many internal processes (e.g., Kamiya, 1972). Also, there is the potential for control and enhancement of specialized brain functions (Ornstein, 1972).

Copious research has demonstrated the success of biofeedback training in the human control of biological processes (e.g., Shapiro, 1973). However, there are some important drawbacks and limitations to biofeedback. Blanchard and Young (1973) distinguish between statistically and clinically significant results. These researchers consider a clinically significant result to be one that is 20% of the baseline, or when the response is brought from an abnormally high range back into a normal range. Many biofeedback results reach statistical but not clinical significance. However, Shapiro (1973) has pointed out that this is no reason to demean statistically significant results; each mm Hg decrease in blood pressure is of aid to the hypertensive patient. Another problem for biofeedback is that of transfering laboratory learning to everyday life. Data regarding long-term follow-ups and generalizability often has been missing from the literature. Astor (1977) has offered some tenable explanations for this fact. Specifically, he points out that there are often variances in instrument characteristics and standards of research vary making replication quite difficult. In addition, biofeedback can be quite "cold" in that it replaces human contact with instrumentation.

Discrimination of Internal Processes

Research in biofeedback learning is not always clear concerning the role of discrimination. That is, can one make the assumption that as the subject successfully completes biofeedback learning he or she is simultaneously learning to discriminate between bodily state X and non-X. Due to the obvious and important role that discrimination plays in learning, it appears discrimination of bodily states is important to physiological control. Suprisingly, there is a paucity of research in this area and that which exists is often ambiguous and contradictory.

Kamiya (1972) has addressed the question of discrimination of alpha states. He was interested in determining if subjects could say "A" when alpha was present and "B" when not present. The author noted that the stimuli to be discriminated were internal states; subjects who were midpoint in training tended to give ambiguous verbalizations on their strategy of dividing "A" and "B". In a second phase of the experiment, Kamiya found that subjects could learn to discriminate alpha from non-alpha without prior discrimination training.

Probably the most important research on discrimination of biological states has been performed by Stern (1972) and Diekhoff (1976). Stern (1972) studied detection of spontaneous galvanic skin responses (GSRs) as a function of a training period (with feedback) and size of the GSR. The author proposed that training would facilitate detection and that large GSRs would be more easily detected than small GSRs. In his procedure half of the subjects were given a preliminary 15 minute training session. During this time they were to note their bodily sensations while watching an ohmmeter. The other half of the subjects did not get this experience. During the testing phase subjects pressed one of four response buttons when signalled by means of a buzzer. Button 1 corresponded to a "positive GSR;" button 2 - "probable GSR;" button 3 - "probable no-GSR;" button 4 - "positive no GSR." Using d' as the measure of detectability, it was found that the training period did not facilitate detection of the galvanic skin response. However, prior training did affect discrimination between small and large GSR detection. Subjects who received prior training were superior in detecting large GSRs, while the no-training group showed no difference in ease of detectability of large or small GSRs.

Similarily, Diekhoff (1976) used a signal detection paradigm to study GSR discrimination. He made the assumption that feedback is not necessary to discriminate GSR and no-GSR. Furthermore, Diekhoff called for a distinction between "detection" and "identification" of internal events. The procedure involved probing the subject to respond whether he or she was in a GSR state under three stimulus conditions: High magnitude (over 500 ohms), low-magnitude (100-500 ohms) or no-GSR. As in Stern (1972) subjects used a four button response panel. There were four feedback conditions: 1) magnitude (subjects were told the extent of correctness of incorrectness); 2) correctness (subjects were told only if right or wrong); 3) no-feedback and 4) conflicting feedback (subjects were given yoked bogus information). Detection was defined as the absolute difference between the areas above and below the ROC curve. Identification was defined as the area below each ROC curve. The results showed that external feedback was not required to learn the GSR/no-GSR detection but was of significance in learning the labelling process (identification).

The relationship between discrimination and physiological control has been examined by several studies. Using GSR as their measure, Lacroix and Mignalt (1977) tested the hypothesis that subjects can discriminate changes in responses they are not able to control. Control was demonstrated in the condition requiring the subject to increase skin potential, not in the decrease condition. Evidence of discrimination in support of the hypothesis was demonstrated only after training. Clemens and McDonald (1977) studied the relationship between performance in discriminating heart beats and ability to voluntarily control heart rate, with and without feedback. It was found that only the feedback group had significant positive correlations between self-control performance and heart beat discrimination. Clemens (1977) studied heart rate discrimination by giving subjects 200 trials in four days in which subjects were required to press a button if they thought a series of ten-second flashes were synchronous with their heart rate. In the condition in which the signal was zero msec. after the R-wave, subjects showed considerable discrimination; they were able to tell when the signal was synchronous with their heart beat and when it was not. Also, the subjects showed comparable discriminability when the signal was presented 100 msec. after the R-wave.

The general conclusion from these studies is that discrimination of internal states is possible without feedback. Feedback appears to be useful when subjects are asked to use the discrimination knowledge for cognitive manipulations or applying the information to different contexts.

Efficacy of Feedback

Biofeedback assumes without question the necessity of feedback (it is inherent to biofeedback theory and application). There is a body of literature in the area of physiological discrimination that is not supportive of this view. That is, the discrimination data do not merge with the biofeedback literature as one might intuitively predict. Research that actively questions the role of feedback appears to challenge the theoretical contentions of biofeedback in that the reason biofeedback is effective may not be the reason the theory proports.

Stern (1972) studied detection of spontaneous GSRs as a function of feedback training and GSR magnitude. The results showed that training did not significantly influence d' but did produce lower hit and false alarm rates. Also, trained subjects were somewhat better in detecting large vs. small GSRs. Stern listed several possible reasons for these findings. First, the training period may have been too brief. In addition, the training period was different from the task in the testing period. In training, the subject was instructed to produce GSRs' the test task was one solely of GSR detection. Finally, the training effect may have been negated by the feedback that was given throughout the detection task.

The effects of feedback on judgements of absolute magnitudes of loudness have been studied by McNicol (1975). The subjects received either accurate, random, or no-feedback. It was found that the d' score for the no-feedback condition was larger than those for the accurate or random groups. McNicol gives a succinct but helpful rationale for these data. He asserts that discriminability is a function of both sensory and decision processes (establishing criteria). In this kind of judgement task the subject is often incorrect. When feedback is given, the subject becomes aware of the error and will shift his or her response criterion to compensate. This feedback-induced shift in criterion acts to add noise to the system; the task actually becomes more difficult.

Luborsky et al. (1976) studied the ability to estimate systolic blood pressure. Twenty-one male and female subjects who demonstrated at least ± 20 range mm Hg in systolic pressure over an initial baseline period. The study consisted of the following phases:

PHASE 1 - Subjects had three blood pressure readings taken daily for eight consecutive days. At the end of the period subjects were given range data concerning these 24 measurements (e.g., a subject would be told his readings ranged from 105 to 141).

PHASE 2 - This was a no-feedback period lasting ten sessions. Each subject was asked to estimate his blood pressure. Next, two blood pressure readings were taken; however, no information was given to the subject.

PHASE 3 - Subjects were split into two groups. One group received accurate feedback and the other received yoked feedback based on the results of the former group. Group A received information consistent with their own performance. Group B received information based on Group A; that is, they were yoked to Group A. All subjects participated in 15 sessions during this phase. Each subject was asked to check his estimate on a response scale of systolic readings that showed this particular subject's range information. Two blood pressure readings were taken and the subject was told the average of these readings. In addition, all subjects were asked to rank their degree of confidence in estimation on a 1 to 5 scale.

PHASE 4 - Identical to Phase 2.

PHASE 5 - Group B subjects were given accurate feedback for 15 daily sessions.

It was found that the subjects were accurate in estimating their blood pressure. This held true even in the no-feedback Phase 2. Subjects had a mean raw error of $\pm$12.4 mm Hg compared to a variation of $\pm$6.0 mm Hg from one reading to the next.

Additionally, feedback was found to positively influence accuracy scores. Group A (accurate feedback) improved significantly ($\pm$11.5 mm Hg error in Phase 2 to $\pm$7.4 mm Hg in Phase 3, $p<.01$). However, Group B which received yoked feedback also improved ($\pm$13.2 mm Hg to $\pm$8.5 mm Hg, $p<.05$). Luborsky et al. (1976) concluded that those subjects who were inaccurate in estimating their blood pressure had two main characteristics. One was that they paid less attention to the feedback information and more attention to external (non-physiological) cues. Secondly, these subjects tended to be field independent.

The Luborsky group found that subjects receiving either accurate or yoked feedback were able to estimate systolic blood pressure. Perhaps those subjects who were successful at the task were relying solely upon range information. That the yoked group was successful may have been due to the fact that the persons they were yoked to had blood pressures very much like their own; again, the importance of knowing the range is suggested. The use of a no-feedback group or a group receiving bogus feedback very different from their own would have been helpful in assessing these data.

The role of external feedback has been questioned by Shapiro et al. (1975). Their major objections with the biofeedback treatment of heart rate and blood pressure are as follows: 1) the reported changes are statistically, but not clinically, significant; 2) statistical significance is usually obtained by contrasting oppositely directed groups - not by comparison to a constant baseline performance or no-feedback condition; 3) in multi-session studies there often is no control for the repeated visits and treatments; 4) reward or reinforcement is often of uncertain value; 5) the instructional set is not always clearly defined and controlled; and 6) generalizability has not been demonstrated. These authors believe that instructional set and the directional task awareness play a major confounding role in assessing the efficacy of external feedback. To test this assumption the authors designed a study using six hypertensive subjects who were given specific information on how to make the blood pressure changes, directional information, and relaxation training. The results showed that the three factors, specific instructions, relaxation, and directional information were sufficient to produce significant increases or decreases in blood pressure.

These researchers raise further issue with external feedback due to perceptual characteristics of hypertensives. That is, there is reason to believe that hypertensive persons perceive conflict, anger, and hostility differently from normotensive people. Shapiro et al. (1975) discuss the "hypertensive personality." This person is characterized by the inability to express anger and may retreat from expressing hostility. This anger is turned inwards and manifests itself in the cardivascular system as an integrated pressor response. In previous work they found an inability of hypertensive patients to perceive a conflict. Specifically, hypertensive and normal subjects watched two movies involving an interaction between a doctor and a hypertensive patient (Sapira, Scheib, Moriarity, & Shapiro, 1971). In one movie the doctor was sympathetic and supportive; in the other the doctor was hostile and offensive. Neither the hypertensive nor the normal subjects gave a pressor response to the movie. However, when questioned about the movie the normal subject easily saw the contrast which was denied by the hypertensive patient. It was during this time that the hypertensive subjects began to show significant pressor responses not made by the normotensives. This apparent inability to perceive conflict appears to be specific to the disease; in a movie in which the problem was a dermatological one, the hypertensive patients had little difficulty recognizing the contrasting roles of the physicians. The contention is that these patients are so well insulated against their problem that there is room to question how effective external feedback can be.

Schmidt (1975) actively has questioned closed-loop feedback systems in the area of motor skill learning. Schmidt's analysis is pertinent to understanding the effects of feedback on tasks based on physiological responses. According to Schmidt, existing closed-loop theories (e.g., Adams, 1971; Sokolov, 1969) have several characteristics in common. That is, they all provide feedback which is checked against some reference. If a discrepancy is detected it is noted as an error and then corrected. Schmidt (1975) sees two problems with this conceptualization. First, where does the CNS store the maps or references that the feedback is checked against? Second, how can new behaviors be explained?

Schmidt has devised a theory that eliminates these shortcomings. It is a theory that combines schema theory, notions of closed and open-loop theories, and the use of "motor programs." The notion of the schema is very important to this theory. Evans (1967) defines a schema as a set of rules which are characteristic to some population; the rules provide instructions for producing a population prototype or concept. The Schmidt theory makes different predictions regarding the necessity of feedback (knowledge of results) for different motor tasks. In positioning tasks the movements are slow. A recognition schema is developed and a comparison of actual feedback and sensory consequences is made. Learning requires knowledge of results. However, in rapid movement knowledge of results is needed at first, but after practice the recognition schema is developed sufficiently and it can provide subjective reinforcement in the absence of results. Schmidt has asserted that looking only at closed-loop models has stifled research in motor learning. When writers no longer rigidly adhere to a closed-loop approach more research will be generated.

Diekhoff (1976) has discussed schema formation in the context of GSR detection. According to Diekhoff, the subject must learn to attend to the stimulus dimensions relevant to the differentiation of schematic groups (GSR and non-GSR). When the differentiation has been made the stimulus events can be assigned to appropriate schema families. Specifically, Diekhoff found that external feedback concerning the GSR response was not required for differentiation of GSR and non-GSR trials. Furthermore, feedback was found to be detrimental to differentiation over sessions. These data were explained in terms of schema theory. The GSR detection task, according to Diekhoff, can be viewed as an example of schema formation involving internal stimulus events. The problem arises when the subject compares the perfect reliability of the external feedback to the diffuse and less consistent internal cues pertinent to the formation of schema families.

These results are consistent with the findings of Edmonds, Muellar, and Evans (1966) who studied schema theory in a concept learning task. Subjects in this study were asked to distinguish among different schemata (histoform patterns) with and without the knowledge of results. The findings showed the subjects could form the schemata without external feedback. The results further indicated that feedback (knowledge of results) tends to facilitate early identifications of the schema and not the formation of the schemas themselves. In a similar study Edmonds and Muellar (1967) showed learning occured in an insightful fashion and found external feedback was not required.

These studies collectively question the efficacy of feedback in a variety of discrimination tasks. McNicol (1975) has suggested that feedback has the potential for adding noise to a system. Shapiro et al. (1975) believe that external feedback may be simply a less efficient way of instructing the subjects in the task at hand. Schmidt (1975) has suggested that closed-loop theories have been stifling to motor skill theorizing and research; perhaps the same conclusion can be made for research in physiological control.

Blood Pressure Estimation

The discrimination and feedback literature are related to the ability of the subject to estimate physiological processes. Discrimination ability is an important question with respect to blood pressure. This is of special concern, for example, regarding essential hypertension. In fact, this disorder is often referred to as the "silent killer" due to the virtual absence of symptoms. Even in normotensive individuals there are large blood pressure variations due to situational factors (Hassett, 1978). These changes often go unnoticed. With respect to blood pressure, it seems desirable that individuals be able to estimate the magnitude of their blood pressure readings. Obviously, awareness of elevated readings would be useful information. Thus, factors influencing blood pressure estimation are important to study. Specifically, one might question the role of discrimination and feedback training in augmenting blood pressure estimation.

Luborsky et al. (1975) demonstrated that both accurate and yoked feedback were successful in assisting blood pressure estimation. However, even during a no-beedback phase the subjects were also successful in blood pressure estimation. The important variable seemed to be providing the subjects with information on the systolic blood pressure range. When this was done subjects were successful in blood pressure estimation.

Shapiro et al. (1975) also reported blood pressure recognition data. The major hypothesis was that significant blood pressure changes could be made if the subjects were given explicit directional instructions and relaxation training. Feedback was hypothesized to be irrelevant. The subjects were six hypertensive subjects who were given five sessions involving different strategies. Session 1 involved specific instructions; session 2 introduced progressive muscle relaxation (PMR); session 2 also consisted of PMR; session 4 was self-induced relaxation; and session 5 consisted of specific directional instructions.

In order to study recognition of blood pressure, three additional sessions were used. Session 6 was a rest period; session 7 was a PMR session; and session 8 was a PMR session with the added suggestion that the subject could "'recognize better if he attended to his perception of heart rate, and forced contraction and tightness of his blood vessels'" (p. 36). During each of these sessions the subject was provided with a panel of buttons that allowed him to respond to the blood pressure as being up, down, or the same. The difference in accuracy scores between these three sessions was not significant. However, pooling the data did provide evidence of an ability to make accurate estimations. The subjects were correct on 45% of the trials (chance correct = 36.3%, ($p<.01$).

The ability to estimate blood pressure is an important issue because its symptoms are often vague. Research dealing with situations that augment detectability are therefore of value. Also, it would be beneficial to know if feedback helps or hinders the ability of estimate.

Field Independence and Dependence

Personality factors are often involved in the etiology of hypertension. Shapiro, et al. (1975) discussed the hypertensive person as one who insulates himself from conflict; anger is often turned inwards. The anger turned inwards acts as a pressor response on the cardiovascular system. The Shapiro group have asserted that the hypertensive patient insulates himself from situations involving conflict. This insulation may be the behavioral awareness of innate hyper-reactivity; by "failing to preceive," the person is attempting to guard against the hyper-reactivity by not reacting. However, the person soon loses the ability to express anger and hostility openly. The sequence of events leading to hypertension are reversed from the normal conceptualization. Behavior stems from the hyper-reactivity rather than the hyper-reactivity arising from the behavior.

Luborsky et al. (1975) discussed the characteristics of persons inaccurate as blood pressure estimators; these subjects were found to be field independent.

The notion of field independence and dependence has received much attention in perceptual psychology. Witkin, Dyk, Faterson, Goodenough, and Karp (1962) discussed how the person experiences his or her body in relation to objects outside the body. In the laboratory setting, the Witkin group identify field independence as the ability to escape the field in making judgements regarding certain stimuli. Field dependent subjects cannot escape the field; conceptual factors are important variables in the person's responses to the stimuli. Thus field independent people have higher scores on the rod-and-frame and embedded figures test. They are able to escape the influence of the field (frame or background) in making perceptual judgements.

These perceptual characteristics extend beyond the laboratory setting. The Witkin group found that field dependent people have a less developed sense of their identity and of their separateness from others. Dale and Eagan (1975) administered the group embedded figures test to 156 introductory psychology students. They were able to correlate anxiety and coronary proness to mode of perception. Their results showed that coronary proneness was associated with Type A behavior in males; that is, Type A behavior correlated with analytic perception. Field dependence correlated with manifest anxiety. The conclusion reached was that field independent persons are likely to express anxiety in terms of coronary proneness; field dependent subjects tend to express anxiety in terms of manifest anxiety. Attempts to correlate mode of perception with other paper and pencil tests have been only minimally successful. For example, efforts to correlate attributes such as sensation-seeking with mode of perception have been contradictory and ambiguous (Zuckerman, Kolin, Price, & Zoob, 1964; Farley, 1974). Adevai, Silverman, and McGough (1968) administered the MMPI to field independent and dependent subjects. Only the F scale, a validity measure, correlated with mode of perception. It was found that field dependent subjects scored higher on this scale. Pizzamizlio (1974) studied the relationship between lateralization of various functions and cognitive differentiation. He found right-handed subjects to be more field independent than ambidexterous subjects. On a dichotic listening task, subjects with strong ear preferences were more field independent than a group of subjects with mixed ear-preference.

The data suggest that personality and perceptual factors are associated with hypertension. Furthermore, these personality and perceptual factors appear to relate to awareness of blood pressure changes and the subsequent ability to make blood pressure estimations.

CHAPTER III

STATEMENT OF PURPOSE

The purpose of the present study is to investigate the ability of subjects to estimate systolic blood pressure. Estimation ability will be studied as a function of feedback and type of information given about baseline performance (average or range information). The present study is modeled on the work of Luborsky et al. (1976). This group used labile subjects; however, labile and non-labile subjects will be used in the present context. If there is no difference between labile and non-labile subjects in estimation ability, then more powerful generalizations can be made.

Luborsky et al. (1976) conclude that gaining knowledge of one's range information is an extremely important factor in imporving estimation accuracy; yet their study includes no other type of blood pressure information. Thus, an area of interest is determining if there is a difference in accuracy when subjects are given range information vs. an average figure.

The feedback results of the Lubrosky group are suprising. They found both accurate and yoked feedback was helpful in increasing estimation ability. Yet, the results complement the findings of Diekhoff (1976). Both question the role of feedback - be it accurate, bogus, or absent. Thus, investigating the role and efficacy of feedback becomes an important theoretical question.

It is expected that there will be no difference between groups receiving range vs. average information. The important factor is expected to be the extended nature of feedback not the form of feedback. Finally, feedback is expected to have a role in promoting more accurate blood pressure estimation.

CHAPTER IV

METHOD

Subjects

Twenty-four female students in an introductory psychology class, ages 18-19, participated in the study. All subjects were normotensive; that is, all the subjects had a diastolic pressure lower than 95 mm Hg (a figure suggested by a doctor at the OSU clinic). Diastolic pressure was the sole criterion for hypertension due to the labile nature of the systolic readings. No subjects were dismissed on the basis of elevated blood pressure readings. One subject was replaced near the start of the study when it became clear that she frequently was off campus and had difficulty making the sessions.

Female subjects were chosen to increase the incidence of field dependence. Screening on this measure was not possible before subject selection. Instead, all subjects were administered the group embedded figures test (Oltman, Raskin, & Witkin, 1971) after completion of all test sessions.

Subjects were randomly assigned to four groups: Feedback-Range, Feedback-Average, No-Feedback-Range, and No-Feedback-Average. Subjects received extra-credit in their psychology class for participation.

Design

In a fixed design, Feedback (present or absent) and Type of

Systolic Information (Average or Range) were varied factorially. Six dependent variables were observed. These were the correlations between (1) estimate and actual systolic, (2) estimate and systolic of the previous session, (3) estimate and diastolic, (4) estimate and diastolic of previous session, (5) actual systolic and confidence rating, and (6) actual diastolic and confidence rating.

Apparatus

A standard sphygmomanometer and stethoscope were used in the study. Instructions to the subject were tape-recorded.

Two experimental rooms were used. These were adjacent and sound attenuated. Two subjects often were scheduled simultaneously; time lapses between the readings easily permitted attention to both subjects. Also, this assured a constant interval between the two readings taken each session.

Procedure

Subjects were recruited for the experiment in their psychology class. At this time they were told that the study involved making blood pressure estimates; it was stressed that the experiment would be time-consuming. To compensate for the time involvement, subjects were given the maximum number of extra credit points allowed in their class. Interested students signed a list at the end of class and further contacts were made by phone.

Upon reporting to the first session each subject listened to taped instructions explaining the study (see Appendix A). At the conclusion of the tape any questions were answered. At this point the baseline period began.

PHASE 1 - Subjects reported to blood pressure sessions on three consecutive days.

To maintain consistency of readings, subjects were scheduled to either the morning, afternoon, or evening. A subject consistently reported to the experimental sessions within one of these time periods.

During each of the three baseline sessions, two blood pressure readings were taken. These were separated by three to five minutes. At the end of the baseline period subjects were given either their range or average information depending upon group assignment. Both the feedback group and the no-feedback group received this information. Systolic information was used for several reasons. First, a pilot study demonstrated that the estimation of two readings (systolic and diastolic) were too confusing to the subjects. Also, systolic information feedback is thought to be superior in studies where sessions are spread over days (Kannel & Schwartz, 1971; Luborsky, et al., 1976). In this way the labile nature of the systolic pressure is maximized.

PHASE 2 - Subjects were divided into four groups following baseline. These four groups were Average/Feedback, Average/No-Feedback, Range/Feedback and Range/No-Feedback.

Subjects made their estimate on a checksheet that had their personal average or range data based on systolic scores. Also, subjects were asked to make a confidence rating on their estimate and give comments on their strategy (see Appendix B).

Phase 2 consisted of 12 experimental sessions. After reporting to the study, the subject was instructed to rest quietly for a few minutes before the first reading was taken. This rest period was given in all sessions. After the rest period the subject was given a scale of systolic readings on which that person's own average or range information had been marked. During each of the 12 sessions of Phase 2, the subject was asked to make a systolic estimate, a confidence rating on that estimate, and any written comments about her strategy. Following the estimate two blood pressure readings were taken. Students in the Feedback condition were verbally told their systolic reading (the average of the day's two readings). Subjects in the No-Feedback group did not get this information. At the end of each session, scheduling for the next session was arranged.

Measures Recorded - During the three baseline sessions several measures were taken. These included two blood pressure readings at each session. Thus, during baseline six readings were taken, from which an average or range systolic figure was determined.

Phase 2 yielded more information. Just as in the baseline period, an average systolic and diastolic reading was determined. Also, the subject's systolic estimate and confidence rating on that estimate were recorded.

Embedded Figures Test and De-briefing - Subjects were given the EFT approximately two weeks after the completion of the study. It was stressed to the subjects that this was a perceptual test and that it was in no way related to intelligence. The recommended time period of five minutes per section was used. Following EFT administration a de-briefing period was held. The complete design of the study as well as preliminary findings were discussed.

CHAPTER V

RESULTS

Six dependent variables were of interest. These were 1) the correlation between the subject's estimate and actual systolic blood pressure [r(est.s)]; 2) the correlation between estimate and the systolic reading of the prior session [r(est.s-1)]; 3) correlation of the estimate and the actual diastolic blood pressure [r(est.d)]; 4) correlation of the systolic estimate and the diastolic reading of the prior session [r(est.d-1)]; 5) the actual systolic reading and the confidence rating [r(est.d)]; 6) the actual diastolic rating and the confidence rating [r(d.conf)]. The Pearson product-moment correlation coefficient was used. In the case of estimates, r is interpreted as an unbiased measure of discrimination ability, analogous to d' (Rubin, 1978). These scores were re-cast in terms of the Fisher Z-transformation (Hays, 1973). Therefore six correlations were obtained from each of the 24 subjects.

Each dependent variable was analyzed in two ways. First, an F-test was performed on the grand mean to test the hypothesis that the mean correlation differs from zero. Second, a two-way fixed effects ANOVA was used to compare the mean correlations in each of the four conditions.

The test on the grand mean was not significant ($p>.05$) for the test on Z[r(est.s)]; Z[r(est.d)]; Z[r(est.d-1)]; Z[r(s.conf)]; Z[r(act.d-conf)]. The test on the grand mean was significant on the dependent variable relating the estimate and the previous systolic blood pressure reading, Z[r(est.s)], (mean $Z = 5.95$; $F(1,20) = 7.76$, $p<.05$).

A two-way fixed effects ANOVA allowed comparison of the four experimental groups on the six dependent variables. The ANOVA on the correlation between the estimate and the actual systolic reading Z[r(est.s)], yielded the following results: Feedback vs. No-Feedback $F(1,20) = 9.79$, $p<.01$; Range vs. Average $F(1,20) = 2.73$, $p>.05$; Interaction $F(1,20) = .41$, $p>.05$. The analysis on the correlation of the estimate and the actual systolic reading from the prior session, Z[r(est.s-1)], showed: Feedback vs. No-Feedback $F(1,20) = .03$ ($p>.05$); Range vs. Average $F(1,20) - 1.45$, $p>.05$; Interaction $F(1,20) = .05$, $p>.05$. The test on the estimate and the actual diastolic reading, Z[r(est.d)] was as follows: Feedback vs. No-Feedback $F(1,20) = 1.01$, $p>.05$; Average vs. Range $F(1,20) = 1.53$, $p>.05$; Interaction $F(1,20) = .24$, $p>.05$. The relationship between the estimate and the diastolic reading of the prior session, Z[r(est.d-1)] showed: Feedback vs. No-Feedback $F(1,20) = .09$, $p>.05$; Average vs. Range $F(1,20) = .03$, $p>.05$; Interaction ($F(1,20) = 1.28$, $p>.05$. The correlation between the actual systolic reading and the confidence rating Z[r(s.conf)] were: Feedback vs. No-Feedback $F(1,20) = 1,20) = 1.22$, $p>.05$; Average vs. Range $F(1,20) = 2.34$, $p>.05$; Interaction $F(1,20) = .004$, $p>.05$. Finally, the correlation between the actual diastolic reading and the confidence rating Z[r(d.conf)] yielded: Feedback vs. No-Feedback $F(1,20) = 1.06$, $p>.05$; Average vs. Range $F(1,20) = .02$, $p>.05$; Interaction $F(1,20) = .65$, $p>.05$. Thus, the only significant score was the Feedback vs. No-Feedback group on the estimate vs. actual systolic reading variable Z[r(est.s)] (see Figure 1).

Group means on the Z transformation of the correlation coefficients

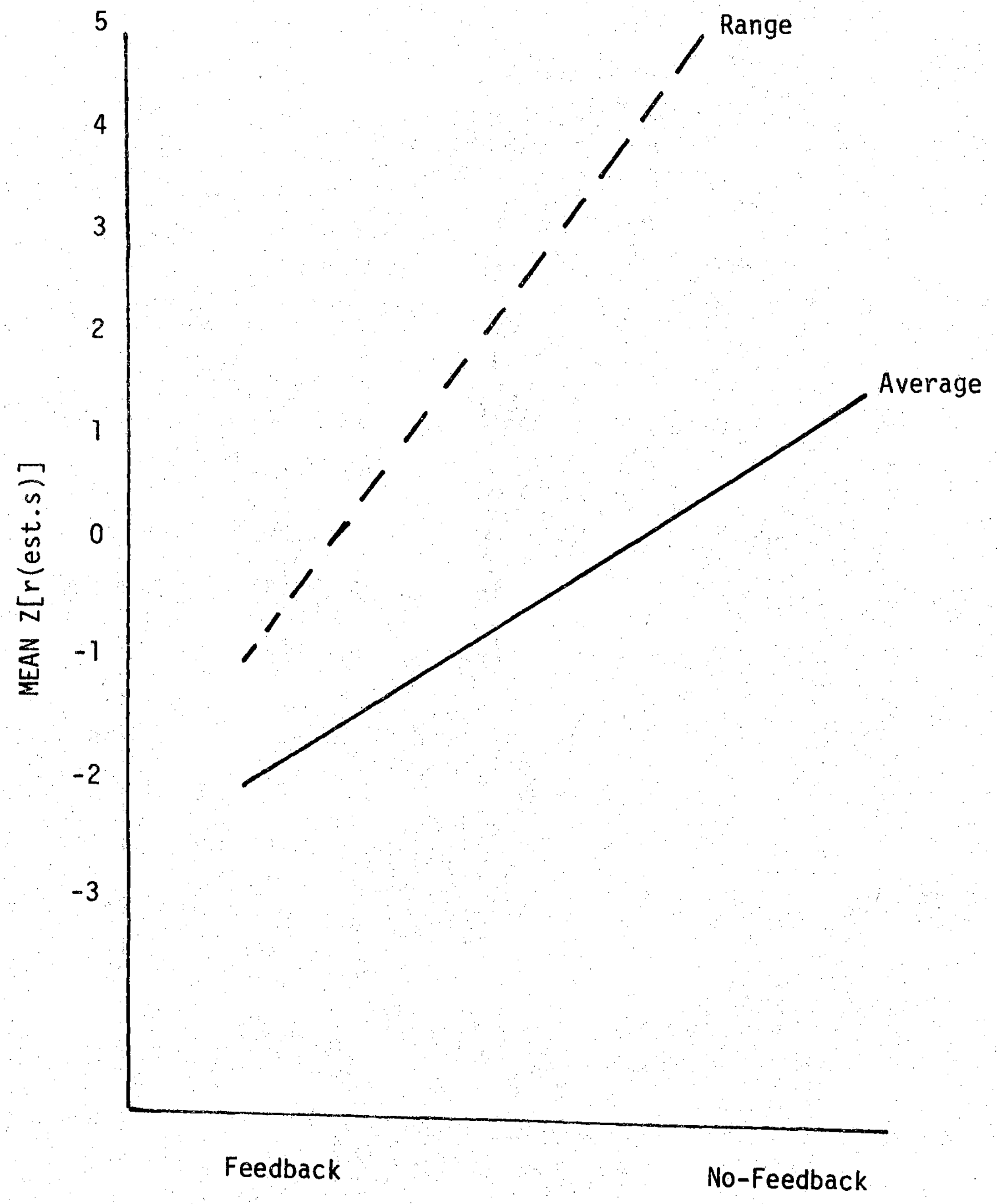

Figure 1. Relationship of Estimate and Actual Systolic Blood Pressure as a Function of Feedback

for the r(est.s) dependent variable were analyzed further. The transformed means were as follows: Average/Feedback = -.33; Average/No-Feedback = .03; Range/Feedback = -.18; Range/No-Feedback = .36. Analysis involved a nondirectional t-test to determine if the group means differed significantly from zero. The values were significant in the Average/Feedback group $t(5df) = 2.19$, $p<.05$, and Range/No-Feedback group $t(5df) - 2.19$, $p<.05$. The data within these two groups suggest that no-feedback improves blood pressure estimates while receiving feedback does not. In fact, receiving feedback appears to decrease estimation ability. This trend also appeared when the two feedback group means were averaged $t(11df) = -2.53$, $p<.05$. Both groups, whether receiving average or range information did significantly worse when given feedback.

The data were further analyzed in terms of labile and non-labile subjects. Lability, or degree of lability, was determined by subtracting the highest and lowest systolic reading for each subject on all 15 sessions. The Z transformed correlation of their estimate and actual systolic reading were examined as a function of lability score. This was done to determine if there was a difference between labile and less labile subjects in the ability to estimate blood pressure. Two lability groups (high, low) were formed and a non-directional t-test was performed. No difference in sensitivity on this measure was shown $t(22df) = -.39$, $p>.05$.

Post-experiment testing showed that all subjects were field dependent (none of the subjects correctly identified all the hidden figures). The actual scores of the test are shown in Table I (see Appendix C).

The relationship between the embedded figures test (EFT) and the dependent variable relating the estimate and actual systolic information was determined in a similar fashion. The correlation between the EFT and the Z transform of r(est.s) was found to be -.10, $p>.05$.

CHAPTER VI

DISCUSSION

The major findins are as follows. First, no sensitivity was demonstrated on the test of the grand mean relating the estimates and actual systolic readings, r(est.s). Second, the test on the grand mean was significant relating estimates and systolic readings from the previous session, r(est.s-1). Additionally, the ANOVA on r(est.s) was significant in terms of feedback (simple main effects test showed that no-feedback augmented estimation ability while feedback hindered the process). The data also suggest no difference in sensitivity between labile and non-labile subjects. Apparently this variable is not important to discrimination ability. It was also noted that results concerning the relationship between field independence and estimation ability were not significant but showed a trend in the proper direction. Finally, confidence ratings did not seem related to any of the blood pressure readings.

Lack of Sensitivity on r(est.s)

The subjects in this experiment did not demonstrate an ability to estimate blood pressure. This finding is not in agreement with the findings of Luborsky et al. (1976), who found subjects were accurate in estimating blood pressure. Sensitivity was demonstrated before feedback was introduced. There are major differences in method between the two studies which may account for the discrepancy in results.

Luborsky et al. (1976) used only labile subjects (±20 mm Hg variation). Their baseline period was extended to 8 days. The subjects had the following blood pressure readings: 16 subjects were in the high normal range (115-136); 5 subjects had moderately high blood pressure (143-156); no subjects were highly hypertensive (over 160). Furthermore, 18 of their subjects were on anti-hypertensive medication. In terms of subject ages, 4 subjects were in their 50's; 10 in their 40's; 2 in their 30's; and, 5 in their 20's. Subjects were paid $1.00 for each session; payment was contingent upon completion of the study.

The subjects used in the present study were all in the age range 18-19. The subjects were not paid and were both labile and non-labile. No degree of hypertension was demonstrated; in fact, many of the subjects consistently had systolic readings of 90-110. These differences may have been great enough to have contributed to the difference in findings.

Shapiro et al. (1975) also demonstrated that subjects were able to estimate blood pressure changes. These researchers used six hypertensive subjects. The recognition phase of the study followed five sessions seeking to test the notion that biofeedback constitutes a placebo effect. Three recognition sessions were given; subjects demonstrated the ability to estimate blood pressure change. The fact that these subjects had received extensive laboratory study in blood pressure control negates the comparibility between the present study and the work of the Shapiro group.

Relationship Between Estimate and Previous Reading

The test of the grand mean relating estimation to prior systolic readings, r(est.s-1), was significant. The relationship could have resulted for two reasons. First, the feedback group could have based their estimate on the reading given to them during the prior session. This seems to be a possible explanation for this result, but the lack of difference in r(est.s-1) as a function of feedback mitigates against this explanation.

Role of Feedback on Estimation Ability

Feedback did not augment ability to make accurate blood pressure estimates. In fact, subjects receiving no-feedback did significantly better than the feedback group on the r(est.s) measure. This finding is in agreement with the theoretical implications of schema theory (e.g., Diekhoff, 1976; Edmonds & Muellar, 1967) and signal detection theory (e.g., Diekhoff, 1976; McNicol, 1975). Apparently, when the task is one of discrimination or estimation of a physiological response rather than one of controlling of a physiological response, feedback is detrimental to sensitive performance. This result appears to have important implications for research and practice concerning biofeedback learning.

McNicol (1975) has reported data in a task of absolute judgements of loudness. McNicol explained his results in terms of signal detection theory. Specifically, he states that discriminability is a function of sensory inputs and criterion establishment. When feedback is given the subject will frequently shift their criterion in order to maximize correct decisions in the task. The implication is that feedback introduces unnecessary, ineffective and inefficient changes in the criterion which actually makes the task more difficult; in other words, additional noise has been added to the system.

In the present study feedback may have been comparable to adding noise to the task. Estimating one's blood pressure is not an easy task, or at least not a familiar one. A pattern suggested by McNicol could have been established. Diekhoff (1976) also has found feedback to be detrimental to GSR discrimination over sessions. Diekhoff argues that feedback interferes with the GSR detection task (a task which involves complex schematic formation). That is, the formation of schema for GSR and non-GSR states is interrupted. Diekhoff believes this result is due to the inconsistency between the perfect reliability of external feedback and the less reliable internal cues relevant to schematic formation. Thus, the task of schematic formation has been made more difficult due to additional noise.

Shapiro et al. (1975) do not use signal detection or schema formation terminology. However, their results and interpretation lead to a similar conclusion. The Shapiro group conducted a dual purpose study. One purpose involved examining biofeedback as a placebo effect, the other purpose dealt with the subject's ability to estimate blood pressure. These authors suggest that because their subjects demonstrated some degree of blood pressure awareness that this is evidence of an "internal feedback loop." Thus, under proper conditions, external feedback may interfere with this internal feedback loop and/or the formation of the appropriate schema families.

Schmidt (1975) vigorously questioned the usefulness of closed-loop feedback theories in the realm of motor learning. He asserts that closed-loop theories are not sufficient in and off themselves to explain motor learning. Also, he believes rigid adherence to this conceptualization has stifled research. On the basis of the findings by McNicol (1975), Shapiro et al. (1975), Diekhoff (1976), and others, it appears reasonable to extend Schmidt's (1975) discontent with closed-loop models to physiological learning. Schmidt has argued for the necessity of feedback in some motor tasks and not in others. Feedback appears relevant and helpful in some, but not all tasks involving internal physiological responses.

The problem appears to stem from a confusion and erroneous equating of two distinct groups of tasks. The tasks involving discrimination and (overt) estimation are apparently hurt by the addition of feedback, while tasks concerned with production and control of physiological responses are helped by feedback. The literature implicitly states the importance of feedback to physiological control; it may be crucial. Other research has implied that feedback is detrimental to estimation and discrimination. If one assumes that estimation and discrimination are a prerequisite or a by-product of control then there is a logical conflict. However, if these tasks are discrete and separable events then the paradox diminishes (Kamiya, 1972). Possibly closed-loop feedback theory is best limited to the area of physiological control. Physiological estimation and discrimination can be more adequately described in terms of open-loop theory and internally generated schema families.

Both Shapiro et al. (1975) and Luborsky, et al., (1976) report ability of subjects to estimate blood pressure. Several possible reasons for the findings have been suggested (prior practice and lengthy sessions). Another possible reason is that both of these researchers used labile subjects in the hypertensive range. It appears that lability when combined with higher than normal blood pressures may contribute to this estimation ability. In the present study, about half of the subjects were labile ($\pm$20 mm Hg). The analysis showed that sensitivity in estimating blood pressure was not distinguishable on the basis of lability. Possibly the crucial factor in estimation ability is not just lability, but specifically, lability combined with normal-high to high blood pressure. Insufficient data is now present to lead to a more definite conclusion. In this study, subjects tended to have low to normal blood pressure readings (16 of the subjects had their lowest reading falling under 100 mm Hg; 14 of the subjects had their highest reading falling under 120 mm Hg).

Relationship to Field Dependence

None of the 24 subjects were able to locate all figures in the hidden forms. Thus, all subjects demonstrated some degree of field dependence. The scores on the EFT showed a moderate negative correlation with the relationship between actual systolic readings and estimation ability, $r(22df) = -.10$, $p>.05$. The relationship was not significant; however, it did fall in the direction expected on the basis of Luborsky et al., (1976).

Although the relationship between field dependence and estimation ability was not significant, it does appear noteworthy that all the subjects were field dependent and were either hypotensive or normotensive.

These data agree with the findings that feild dependent individuals do not manifest anxiety via coronary outlets whereas field independent people have a stronger tendency to do so. It appears that the "ideal" estimator would be a field dependent person showing elevated and highly labile systolic readings. However, based on available information some combinations of characteristics appear to be less likely than other combination of traits (e.g., field independence, lability or hypertensive readings).

Confidence Ratings

Luborsky et al. (1975) found that the degree of confidence in estimation correlated with blood pressure in a positive fashion. Thus, on days that subjects had high readings they tended to feel confident about the accuracy of the estimation. This finding was not observed in the present study. Again, the general lack of subjects with high systolic readings could be a factor in the present results.

Subject Strategies

Subjects were asked to note the strategies they employed in making the blood pressure estimates. Clearly, the two most common strategies reported were guessing and basing the estimate on the previous readings.

These strategies are not suprising considering the general lack of sensitivity and positive correlation between the estimation and the previous systolic reading.

Another trend that emerged was that subjects who were given feed-back seemed to use a variety of strategies (based on coldness, warmness, test anxiety, birthday, feeling rushed, uptight). The no-feedback group tended to stay with one or fewer strategies. For example, a no-feedback subject reported increased blood pressure when feeling "uptight" and decreased blood pressure when feeling "relaxes." Another no-feedback subject based estimates on whether the pulse rate was up or down and stayed with this strategy throughout the study. This information is not easily quantifiable, however, it is consistent with the suggestions of McNicol (1975). In the present study the feedback group did tend to employ more strategies than did the no-feedback group. Thus the feedback may have induced a criterion shift and, thereby, added noise to the task faced by the feedback group.

Future Directions

The vast biofeedback literature explicitly or implicitly assumes feedback plays a central role in achieving physiological control over biological processes. However, the present research suggests a paradox concerning the efficacy of feedback. The paradox is the control over a biological process seems to require that the subject be able to discriminate between two or more bodily states, but that discrimination learning appears to be acquired faster in the absence of feedback.

Shapiro et al. (1975) conceptualize feedback as an elaborate placebo effect. This group has generated evidence suggesting that a specific instrumental and relaxation training alone are sufficient to duplicate the control shown by biofeedback training.

The area of contradiction appears to concern the acts of control versus discrimination of physiological processes. It is the opinion of the present writer that control and discrimination are two distinct processes in the sense that feedback has a different influence in each.

Estimation tasks (also hampered by feedback) appear most closely related to discrimination problems.

The distinct nature of perceptual learning and response learning has been emphasized by Gibson (1967). Specifically, she asserts that these two forms of learning differ on the role of knowledge of results (feedback). Knowledge of results is necessary to response learning as a means of strengthening associations. However, feedback is not necessary to perceptual learning. For example, Eriksen (1958) has studied the effect of feedback on absolute judgements of brightness and size. He found no sensitivity difference between subjects given correction and no-correction information. It is interesting to note that correction, as viewed by Eriksen, served primarily to influence the choice of words used by the subject. This is similar to the Diekhoff (1976) conclusion that feedback did not enhance the detection of GSRs but did enhance identification (labelling).

Gibson (1942) has shown an even clearer distinction between perceptual and response learning. Here it was shown that extinction did not occur in perceptual learning. The task was apired-associate learning. After learning, reinforcement was removed (stimulus items presented alone). Extinction did not occur. Gibson interprets this finding in a fashion similar to schema formation. That is, by the time the reinforcement is removed, distinctive properties of the stimulus set have already been established. External reinforcement is no longer needed.

The issue of importance thus becomes the selective nature of perceptual learning. That is, perceptual learning appears to be enhanced by a factor other than knowledge of results. This selective factor according to Gibson (1967) is a reduction in uncertainty. Perceptual learning involves "reducing uncertainty in the sense of the number of alternatives to be cognized, by filtering the irrelevant and detecting invariant relations" (p. 140). Thus, filtering and abstraction are the important mechanisms in perceptual learning, not association by feedback.

Gibson (1967) views perceptual learning to be of survival value just as the seeking of food. An information search is terminated by the reduction in uncertainty not by external rewards and punishments.

Useful research in the future will recognize the difference between estimation, discrimination, and control. It will become essential to be aware of the impact of feedback on discrimination of physilogical states. Research must experimentally separate these states as well as providing appropriate reinforcement (rewards versus reduction in uncertainty).

Finally, there is a need for comparability of research. Individual methodologies under the same area of study often preclude support or contradiction of previous findings.

CHAPTER VII

SUMMARY

The present study was concerned with blood pressure estimation as a function of feedback. The design was similar to the Luborsky study. However, in the present context subjects were given both range and average information. Feedback was either accurate or absent.

The findings showed no difference between receiving range or average information. Apparently, either the range or average information were sufficient to allow the subject to put a workable frame of reference onto her estimate.

On one of the six measures of estimation ability, feedback was found to decrease subject's accuracy while no-feedback augmented this ability. This finding was interpreted in terms of the rationale of Diekhoff (1976) and McNicol (1975). That is, the feedback was viewed as interfering with schematic formation of inducing criterion shifts, or both.

Finally, field dependency was examined as a relevant characteristic relative to estimation ability. It was found that all the subjects were field dependent. The correlation between field dependence and estimation ability was not significant.

SELECTED BIBLIOGRAPHY

Adams, J. A. A closed-loop theory of motor learning. Journal of Motor Behavior, 1971, 3, 111-150.

Adevai, G., Silverman, A. J., & McGough, W. E. MMPI findings in field-independent subjects. Perceptual and Motor Skills, 1969, 26, 3-8.

Astor, M. H. An introduction to biofeedback. American Journal of Orthopsychiatry, 1977, 47, 615.

Blanchard, E. B. & Young, L. D. Self-control of cardiac functioning: A promise yet unfulfilled. In D. Shapiro, T. X. Barker, L. V. Dicara, J. Kamiya, N. E. Miller, and J. Stoyva (Eds.), Biofeedback and Self-Control. Chicago: Aldine Publishing Company, 1973.

Brown, B. B. New mind, new body biofeedback: New directions for the mind. New York, New York: Harper Row, 1974.

Clemens, W. J. Procedures for studying the discrimination of heart beats. Psychophysiology, 1977, 14, 98 (Abstract).

Clemens, W. J. & MacDonald, D. F. Relationship between heart rate discrimination and heart rate control. Psychophysiology, 1977, 14, 315 (Abstract).

Dale, A. & Eagan, R. Anxiety and coronary proneness as a function of perceptual mode. Paper presented at the Annual Meeting of the Canadian Psychological Association, Quebec, Canada, June, 1975.

Diekhoff, G. M. Effects of feedback in a forced-choice GSR detection task. Psychophysiology, 1976, 13, 22-26.

Edmonds, E. M. & Muellar, M. R. Effects of knowledge of results on mixed schema discrimination. Psychonomic Science, 1966, 6, 377-378.

Edmonds, E. M. & Muellar, M. R. Schema discrimination without external reinforcement. Perceptual and Motor Skills, 1967, 24, 436-438.

Epstein, L. H. & Stern, D. B. Feedback influenced heart rate discrimination. In D. Shapiro, T. X. Barber, L. V. Dicara, J. Kamiya, N. E. Miller, and J. Stoyva (Eds.), Biofeedback and Self-Control. Chicago: Aldine Publishing Company, 1974.

Eriksen, C. W. Effects of practice with or without correction on discrimination learning. American Journal of Psychology, 1958, 71, 350-358.

Gibson, E. J. Intra-list generalization as a factor in verbal learning. Journal of Experimental Psychology, 1942, 30, 185-200.

Gibson, E. J. Principles of perceptual learning and development. New York, New York: Appleton-Century-Crofts, 1967.

Griggs, R. C. & Stunkard, A. The interpretation of gastric motility. Archives of General Psychiatry, 1964, 11, 82-89.

Hassett, J. Teaching yourself to relax. Psychology Today, 1978, 12, 28-40.

Hayes, W. Statistics: For the social sciences. New York, New York: Holt, Rinehart & Winston, 1973.

Kamiya, J. Operant control of the EEG alpha rhythm and some of its reported effects on consciousness. In C. Tart (Ed.), Altered States of Consciousness.

Kannel, W. B., Gordon, T., & Schwartz, M. Systolic versus diastolic blood pressure and risk of coronary heart disease (The Framingham Study), American Journal of Cardiology, 1971, 27, 335-346.

Lacroix, J. M. & Mignalt, F. B. Effects of feedback training on the discrimination of skin potential responses. Psychophysiology, 1977, 14, 90 (Abstract).

Luborsky, L., Brady, J. P., McClintock, M., Kron, R. E. Bortnichack, E., & Levitz, L. Estimating one's one systolic blood pressure: Effects of feedback training. Psychosomatic Medicine, 1976, 38, 426-438.

McNicol, D. Feedback as a source of information and as a source of noise in absolute judgements of loudness. Journal of Experimental Psychology: Human Perception and Performance, 1975, 1, 175-182.

Ohman, P., Raskin, E. & Witkin, H. A. Group embedded figures test. Palo Alto, CA.: Consulting Psychologist Press, 1971.

Pizzamizlio, L. Handedness, ear-preference, and field-dependence, Perceptual and Motor Skills, 1974, 38, 700-702.

Rubin, W. N. Application of signal detection theory to error detection in ballistic motor skills. Journal of Experimental Psychology: Human Perception and Performance, 1978, 4, 311-320.

Sapira, J. D., Scheib, E. T., Moriarity, R. & Shapiro, A. P. Differences in perception between hypertensive and normotensive populations. Psychosomatic Medicine, 1971, 33, 230-246.

Shapiro, A., Redmond, O., MacDonald, E., & Gaylor, R. Relationships of perception, cognition, suggestion in operant conditioning in essential hypertension. Progress in Brain Research, 1975, 42, 299-312.

Shapiro, D. Operant-feedback control of human blood pressure: Some clinical issues. Blood Pressure-Clinical Issues, 1973, 15, 448 (Abstract).

Shapiro, D., Tursky, B., Gershen, E., & Stern, M. Effects of feedback and reinforcement on the control of human septolic blood pressure. Science, 1969, 163, 588-590.

Silverstein, S. J., Natan, D. E., & Taylor, H. A. Blood level estimation and controlled drinking by chronic alcholics. Behavior Therapy, 1974, 5, 1-15.

Sokolov, E. N. The modeling properties of the nervous system. In M. Cole and I. Maltzman (Eds.), A handbook of contemporary Soviet psychology. New York, New York: Basic Books, 1969.

Stern, R. M. Detection of one's own spontaneous GSRs. Psychonomic Science, 1972, 29, 354-356.

Witkin, H. A., Dyk, R. B., Faterson, H. F., Goodenogh, D. R. & Karo, S. A. Psychological Differentiation: Studies in Development. New York: John Wiley and Sons, Inc., 1962.

APPENDIXES

APPENDIX A

PRE-BASELINE INSTRUCTIONS

This is a study dealing with blood pressure estimation. As you may or may not know, blood pressure is the force of blood against the arterial walls. The force of blood originates in the heart as it pumps blood throughout the body.

The most widely used technique for taking the readings is the use of the blood pressure cuff and stethoscope. Blood pressure is measured at two levels, the pressure in the arteries when the heart is contracting (systolic) which is the larger reading, and the pressure when the heart is relaxing (diastolic), which is the lower reading.

Normal blood pressure is difficult to define because factors such as age, sex, weight, personality characteristics all influence the readings. In very general terms, an average blood pressure reading would be 120/80. However, when considering these extraneous factors, the range of normal pressures could extend from 90/60 - 150/90.

During the next three sessions I will take your blood pressure twice per session at two minute intervals. At the end of the third session you will be given information on these readings. I will give you information on only the systolic (or higher reading). At the beginning of the fourth session, you will be asked to estimate your systolic pressure.

In total, you will be asked to participate in 15 sessions that will average 10-15 minutes each. Please keep in mind that I will need you for all these sessions and would appreciate your sincere expectation of finishing the study. If you have any questions at this time please feel free to ask.

APPENDIX B

SUBJECT CHECKSHEET

Name ______________________________

Date ____________ Time of day ____________

I would like you to place a check where you estimate your pressure is at moment. The dotted lines give you the approximate range (or average) of your systolic pressures. If you believe your pressure is outside this range do not hesitate to to outside this region.

149

145

141

136

131

125

120

116

112

108

104

100

96

Briefly describe your method in deciding your estimate.

I would like you to rank your confidence of estimation. Please place a check on the line at a section that represents your confidence.

Not at all certain about the estimation ________________________________ Certain about the estimation

APPENDIX C

EMBEDDED FIGURES SCORES

TABLE I

SCORES ON THE EMBEDDED FIGURES TEST OUT OF TWENTY-FOUR TOTAL ITEMS

Twelve Highest Scores	Twelve Lowest Scores
22	17
21	16
21	16
19	16
19	15
19	15
19	15
19	15
18	14
18	13
18	13
17	12

VITA[2]

Sarah Marlene Weiss

Candidate for the Degree of

Master of Science

Thesis: THE ROLE OF FEEDBACK AND TYPE OF INFORMATION ON SYSTOLIC BLOOD PRESSURE ESTIMATION

Major Field: Psychology

Biographical:

Personal Data: Born in Sewickley, Pennsylvania, August 13, 1954, the daughter of Sarah P. Weiss and Robert C. Weiss (deceased).

Education: Graduated from Avonworth High School, Ben Avon, Pennsylvania, June, 1972; received Bachelor of Arts degree in Psychology from Allegheny College, Meadville, Pennsylvania, June, 1976; attended Bucknell University, Lewisburg, Pennsylvania, September, 1976 to January, 1977; completed the requirements for the Master of Science degree in Psychology at Oklahoma State University, Stillwater, Oklahoma, in May, 1979.

Professional Experience: Worked in the recreational therapy department, Dixmont State Hospital, Sewickley, Pennsylvania, June to August, 1973; National Science Foundation Grant dealing with essential hypertension Meadville, Pennsylvania, June to August, 1975; Social Service work at Stillwater Nursing Home, Stillwater, Oklahoma, April to August, 1978; Graduate Teaching Assistant, Oklahoma State University, Stillwater, Oklahoma, January 1978 to May, 1979.