1-1-1984

Attention deficit disorder with hyperactivity : effects of stimulant drug and biofeedback treatments on selected measures of attention, memory, and locus of control.

Francis C. Dufresne
University of Massachusetts Amherst

Attention Deficit Disorder with Hyperactivity: Effects of Stimulant Drug and Biofeedback Treatments on Selected Measures of Attention, Memory, and Locus of Control

A Dissertation Presented

By

Francis Calo Dufresne

Submitted to the Graduate School of the University of Massachusetts in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

September 1984

School of Education

Attention Deficit Disorder with Hyperactivity:
Effects of Stimulant Drug and Biofeedback Treatments
on Selected Measures of Attention, Memory
and Locus of Control

A Dissertation Presented

By

Francis Calo Dufresne

Approved as to style and content by:

Ronald H. Fredrickson, Ph.D., Chairperson of Committee

Marvin Daehler, Ph.D., Member

Ena Nuttall, Ed.D., Member

Hariharan Swaminathan, Ph.D., Member

Mario Fantini, Ed.D.,
Dean, School of Education

for Karen and Justin

"Pour parvenir il faut endurer"

ACKNOWLEDGEMENTS

I would like to express my deep appreciation to the people whose support made this dissertation possible. In particular, I would like to thank my committee members Swaminathan for helping me decide on the right questions, Ena Nuttal for her constant support, and Marv Daehler for helping me say what I mean. Above all, I owe Ron Fredrickson my deepest gratitude. For ten years Ron has been unstinting in his generous encouragement and helpful guidance of me through both academic and professional decisions.

Many individuals have offered valuable suggestions; in particular the efforts of Dr. Gilbert Toleherst F.A.P.A. and Dr. D.H. Whalen regarding the attention tasks were deeply appreciated. I also wish to thank Dr. Robert Goshko, Margaret Kulis, Susan Long, Norman Morris, Mary Alice McQuade and Robert Tonner for their suggestions and help.

The finished product was made possible by the excellent typing and editorial reviews by Muriel Cranson, Virginia Michie and Caroline Sly. To them I offer my sincere appreciation.

I have dedicated this dissertation to my family and I once again thank them for their patience.

A B S T R A C T

Attention Deficit Disorder with Hyperactiviety:
Effects of Stimulant Drug and Biofeedback Treatments
on Selected Measures of Attention, Memory
and Locus of Control

September, 1984

Francis Dufresne, B.A., Stonehill College
M.A., M.Ed, University of Massachusetts
M.Ed., Westfield State College
Ed.D., University of Massachusetts

Directed by: Professor Ronald Fredrickson

Five children (four males and one female) diagnosed Attention Deficit Disorder with Hyperactivity received stimulant drug and biofeedback treatments. The subjects were tested on a recognition memory, locus of control and four auditory attention tasks. The experiment used an ABACA design with drug preceding biofeedback treatments. Two weeks separated each phase with the exception being four weeks between the biofeedback and second no treatment conditions to allow for biofeedback training. Each subject had at least eleven biofeedback sessions.

Statistically significant effects were noted in both the individual and group cases. Both treatments significantly reduced false alarms on a modified Rosovold task ($p<.01$). Neither treatment produced significant effects on a continuous performance task using a target embedded in a story. Only biofeedback significantly reduced false alarms ($p<.01$) and intrusions ($p<.01$) on a dichotic task with shadowing. Biofeedback also significantly reduced intrusions ($p<.01$) on a dichotic task requiring the rapid switching of attention. Neither treatment significantly altered recognition memory nor locus of control performance.

Both treatments had significant effects on individual performance. Drug treatment produced the most significant change in subjects experiencing a high level of life change events. Significant biofeedback effects were noted for all individuals.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The purpose of this research is to investigate the effects of stimulant drug and biofeedback treatments on children diagnosed as Attention Deficit Disordered with Hyperactivity (D.S.M. III, 1980, Appendix A). The question of interest is whether methylphenidate and dextro-amphetamine sulfate (stimulant drugs) affect auditory selective attention, auditory sustained attention, memory recognition and measured locus of control differently than electromyographic and skin temperature (biofeedback) treatments.

Stimulant drug and biofeedback treatments were investigated for several reasons. For the last three decades stimulant drugs have been the treatment of choice for the majority of children displaying hyperactive behavior. Based on available data, between 300,000 (Office of Child Development, 1971) and 600,000 (O'Leary, 1980) school age children are receiving medication to control their hyperactivity. However, within the last few years concern over the unintended (side) effects of stimulant drugs has resulted in a decrease in their prescription and dosage levels (Halpern, 1977; Lambert, Sandoval and Sassone, 1979, 1981). The side effect which causes the greatest concern is reduction in attainment of growth potential. While growth retardation effects continue to be the subject of some debate, the pediatric subcommittee of the Food and Drug Administration cautions that daily dosages in excess of 30 mg. may suppress weight gain (Roche, et al., 1979). Other researchers also note suppression in both height and weight due to stimulant drug treatment (Aarskog et al., 1977; Eaton et al., 1977; Lucas and Sells, 1977; Safer and Allen, 1976; Safer, Allen and Barr, 1972). Additional, apparently enduring, physical side effects which have also been identified are increased heart rate (Aman and Werry, 1975; Werry, Aman and Diamond, 1980) and extrapyramidal signs, abnormal motor movements. (Denckla et al., 1976; Weiner, Navsieda and Klawans, 1978). A second cluster of side effects have been noted which seem to affect social behavior in hyperactive children such as increased isolated play (Barkley and Cunningham, 1979; Gadow, 1981), and an exaggeration of self-directed negative statements (Collins, Whalen and Henker, 1980). A final group of side effects have been documented which seem to affect memory performance (Sprague and Sleator, 1975, 1977; Swanson and Kinsbourne, 1979[a], 1979[b]; Swanson, Kinsbourne, Roberts and Zucker, 1978; Weingarter et al., 1980). In summary, approximately 15-35% of the children receiving stimulant drugs will require close physician monitoring of side effects and an additional 5% will show side effects sufficiently serious to warrant discontinuation of the treatment (Conners, 1971; Gittleman-Klein, 1978; Halpern, 1977; Leary et al., 1979). This situation requires that trenchant treatment alternatives be identified for children when drug treatment is neither desirable nor effective.

A second reason for studying drug and biofeedback treatments is the hypothesis that both affect an individual by altering the activation level of the autonomic nervous system (Gittleman-Kline and Kline, 1975; Stoyva, 1979). The implication is that both treatments directly affect attention, since changes in activation levels have been positively correlated with measured changes in attention (Kahneman, 1973; Meldman, 1970; Satterfield, et al., 1974; Swanson and Kinsbourn, 1979; Zahn, Rapoport and Thompson, 1980). The contrast of treatment affects on attention is of particular salience given the characterization of hyperactive children in the current _Diagnostic and Statistical Manual_ (1980). Up to 1980 the focus of both research and treatment was on the description and reduction of activity levels with only an incidental focus on attentional skills. Consequently, the attentional characteristics of children identified as hyperactive are at best only generally understood and treatment effects on attention barely documented (Douglas and Peters, 1979). There is also some evidence which suggests that the optimal medication level for control of activity may have adverse effects on attentional behavior (Sprague and Sleator, 1975, 1977; Swanson et al., 1978). Thus, it becomes critical to increase our understanding concerning treatment effects since a disorder in attention is now considered to be of central importance in hyperactive children, and adaptive attention can be seen as necessary for learning and achievement in school.

Another rationale for contrasting stimulant drug and biofeedback treatments is that their effects are achieved through different processes, chemical control as opposed to self-regulation. There is a growing body of literature which suggests that the child's perception of the source of control is correlated with a variety of behaviors including academic achievement. High achieving children tend to display a low number of measured external responses. (Barling, 1982; Duke and Nowicki, 1978; Galejs and Dsilva, 1981; Krishna, 1981). Hyperactive children tend to attribute control of their behavior to external factors (Finch, Pezzuti and Nelson, 1975; Henker and Whalen, 1980; Rivera and Omizo, 1980). Academic underachievement is also a factor in the hyperactive syndrome (Safer and Allen, 1976). It follows that establishing a change in attribution, due to treatment, would be an important step in evaluating whether there are correlated changes in academic achievement. This study limits itself to noting whether the subjects demonstrate a difference in attribution of control following stimulant drug or biofeedback treatments.

Each of the experimental tasks will be presented through the auditory modality. Auditory presentation was selected for two reasons, experimental simplicty and instructional implications. In the first case investigation of attention has often been through the auditory mode; consequently, there exists a well-established tradition of what are considered valid measures of attention (Broadbent, 1957, 1958; Kahneman, 1973; Moray, 1969; Treisman, 1969). It has also been hypothesized that the use of the auditory mode may provide a more direct measure of central processes than the visual mode which is mediated by eye movement (Kahneman, 1973; Kunst, Wilson and Zajonc, 1980). In the second instance, the ability to receive and respond to verbal instruction is a critical factor in the child's ability to gain from instruction.

The attentional behaviors that were selected for measurement generally correspond to current theoretical positions regarding the attentional deficit of hyperactive children. Peters and Douglas (1979) contend that the inability to sustain attention over time is the major characteristic of the attentional disability. Ross and Ross (1976) believe that the primary attentional difficulty is a failure in selective attention, the inability to ignore irrelevant stimuli. Dykman and Ackerman (1976) postulate that the attentional difficulties of hyperactive children lay in their inability to efficiently switch the focus of attention.

For the purposes of this experiment, sustained attention was defined as the ability to correctly identify an infrequent stimulus over an extended time period. Sustained attention was measured by continuous performance tasks which are a traditional technique for describing sustained attention (Jerrison, 1970; Moray, 1969). The vigilance paradigm has also been used extensively in the study of hyperactive children (Doyle, Anderson, Halcomb, 1976; Dykeman et al., 1976; Rosvold, Minsky, Sarason, Bransome and Beck, 1956; Sykes, Douglas and Morganstern, 1973).

Selective attention in this experiment is defined by the subject's ability to report an identified message while ignoring a second, simultaneously presented message. Dichotic listening task were used as the vehicle for measuring selective attention. In a dichotic listening task the subjects must report a message delivered to one ear while ignoring a simultaneously presented message heard in the other ear. The dichotic listening model has been a major technique for investigating selective attention (Norman, 1976), and it has been used to study auditory attention in hyperactive children (Hiscock, Kinsbourne, Caplan and Swanson, 1979).

The ability to switch attention was also measured by a dichotic task. In the context of this experiment attention switching will be described by the subject's ability to rapidly change the focus of attention from one auditory channel (ear) to another. The dichotic task used to measure attention switching will be modified by the addition of a signal which tells the subject which channel to monitor for the target message (Gopher and Kahneman, 1971; Kahneman, Ben-Ishai and Lotan, 1973).

A factor closely associated to attention is memory and its various properties. A simple principle illuminating this relationship is that we are only able to recall that to which we attend. The memory property of interest in this experiment is auditory memory recognition. Auditory memory recognition was measured by the subject's accuracy in identifying material previously exposed when presented in a multiple choice format.

The final dependent variable of interest is the subject's measured locus of control orientation. This construct was defined and measured by the subject's score on the Nowicki-Strickland Locus of Control Scale for Children (Nowicki and Strickland, 1973).

A single case experimental model is used to investigate the effects of drug and biofeedback treatments employing an A,B,A,C,A design. There are difficulties inherent in the use of this technique for comparison studies (Hersen and Barlow, 1976). However, due to the idiosyncratic nature of physiological responses (Lynn, 1966), the intensive study of an individual is recommended as the optimal technique for establishing the clinical effects of drug and biofeedback treatments (Kiesler, 1971; O'Leary, 1980).

This experiment is not designed to test a specific theory, but its results may have implications for some theoretical formulations concerning attentional disorders. Attention has been conceptualized as a multifactored construct (Boring, 1970; Moray, 1969), yet theories concerning attention disorders have emphasized a single aspect of attention and tend to ignore or dismiss other aspects as irrelevant. Since the proposed experiment will study a variety of attentional behaviors within an individual, experimental results may offer information concerning the relationship among attentional factors. There are four possible general results that could be obtained from the experiment. A finding of no difference between drug, biofeedback and no treatment conditions would imply that neither treatment has a significant effect on the behaviors being studied.

A difference between treatments and no treatment conditions would indicate that interventions are effective in producing change but, due to the nature of the design, only limited statements may be made concerning their relative efficacy. However, this result may be of benefit to the clinician. Noted differences between each condition may provide information concerning individual differences and the criterion for treatment selection.

A third possibility is a performance equivalency between biofeedback and no treatment phases. This situation would imply that drug treatment is superior to biofeedback treatment. The opposite result, drug and no treatments equivalent, and biofeedback treatment being superior would imply that biofeedback would be the preferred method for treating the experimental behaviors.

The proposed experiment contains four direct replications, consequently, it will be able to answer questions of generality across clients, but the results will be unable to address generality of findings across therapists or settings. Furthermore, given the procedures for ensuring a homogenous population, the direct replication procedure cannot address treatment consequences on the identified experimental behaviors in children with other attentional disorders, such as Attention Deficit Disorder without Hyperactivity (D.S.M. III, 1980). However, the limitations on the research offer clear directions for future research, namely, further direct replication across diagnostic categories and systematic replication across experimenters and settings.

CHAPTER II

REVIEW OF THE LITERATURE

Preface. This chapter will provide a review of research on the effects of stimulant drug and biofeedback treatments on attention, memory and the attributional behavior of hyperactive children. Although research on hyperactivity is abundant, reflecting a half-century of concentrated interest, only a limited fraction of the many studies have investigated the cognitive effects of drug treatment. Studies on the effects of biofeedback treatment only number a score yet few even address questions of attention and memory.

The material presented in this chapter will be organized into two sections -- medication and biofeedback. Each section will begin with a brief introduction and proceed to an analysis of relevant research. Each section will conclude with an analysis of current research limitations.

Drug Treatment

Introduction. The central issue in the treatment of hyperactive children is the reliance on stimulant medication as the preferred mode of intervention (Gadow, 1981; Lambert, Sandoval and Sassone, 1979, 1981; Murray, 1980). The primacy of medication to control the behavior of hundreds of thousands of school aged children (Gadow, 1981; Grinspoon and Singer, 1973; O'Leary, 1980; Office of Child Development, 1971; Wunsch-Hitzig, Gould, and Dohrenwend, 1980) has engendered legitimate public concern and controversy, a concern which has encouraged research on alternative treatment interventions and a controversy which makes a balanced presentation difficult.

For the past decade a new emphasis on research has emerged in an attempt to document the attentional characteristics of hyperactive children. The focus on attention has developed in order to clarify why, despite a drug treatment program, problems with learning and attention continue through adolescence (Douglas, 1974; Hoy, Weiss, Mind and Cohen, 1978; Mendelson, Johnson and Stewart, 1971; Riddle and Rapoport 1976; Whalen and Henker, 1976) and young adulthood (Feldman, Denhoff and Denhoff, 1979; Weiss et al., 1971). Associated with this documentation effort has been a more careful scrutiny of medication effects on cognitive behavior as measured by physiological reactivity, performance on laboratory tasks such as vigilance, standardized testing and observation procedures.

<u>Drug effects on physiological, laboratory and observational</u>

measures of attention. In 1980, Philip Firestone raised a fundamental issue by asking why there is no clear evidence for enhanced academic achievement in the classroom from children receiving medication that is alleged to improve attentional abilities. The first question which must be addressed is whether medication* does affect attention. Several authors have chosen to answer this question through studies of medication effects on arousal level.

A number of studies have linked activation of the autonomic nervous system with performance on attention tasks. Research by Eliot (1970), Doyle (1976), Tarver (1974), Swanson (1979), Flanagan (1967), Raskin (1973) and Satterfield (1974) have all associated increased attention with increases in electrodermal activity. Attention has also been associated with heart rate deceleration (Cohen and Johnson, 1971; Porges et al., 1975; Soloman and Brehony, 1970; Zahn et al., 1978, 1980), electromyographic activity (Cohen and Johnson, 1971), pupillary reactivity (Kahneman, 1973) and slowed respiration (Simpson and Nelson, 1972a). These studies have consistently found that increases in the autonomic nervous system are correlated with improved performance on tasks requiring attention.

The use of EEG measures in the study of hyperactivity

*For the purposes of this chapter, the effects of three medications will be reviewed: methylpenidate HCL, dextroamphetamine sulfate and pemoline (see Appendix B).

has been common since the 1950's (Laufer and Denhoff, 1951). The tendency in these studies has been to review the effects of amphetamine level on visual and auditory evoked potentials which are viewed as indicators of the attention of hyperactive subjects. The consensus of these studies has been that stimulants tend to normalize the EEG response of hyperactive children to specific stimuli (Connors, 1974; Buchsbaum and Wender, 1973; Satterfield et al., 1973; Satterfield, 1974; Shetty, 1971a, 1971b).

Some of these results have been questioned. Milstein and Small (1974) attempted a replication of Shetty's (1971b) experiment where abnormal photic responses (associated with visual attentional difficulties) were eliminated by dextroamphetamine. Milstein and Small's (1974) study failed, after the administration of Pemoline, to find any normalization of photic response in the 20 parent- and teacher-identified hyperactive children. They did note a clear central nervous system effect. A possible reason for the difference between experiments is that the CNS effect of pemoline is more generalized than that of dextroamphetamine.

Most recently, research from the EEG System Laboratory of the University of California Medical School has begun to question the validity placed on some EEG interpretations (Stein, 1981). In particular, doubt has been cast on the claims made that evoked potential response is able to isolate and measure central control mechanisms such as attention.

Other authors have studied the effects of stimulants on various measures of autonomic nervous system arousal. Satterfield (1974) analyzed the effects of stimulants on electrodermal activity in hyperactive (N=18) and normal (N=18) children. He found that a subject taking stimulants exhibited increased non-specific skin conductance responses upon hearing a tone. Raskin (1973) hypothesized that such non-specific responses reflect the process of selective attention. An increase in skin conductance is reported also by Hastings and Barkley (1978); with a dose of 15mg/day of methylphenidate Zahn et al.'s (1978) study of stimulant effects on hyperactive children provides some limited support for the above findings. In this experiment several autonomic nervous system measures were studied: pupil reactivity; heart rate; skin conductance; and distal finger temperature. While both hyperactive (N=50) and control subjects (N=59) increased ANS measures in a matched fashion, the hyperactive sujects showed a greater increase in skin conductance responses. The authors also noticed a tendency in both groups for the drug to produce a heart rate deceleration during the fore period in a reaction time task, which they assumed reflected a state of focused attention.

In a single blind study, Conners and Rothschild (1978) found that subjects receiving dextroamphetamine increased vascular autonomic response from their baseline level and demonstrated more rapid habituation to white noise than the placebo group. They claimed the observed habituation of the subjects to distracting noise demonstrated that the drug reduced the distractibility of hyperactive children. However, the results are confounded by several factors. The single blind design may have introduced experimenter bias, and/or the high dosage level of 2mg/kg may have overly inhibited motor activity. The latter possibility is further supported since their medicated subjects did not display an orienting response to frequency variation of the auditory stimuli.

Gittleman-Klein and Klein (1975) and Lubar and Shouse (1979) report more cautious results in their studies of methylphenidate. Both claim effects on the autonomic nervous system but feel the results are complex and involve various bodily systems with no clear unitary drug effect. Lubar and Shouse (1979) do not report dosages in their study, so it is impossible to tell whether this variable influenced their measures. Gittleman-Klein and Klein (1975) used a mean dosage level of 50mg/day, well above 20mg/day which is considered the maximum end of the therapeutic range ("Using," 1978). The double-blind, crossover design of their experiment controlled many of the variables not controlled in other studies, yet it did not eliminate the possibility of a dosage effect.

Recent studies have reviewed the effects of both dextroamphetamine (Rapoport et al., 1978; Zahn, Rapoport and Thompson, 1980; Weingarter et al., 1980) on hyperactive (physician diagnosed) and normal (volunteer) children. In Zahn et al.'s (1980) experiment, which was a double-blind, controlled and crossover design, they found no significant differential drug effects distinguishing between normal (N=28) and hyperactive children (N=30) on a variety of measures including skin conductance (SC), heart rate (HR) and skin temperature (finger). Weingarter et al. (1980) also found parent and teacher ratings did not differentiate between the two groups. Zahn et al. (1980) noted that for both groups HR and ST measures did increase above baseline measures and no significant differences between groups. They controlled for dosage effect by prescribing medication levels which were one half of the minimum daily dosage (methylphenidate .5mg/kg, dextroamphetamine 10mg/day).

Rapoport et al. (1978) also questioned the validity of the traditional concept of active drug life. The assumption was that stimulant drugs were effective for approximately four to five hours after which hyperactive symptoms would return, making another drug dose necessary (Cantwell and Carlson, 1978; Conners, 1978). In Rapoport, et al.'s (1978) experiment, they measured the activity level of normal prepubertal boys (N=14) and found that dextroamphetamine initially reduced activity level; but, after five hours, activity level significantly increased, resulting in a reappearance of hyperactive behavior.

These studies indicate that stimulant drugs increase autonomic nervous system arousal for all subjects with hyperactive children showing a higher but non-significant level in tonic and non-specific electrodermal responses. Given increases in arousal levels due to stimulant medication, drug-treated hyperactive children should demonstrate improved performance on other measures of attention.

One manner in which attention has been studied has been through reaction-time experiments (Barkley and Johnson, Jr., 1977; Spring et al., 1973; Zahn et al., 1978, 1980). The general conclusion of these studies seems to be that stimulant drugs do not affect performance any differently for hyperactive or normal children in initial trials; both groups display fewer errors and shorter reaction time (Spring et al., 1973; Zahn et al., 1980). However, on later trials (12 minutes into the experiment) the medication seemed to maintain the performance level of hyperactive children (Spring et al., 1972; Barkley and Jackson, Jr., 1977a). In Zahn et al.'s (1978) experiments they failed to find any clear improvement in reaction time which could be attributed to the medication. In this experiment, the experimental subjects (N=35) were psychiatric outpatients who may not be comparable to the subjects in the other studies.

The general findings of the reaction-time experiments have been confirmed by a number of vigilance studies performed under various conditions (Brown, 1982; Conners and Delamater, 1980; Dykman, Ackerman and McCray, 1980; Gittleman-Klein and Klein, 1975; Werry et al., 1980). The effects of medication on a simple vigilance task (responding when a single stimulus appears), when compared to controls on a placebo condition, seemed to be an enhancement of sustained attention. In these experiments (typically lasting 30 minutes), hyperactive children on medication reduced their total number of errors and lowered their response latency.

Two experiments, which used a paradigm involving the detection of a two-stimuli sequence, also noted an age difference in the performance of hyperactive children on vigilance tasks (Doyle, 1976; Dykman et al., 1976). In Dykman et al.'s (1976) experiment they used the letters AX as the target; subjects (N=97) had to depress a button held in their preferred hand when the stimuli appeared. They found that subjects older than nine on methylphenidate showed the greater gains in correct signal detection than younger subjects (seven to nine), those taking pemoline, and while in placebo condition. In Doyle's (1976) experiment he found the opposite result in his subjects

(N=60). When asked to choose a red-green light combination, younger subjects on methylphenidate (seven to nine) performed better than older children (ten to twelve). He also noted that there was no significant improvement for either age group in vigilance performance whether in medicated or placebo condition.

It is difficult to account for the different results since both authors employed the same diagnostic criteria, covered the same age range and studied children on the same medication. However, Doyle (1976) does not offer dosage information and he was studying children with admittedly high activity levels. The tasks demands were also somewhat different; consequently, motivational factors may have played a role differentiating between age groups. To confuse the issue even further, Sykes, Douglas, Weiss and Mind (1971) found no significant effect for medication on the detection of letters by forty hyperactive children in two vigilance tasks using single stimuli (letters and forms) and a two-letter sequence. The reported subject selection, medication and design criteria of this experiment were similar to the Dykman and Doyle experiments. In this experiment, significant age differences may have been lost in group aggregate data.

While the consensus seems to be that stimulant medication maintains correct detection of a single stimuli over time, the results of paired stimuli detection are contradictory. Another concern is that the results of these experiments may have very little to offer in terms of the daily attentional demands placed on hyperactive children. Classroom performance does not depend on the patient waiting for a single stimuli to appear but rather requires the adaptation of attention to the rapidly shifting demands of a classroom environmnet.

In an attempt to identify the effects of stimulant medication on selective attention, Dykman et al., (1980) had their subjects (forty-three males ages seven to ten) select relevant stimuli from a 2x4 and 4x12 stimulus letter field with only one stimulus relevant at a time (central-incidental task). They then tested the subjects recall of target and incidental letters. They noticed an improvement in sustained but not selective attention. Fisher (1978) studied the effects of dextroamphetamine on hyperactive males, ages six to eleven, on a central incidental task. She found that medication reduced the amount of interference by incidental material and decreased response time. She also noted that practice in the placebo condition was more effective than practice in the drug condition. Extended placebo practice also reduced incidental task interference and response latency to the levels achieved by medication. In another study employing a central-incidental type task, Thurston (1979) found central learning increased and incidental learning decreased for her thirty-three hyperactive children, with no placebo effect.

Hiscock, Kinsbourne, Caplan and Swanson (1979) studied the auditory selective attention of hyperactive children using a dichotic listening task. Twenty pediatrician-referred hyperactive children were presented with 126 dichotic digit pairs at one pair per second while under placebo and drug (methylphenidate) conditions. Each block of three pairs was separated by an 18-second pause. In the free report condition the subjects were to recall as many digits as possible, and in the selective attention condition they were to report digits heard in the primary (target) channel first and in the secondary channel last. Each subject was presented with 36 pairs twice in each condition. Hiscock, et al. (1979) found no significant difference between drug and placebo conditions on total recall in either the free report or selective listening tasks. In a second data analysis of children considered good drug responders (N=13) by the authors, a significant strategy difference in the free response task was noted. Good drug responders tended to report digits heard in one ear before those heard in the other (ear order report) significantly more ($p<.025$) than subjects considered poor drug responders (N=7). The authors concluded that the medication may reduce maladaptive channel switching as shown by the response strategy of the good drug responders in the free report condition. However, the authors also noted that methylphenidate tended to inhibit effective attention switching during the selective attention task. The authors stated that difficulty with attention switching is not unusual in children, and stated that their finding supports the assumption that stimulants normalize the behavior of hyperactive children.

The work by Witelson and Rabinovitch (1971) raises some questions concerning Hiscock et al.'s (1979) contention that attention switching is a difficult task for children and their implication that ear order report reflects a decrease in maladaptive channel switching. Witelson and Rabinovitch (1971) studied the effect of various rates presentation (.5 sec., 1 sec., 2 sec.,) on the report strategy of normal fourth grade children (N=24). These authors found that the subjects reporting on dichotic digit pairs presented at one-second intervals used both an ear order and temporal report strategy with approximately the same frequency. The temporal report strategy is the recall of digit pairs heard simultaneously. In their discussion, Witelson and Rabinovitch (1971) also noted that their subjects with higher measured intelligence were able to switch report strategies more easily than subjects with lower, but average intelligence.

The non-significant findings reported by Hiscock et al., (1979) may have also been influenced by the brief duration of the experimental tasks. Each experimental trial lasted somewhat less than three minutes; consequently, the duration may not have been long enough to result in any significant difference due to drug treatment. A second difficulty with Hiscock et al.'s (1979) findings is that the effects of memory and guessing were not experimentally controlled. The thirteen-second interval between each of the twelve trials was sufficient for active rehearsal of the digits. The requirement that subjects simply state the presented digits at the end of the experimental task simply does not eliminate effects due to possible guessing by the subjects.

Little can be derived from studies on selective attention due to the use of widely different subject selection criteria (inpatients, home referrals, physician referrals) and a design in which memory strategies may be a larger factor than attention allocation.

Several studies have attempted to focus on classroom behaviors which are assumed to reflect attention. Lubar and Shouse (1979a, 1979b) used a within-subject design (double-blind crossover) with an independent rater (reliability .89) to observe behaviorally defined classroom activities. They noted an increase in sustained work, reading and writing as a result of methylphenidate treatment. Sustained attention, subjects looking at the source of instruction and not engaged in an activity which would interfere with listening, showed no drug effect. While these behaviors can be considered crude measures of attention, as a central process, they represent what may be called classroom attending behavior. In a more recent study employing a group design (double-blind, crossover), Simpson (1980) studied twelve Attention Deficit Disordered-Hyperactive children identified by combined parent, teacher and physician ratings. Over a thirty week period, the only behavior which demonstrated consistent improvement was length of time on task. Barkley (1977) supported these findings in his study of children in free play activities. He postulated that this behavior could reflect a decreased interest in the environment.

Collins, Whalen and Henker (1980) observed the classroom behavior of twenty-two hyperactive males over a five-week period while in a placebo and drug (methylphenidate) condition. The authors employed a triple-blind, crossover design and sampled subject behavior at ten-second intervals. Their findings support other studies which noted an increase in on-task behavior while on medication, as well as a decrease in inappropriate noise.

The major conclusion which can be derived from attention research is that stimulant drugs for hyperactive children reduce a performance decrement over time. This result may be due to the increase in general arousal level, measured by autonomic responses, as a result of stimulant treatment. In a classroom situation this effect may be seen as an increase in time spent on task. However, this general conclusion must be treated with some circumspection.

Two experiments (Doyle, 1976; Dykman et al., 1976) have noted a drug-age interaction. Drug treated children in the primary grades (one to three) seemed to show a different performance on vigilance tasks than children in the intermediate grades (four to six). This finding is consistent with research on the development of attention which noted increasing efficiency in the use of attention as children grow older; consequently, significant effects could be the result of loading the subject population toward one age group or the other. It is unfortunate that none of the reviewed experiments provided more specific information regarding subject age and performance.

The studies on selective attention and stimulant treatment are not amenable to generalization due to wide differences in subject selection, and the nature of the experimental task. Lubar and Shouse (1979a, 1979b) and Hiscock et al. (1979) did note that stimulant treatment did not result in a more efficient switching of attention between competing demands which could imply that selective attention is not improved by stimulant treatment.

Given the limited number of experiments and experimental tasks, the whole area of attention and stimulant drug treatment needs further experimentation. Particular emphasis should be placed on ecologically valid measures of attention and the effects of age and individual response to stimulant drug treatment.

Effects on measures of academic achievement and memory. A major issue facing any treatment of attention disordered hyperactive children is whether the treatment affects the child's ability to learn. A current hypothesis is that medication allows the child to focus and sustain attention and thus increase the use of available learning time (Dalby, 1977; Kinsbourne and Kaplan, 1979). Eaton et al. (1977) and Sprague and Sleator (1975) also suggest that the drug action is not simply unitary but involves a complex interaction between dosage, attention, memory and mood states. In the final analysis, drug induced improvements in attention should result in some long term improvements in learning.

An experiment by Page et al. (1974) found, after nine weeks of treatment with pemoline, significant improvement in the subjects' performance on several tasks including: the Wechsler Intelligence Scale (WISC) Full Scale ($p.<.01$); WISC Performance Scale ($p.<.05$); the Wide Range Achievement Test (WRAT) ($p.<.01$); Factor II of the Lincoln-Oseretzky ($p.<.05$); and fine motor coordination. After nine weeks of treatment with pemoline, no significant results were found on the Porteous Maze Test, the Visual Sequential Memory sub-test of the Illinois Test of Psycholinguistic Abilities (ITPA), Wepman Auditory Discrimination Test, Bender Test of Visual Motor Gestalt, and Harris Draw a Person Test. Page et al.'s (1974) results were supported by Dykman et al. (1976) who, in two experiments lasting for eight weeks, found similar improvements on the WISC Full Scale (p.<.01) and Lincoln-Oseretzky -- Factor II (p.<.01). In a second experiment Dykman et al. (1976) found significant improvement on the WRAT (p.<.05), with no significant improvement on the Harris Draw a Person, Porteous Maze and Wepman Auditory Discrimination Tests.

There are some implicit difficulties with these experiments. The WRAT actually only samples a very narrow band of academic skills and several authors question its validity (Wallace, 1971; Thorndike, 1972; Merwin, 1972); and the Lincoln-Oseretzky Test seems to have little validity or reliability (Wallace, 1971). Another problem is that the length of experimental time could have allowed additional learning to take place, thus accounting for some of the changes. Neither of these experiments used a control group for comparison purposes.

Conrad, Dworkin, Shai, and Tobiessen (1971) carried out a study involving sixty-eight children who were classified as both hyperactive and showing evidence of perceptual cognitive impairment. These children were divided into four groups matched on IQ and degree of hyperactivity. Each group received each level of the two independent variables: Prescriptive tutoring vs. no tutoring and placebo vs. dextroamphetamine. All children remained in the study from four to six months. Wide Range Achievement Tests in reading and arithmetic were given at the end of the study. Even though dextroamphetamine reduced behavioral symptoms there was no significant effect on either achievement score. The results of the Conrad et al. (1971) study may have been due to a difference in experimental populations since their subjects were drawn from a low socioeconomic level and unspecified perceptual cognitive disabilities.

Gittleman-Klein and Klein (1975) studied the relationship between psychometric changes and behavior due to treatment with methylphenidate. Over a twelve-week period, they measured the performance of hyperactive children (N=39) and normal children (N=41) on fifteen measures: Conners Teacher and Parent Behavior Scales; Weery-Weis-Peters Home Activity Scale; WISC Full Scale; WISC Performance and Verbal Scales; Gray Silent Oral Reading Test; Gray Arithmetic Test; Porteous Maze Test; Developmental Test of Visual-Motor Integration and four Continuous Performance Tasks. Their results clearly showed that the association between behavior and test performance did not exceed chance levels. Their study also noted that the four Continuous Performance Tasks showed a significiant correlation with verbal tasks.

While this study has not been replicated, it poses a serious challenge to the assumption that behavioral improvement will result in improved learning.

Studies which have focused on specific aspects of learning, fine motor control, paired associate learning and standardized test performance have generally produced conflicting results.

Arnold et al. (1972) studied the effects of dextroamphetamines on the Bender Visual Motor Gestalt Test. Using a double-blind, placebo, crossover and controlled design, they identified a significant improvement in the experimental groups performance. Swanson and Kinsbourne (1979), however, noticed no significant difference on the Lykken Maze Test between drug and placebo conditions.

Other studies have looked at the effects of stimulants on non-standardized motor performance tasks and have found more encouraging results. Humphries et al. (1979) found that methylphenidate reduced the number of errors committed by his twenty-four hyperactive children on a maze task (Etch-a-Sketch[R] with maze overlays). In the first trials, hyperactive subjects performed the same as the placebo controls. In later trials the drug seemed to improve performance but not to a significant level. They concluded that the drug's effect was to enhance fine motor skills which require repeated responses across time. A dramatic demonstration of this effect was reported by Lerer et al. (1979). They found the cursive script of children improved while on methylphenidate but returned to a baseline level when the drug was withdrawn.

Two studies by Rie, Stewart and Ambuel (1976a, 1976b) studied the effects of stimulant treatment on academic achievement as measured by standardized tests. In these studies the achievement of forty-six primary grade children (mean age, 7.6) was assessed over a six-month period using a double-blind, placebo, controlled and counterbalanced design. The children received a daily dose of methylphenidate from 5 to 10 mg/day (for maximum cognitive effect). Using the WISC, ten subtests of the Iowa Test of Basic Skills and the Auditory Association subtest of the ITPA as their dependent measures, Rie et al. found no support for the contention that academic achievement improves as a result of drug treatment. Only two measures reached significance: the Word Analysis subtest of the IOWA (similar to the word reading of the WRAT) and the Auditory Association subtest of the ITPA. They also mentioned that both parents and teachers noted an improvement in subjects' scholastic achievement, which was not verified by the results.

The results of the above studies are also supported by more recent analyses (Barkley, 1981; Gadow, 1983; Kavale, 1982). These authors found no clear effect on standardized test results due to stimulant drug treatment. Gadow (1983) concluded that while there was an increase in productivity it may not correlate with an increase in acquisition.

The above studies seem to generally confirm Weiss and Laties (1962) findings, based on adult research, that the effects of amphetamines was to marginally improve motor functioning with no consistent effect on overall intellectual performance, at least as measured by standardized tests.

The effects of stimulant medication on hyperactive childrens' memory performance has received some attention in the research literature and may offer a limited explanation of the variation in experimental results. A study by Sprague, Barns and Werry (1970) included a recognition memory task as one measure of drug effects on hyperactive children. The task involved the presentation of a matrix of stimuli that could contain one, two or three pictures. The pictures were familiar objects taken from children's books and were projected on a 12 x 18 viewing screen. the stimuli were presented for one, two or three seconds corresponding to the number of stimuli per presentation. After the initial presentation, the screen went blank for four seconds and then either a familiar picture (one included in the previous presentation) or an unfamiliar picture (one not included in the previous presentation) was presented and the child had to push a button to indicate whether the picture was same or different. The results on this task showed that hyperactive children respond significantly more accurately under methylphenidate compared to placebo and with significantly faster reaction times. The children in this study were receiving medication in the low dose range. Sprague and Sleator (1975, 1976, 1977) provide greater specificity concerning the effects of drug dose on memory performance. In a series of paired-associate learning tasks it was found that methylphenidate in the .1 -.3 mg/kg range enhanced recall over the placebo condition. Sprague and Sleator (1975, 1977) also found that medication exceeding .7 mg/kg impaired performance on their memory task. Swanson and Kinsbourne (1976, 1979) also report similar results using a visual paired associate learning task.

Swanson and Kinsbourne (1976) also claimed that methylphenidate treatment of children resulted in state dependent memory. The phenomenon of state dependent memory refers to the fact that material presented under an altered state is best recalled in that same physiological state (Baddeley, 1976; Sprague et al., 1970). To examine this effect, Swanson and Kinsbourne et al., 1979) taught thirty-two children, diagnosed by a physician as hyperactive, a paired associate task on one day and retrained them the following day. The average dose of methylphenidate was 15 mg/day. They found that children tended to learn the associations quicker and to have more accurate recall when their state was held constant (drug-drug), rather than alternated (drug-placebo), on the second day. Kinsbourne and Kaplan (1979) extended this finding to its logical conclusion. They argued that children should be maintained on a steady drug regimen, rather than use drug breaks, since they will have difficulty remembering material learned while on medication.

In a theoretical discussion Swanson and Kinsbourne (1979) theorized that medication levels which improve performance on a simple reaction time task may interfere with higher order cognitive tasks. Their suggestion was investigated by Weingarter et al. (1980) who studied the effects of methylphenidate (.5mg/kg) on cognitive processes in hyperactive (N=15) and normal (N=14) children. The single significant finding (p.<.05) was that methylphenidate enhanced the coding techniques used by children in a non-drug state. For his hyperactive subjects, this meant a tendency to recall words based on phonetic similarity rather than by semantic associations.

The above studies offer limited evidence to support the hypothesis that stimulant medication improves a child's ability to learn, through enhanced attention as measured by standardized test performance. Rie et al.'s (1976a, 1976b) finding that teachers and parents noted improved academic performance might be, in part, the result of improved fine motor coordination, a clear drug effect, which would be reflected in the subjects' daily pencil and paper tasks. The few studies on memory and drug treatment raise a serious possibility: drug treatment may interfere with efficient memory performance. While these studies are too limited to allow for generalization, they do identify an area demanding further investigation.

Emantive effects. In the last few years there has been increasing interest in psycho-social effects of drug treatment for children. Whalen and Henker (1976) coined the label "emantive" effects to describe alterations in the child's and adult's roles and expectations due to pharmacological treatment.

One hypothesized consequence of drug treatment is that it may create dependence, where improvements are solely attributed to the drug. In adults (parents), this attribution may create an unwillingness to attempt alternative treatments (Krippner et al., 1974; Sroufe and Stewart, 1973). Only one experiment (Stableford et al., 1976) addressed the issue of resistance to treatment alternatives. The experiment employed a single subject design (eight and eleven-year old males), pairing drug and behavior management techniques. The older boy was eventually withdrawn from drug treatment and maintained the desired behavior. The parents of the younger child refused to terminate drug treatment even though he was able to maintain desired behavior while on a behavior management program.

A major concern in the early 1970's was possible substance abuse arising from dependence on stimulant medication. In general, research has not found a greater incidence of substance abuse in the hyperactive population than in their non-hyperactive peers. However, the Physician's Desk Reference (1983) cautions against this possibility. One clear case of stimulant substance abuse has been documented (Goyer, 1979). In this instance, a thirteen-year old male self-administered an average 200 mg/day of methylphenidate, and was clearly dependent based on withdrawal symptoms and blood serum levels.

There is very little evidence that receiving stimulant medication results in either physiological or psychological dependence on the drug. However, there is suggestion that children receiving the medication on a regular basis tend to attribute control of their behavior to external sources. A series of articles have incidentally noted that hyperactive children studied in the experiments tended to exhibit an external locus of control (Bugental et al., 1977; Finch, Pezzuti and Nelson, 1975; Stableford et al., 1976; Tarver and Hallahan, 1974; Tarver et al., 1976). Within J.B. Rotter's (1976) locus of control model, an external orientation means that reinforcement of behavior is attributed to factors outside of personal control. An internal orientation views reinforcement as regularly contingent on personal causality.

Only one study has systematically examined the attribution of control by hyperactive children while actively taking medication. Henker and Whalen (1980) conducted structured interviews with twenty-seven hyperactive children (age range 6.6 -15.7). The children's responses were evaluated by independent raters along four dimensions (interrater reliability .61 - .89), including causal attribution as to the source and solution of their behavioral difficulties. The subjects generally viewed both causes and solutions as being beyond their personal control. The problem source most frequently identified was physiological. The subjects also tended to identify the physician as the factor determining medication discontinuation, rather than behavioral change. However, when older children were compared with younger children, the older were more likely to note the importance of personal factors as solutions to their problem.

Whalen and Henker (1976) have also hypothesized that children receiving stimulant medication may develop lowered self- esteem. This contention has not been systematically studied but there is suggestion that medication may have an effect upon self- perception. Barkley and Cunningham (1979), in a drug-placebo experiment on activity level, reported a decrease in peer and maternal interaction when children were medicated. They also noted an increase in solitary play during recess. Collins, Whalen and Henker (1980) also noted that children in a drug condition had higher levels of negative, self-directed statements than when in a placebo condition.

All of the above studies on attribution and hyperactive children are characterized by a major flaw. In most cases, measurements were taken while subjects were actively medicated, and there is no information about measured orientation prior to treatment included. The cases where placebo treatments were employed offer little additional information since the locus of control orientation, as defined by Rotter (1966), is not subject to momentary change. Therefore, a brief time of placebo treatment is not likely to result in a significant change in the attribution of control. The resulting situation is that the noted tendency of hyperactive children to attribute control to external sources may be due to a number of factors including: the drug treatment itself, sampling bias, and that such an orientation is a sign of the disorder.

The actual effects of medication on the attribution of control is far from clear. Tarver et al. (1976) felt an external locus of control may be correlated with improved attention, but Tarver and Hallahan (1974) theorized that it may be critical to develop internal orientation for optimal academic achievement. Bugental et al. (1977), Galejs and Dsilva (1981) and Swanson (1981) used the Nowicki-Strickland Locus of Control Scale for Children and found that higher academic achievement, particularly for male subjects, was positively related to an internal locus of control. Research on locus of control orientation for hyperactive children has been sketchy; yet it raises several questions concerning the possible role of medication and its effects on social and academic behavior.

Drug research limitations. Reviewing research* in the area of attention disorders with hyperactivity is seriously hampered by three major issues:

1. Limitations of the subject pool utilized in research
2. Uncertainty concerning diagnostic reliability.
3. Adequacy of experimental design.

Subject pool. In the review of the literature approximately 60% of the subjects came from clinic referrals, some including hospitalized children. Clearly this represents a systematic bias in research subjects since not all children who are hyperactive are referred to clinics. Also, not all children referred to clinics are included in experiments and, with a very few notable exceptions, reasons for exclusion are not discussed. One result of this situation may be that our information about the disorder is based only on the most severe cases, thus encouraging a misconception about general population characteristics. We may also be looking at a bias toward the lower socio-economic bracket which could confound the disorder's signs and symptoms with environmental/social issues. One study (Dykman, 1973) noted that 77% of 119 clinic subjects came from lower socio-economic brackets (Hollinshed Index, IV, V). Another problem with the research is that the clinic population represents only a narrow band of the possible range of subjects as defined by D.S.M. III, that is, generally elementary-aged males in urban settings, with average intelligence. While at first there appears to be a plethora of studies concerning attention disordered-hyperactive children, the usefulness of these studies is seriously reduced due to subject problems. It is difficult to generalize from even the most carefully designed experiments given the subject pool.

Diagnosis. Part of the diagnostic uncertainty is due to the fact that hyperactive behavior is an essential component in at least six different diagnostic categories. Therefore, when a researcher identifies subjects as "physician diagnosed-hyperactive," it is impossible for the reader to know exactly which population is being referred to or whether a generic label is being applied. In a survey of San Francisco Bay area physicians, 71% employed a generic diagnosis, "hyperactive-learning-behavior disorders -- etiology unknown" to their patients who showed hyperactive behavior (Lambert, Sandoval and Sassone, 1979).

Physicians tend to diagnose hyperactivity through several methods. One involves meeting the child and interviewing the parents. In this method the physician relies on personal observation and reports from parents and teachers. If the data is consistent with diagnostic criteria, a label of Attention Deficit Disorder with Hyperactivity is tendered. However, one early study found a strong relationship between the personal characteristics of the physician and the diagnosis given the subject (Mehlman, 1952). Loney (1978) randomly assigned children to two psychiatrists and found the diagnosis of hyperactivity varied significantly ($p. < .05$) depending on the psychiatrist. She also found that one psychiatrist prescribed medication for hyperactive children more frequently than his peer. Other sources of diagnostic

*This analysis includes but is not limited to articles reviewed in the chapter. The pool of articles was acquired by an off-line computer search of Psychological Abstracts (1967-82), Medlars (1969-81), Dissertation Abstracts (1971-81), Eric (1970-81) and an extended manual search (Fall, 1983).

error were identified by Ward (1962). He found variation in client reports accounted for 5% of the diagnostic error, and differences between psychiatric interpretation of the presenting problem accounted for 32.5% of the error. While this material is dated when viewed against the current diagnostic manual, it does indicate that a diagnosis can often vary considerably depending on the physician.

A second technique to diagnose hyperactivity employed by physicians is the diagnostic drug trial. In this, the physician uses the report of positive response to medication, as judged by parents and school, as sufficient evidence to diagnose the child as hyperactive (Gittlemen-Klein, 1978; Swanson and Kinsbourne, 1976). One of the difficulties with this approach is that physicians use different prescriptive methods, titration (dosage adjusted to side effects), standard (specified number of milograms per kilogram) and fixed (absolute) amount; depending on the method employed, patient response may vary. Another problem related to this method is that not all children who are hyperactive respond positively to medication (Kinsbourne and Kaplan, 1979). Rapoport (1978) claims that in the case of dextroamphetamine, drug response does not differentiate between hyperactive and normal populations; both demonstrate the same drug effect. While this is not a conclusive repudiation of drug trials, it highlights the lack of clarity concerning the drug response as a diagnostic aid.

Another aspect of diagnosis is the use of parent reports to support or confirm a diagnosis of hyperactivity. It is possible that parents' views of excessive activity may be a function of their own tolerance level rather than a disturbance of the child (Sandoval, 1977). In an early study, LaPouse and Monk (1953) reported that 50% of parents they surveyed considered their sons overactive. The use of parent reports poses a more serious problem when evaluating retrospective studies. These reports may simply not be reliable. The children of parents who have been interviewed have been diagnosed as hyperactive, in some cases, for as long as ten years (Bernstein, 1974); as a consequence, parents may unconsciously attempt to find data which supports the diagnosis. While parents may be quite accurate in describing their child as hyperactive, the possiblity of error adds another element of uncertainty to the diagnosis.

Traditionally, parent ratings of hyperactivity have been compared to classroom teacher ratings. However, recent studies found that there was no significant agreement between teacher and parent, and teacher independent blind ratings of hyperactivity (Gittleman-Klein, 1976; Vincent, Williams, Harris and Duval, 1981). An extensive study by Huessy (1974) of five hundred children from grades two through five found a great deal of variability among teacher ratings. He found that of sixty-four children identified as hyperactive in third grade that nineteen maintained that rating over three years, and fifty-six children seen as hyperactive in the fifth grade had not been identified as such in third grade.

Design limitations. The optimal paradigm for drug research has been considered to be the double blind, placebo, counter-balanced and matched control design (Henker, Whalen and Collins, 1979; Sulzbacher, 1979; Weithorn, 1976). Within this design, subjects are matched (1:1) with a control group, usually on dimensions of age, sex and intelligence quotient. During the course of the experiment each subject in the experimental group receives either drug or placebo in a counter-balanced fashion, of which only the dispensing pharmacist knows. This model purportedly controls extraneous variables such as experimenter bias and effects due to treatment order which may affect experimental outcome.

Within one hundred forty-one drug studies reviewed, eight (5.7%) of the experiments used the above design with another twenty-four (17%) employing the somewhat less desirable double blind-placebo crossover design. Thus, roughly 22% of the experiments employed a design which exercised reasonable control over extraneous variables and only thirty-nine (27.6%) exercised any control procedure.

This data must be borne in mind when reviewing the results of research into the drug treatment of children.

Placebo control. While researchers recognize that in the early phase of a study placebo effects are hard to distinguish from drug effects, as the study progresses it becomes easier to distinguish differences (Henker, Whalen and Collins, 1979). Consequently, double blind procedures were developed to counter any experimental bias since, theoretically, raters would be unaware of the condition (Ross and Ross, 1976). However, both Henker et al. (1979) and Stableford (1976) have shown that raters can detect differences with as much as 72% accuracy. This indicates that the blind condition may have a great deal of acuity and can thus introduce a bias into an experiment.

Another question concerning placebo effect is whether there is a difference between behavior in the two conditions, drug or placebo, and whether the difference can be specified. To answer this question Simpson (1980) undertook a thirty-week double-blind, crossover study of methylphenidate, dextroamphetamine and placebo on seven behaviorally definded disorders. A total of one hundred fifty sixteen-minute observations were made during independent work time with an interrater reliability of .90. Also controlled was drug compliance through urine analysis. 28% of the behaviors evaluated were found to be significant (p.<.05). However, only 13% of these could be attributed to medication; attention to task and inappropriate vocalization both improved by dextroamphetamine.

Drug compliance. The most obvious issue in experimental research is to insure that subjects actually receive the treatment being studied. Yet, only four studies clearly reported techniques which actually controlled for this variable. This does not mean that drug compliance precautions were not taken, only that they were not mentioned or the technique did not guarantee sufficient control. Two articles (Weiss, 1971; Firestone, 1980) reported on rates of drug compliance among clients receiving medication.

Weiss et al. (1971) noted that 35% of the subjects discontinued medication after six months, and 41% stopped between one to three years of treatment. A full 66% of the population discontinued treatment due to side effects or ineffectiveness of medication, and 20% stopped due to improvements. Firestone (1980) also arrived at approximately the same overall percentage for discontinuation of stimulants (74%) in his study. He noted that the majority of subjects discontinued treatment after the first ten months of treatment. Thus, it can be seen that the factor of drug adherence can seriously affect any of the longer term (three months or more) results on the drug treatment of hyperactivity.

The rates of drug adherence on studies of shorter duration has not been studied. However, the apparent short life (approx. four hours) of methylphenidate and dextroamphetamine (P.D.R., 1981) would imply that drug compliance would be a critical factor affecting results.

Dosage level. In the area of medication, more is not necessarily better; each level of drug dosage can result in significantly different effects (P.D.R., 1983; "Using," 1978). Research experiments which reported daily dosage appear to have levels at the upper end of the recommended range (methylphenidate, 20 mg/day, dextroamphetamine, 10 mg/day, pemoline 37.5 mg/day) or in excess of this range ("Using," 1978).

Concluding remarks. In many ways the literature on drug treatment has raised many more questions than it answers. However, it may be possible to answer, in a limited way, Firestone's (1980) question of why we see limited gains due to drug treatment. The first answer is that many of the experiments are flawed due to subject selection criteria, vague definition of population, unreliable diagnostic techniques, subject non-compliance with treatment and lack of basic control procedures. Unreliable data result. Drug treatment seems to improve "fidgety-restless" behavior, fine motor control and the ability to attend to repetitive tasks, i.e., writing. However, it is not clear that changes in these behaviors result in improved scholastic achievement. A second possible hypothesis is that drug treatment may not affect attention, memory and achievement motivation in ways which are conducive to improved academic performance.

Biofeedback Treatment

Introduction. The available experimental literature on the biofeedback treatment of hyperactive children is quite limited. and few of the experiments address the issues identified in the present study. However, the full complement of experiments will be examined in part to establish the utility of biofeedback as a treatment of hyperactivity and as a means of identifying procedural issues.

The current literature indicates that four types of biofeedback techniques have been used in the treatment of hyperactive children: electromyographic (EMG) (Bhatara et al., 1979; Braud, 1977; Braud and Lupin, 1975; Childress, 1978; Haight, Irvine and Jampolsky, 1976; Hampstead, 1979; Omizo, 1980; Omizo and Williams, 1981; Omizo and Michael, 1982); sensorimotor rhythms (Lubar and Shouse, 1979a, 1979b; Shouse, 1976); thermal (Gould, 1978; Martin and

Hershey, 1976); and breathing control (Simpson and Nelson, 1972). In order to appreciate the use of these methods in the treatment of hyperactivity it is necessary to understand the principles of these techniques.

EMG biofeedback is a means of sensing, amplifying and recording electrical currents produced by the contractions of skeletal muscles. Using this technique it is even possible to train individual muscle motor cells (Basmajian, 1976). In the treatment of hyperactive children EMG techniques focus on reducing the muscular tension (electrical discharge) of the frontalis muscle (forehead). The assumption is that frontalis relaxation will generalize the relaxation of other muscle groups (Haight et al., 1976). Both visual and auditory feedback may be employed, but it seems that the auditory condition, with eyes closed, is more effective (Alexander, French, and Goodman, 1975). In order to produce a general state of relaxation, some researchers have also found that EMG training was superior to passive and active relaxation (Alexander et al., 1975; Freedman and Papsdorf, 1976; Haynes, Moseley and McCowan, 1975).

The successful generalization of frontalis relaxation to other muscle groups is variable, depending on the individual differences (Stoyva, 1979). Stoyva (1979) has suggested that EMG training may generalize effects to other physiological systems, in particular the CNS system, where muscle relaxation would tend to reduce general arousal levels and produce a present and centered cognitive state (p. 351). While this hypothesis has yet to be fully examined, Haynes et al., (1975) suggested that such effects would vary depending on the degree of relaxation developed. Krause (1977) found that EMG relaxation training, while lowering frontalis tension, increased galvanic skin reaction and fingertip skin temperature, indicating a mixed effect on arousal levels.

In general, EMG biofeedback has proven effective as a technique for increasing and decreasing specific muscle tension levels. This training can also result in muscle relaxation.

The use of the sensorimotor rhythm (SMR) of EEG measures has also been employed as a technique to regulate hyperactive behavior (Lubar and Shouse, 1979a, 1979b; Shouse, 1976). In this technique a 12-24 Hz sinusoidal wave form is recorded from the sensorimotor cortex. This rhythm is produced in response to an auditory stimulus and subjects are asked to increase the frequency of the SMR rhythm. The hypothesis underlying this approach is that an increase in the frequency of sensorimotor rhythm leads to an increase in peripheral motor inhibition (Lubar and Shouse, 1979a, 1979b; Shouse, 1976). However, Cott (1979) has questioned whether such a relationship exists; he strongly argues that the supposed connection is the result of a design artifact. He suggests the use of adversive time out procedures -- absence of feedback -- could have produced the reduction of motor behavior rather than the SMR feedback. While these comments are directed at research using SMR feedback to reduce epileptic seizures, they offer a challenge to the underlying principles of SMR training.

The use of finger temperature biofeedback (ST) has also been employed in the treatment of both hyperactive (Gould, 1978; Luthe, 1971) and non-hyperactive children (Peper and Grossman, 1974, 1979; Suter and Loughry-Machado, 1981). In this method, a thermal sensor placed on the fingers records skin surface temperature produced by blood flow to the fingers. The flow of blood is increased as muscles in the body are relaxed, thus raising temperature; a temperature reduction indicates increased muscle tension (Connors, 1979; Martin and Hershey, 1976; Peper, 1979). Lynch (1976) found that older children (9-11 -- 11-16) were able to control this response without medication. These children used skeletal muscles and respiration rate to control blood flow, which implied that this technique can be used as a direct measure of autonomic learning, uncontaminated by other autonomic responses. Peper and Grossman (1974, 1979) also found that children could control their peripheral temperature using ST biofeedback, and their performance was superior to adults' (Suter and

Loughry-Machado, 1981).

Breathing control has been investigated as a technique for reducing hyperactive behavior. In this mehtod, a subject's rate of respiration is monitored; the assumption is that production of slow and even breathing is indicative of a relaxed state (Simpson and Nelson, 1972a, 1972b). This is supported by Vaitl, Kenkmann and Kuhmann's (1979) research, which found that respirations varied proportionally with heart rate, a traditional measure of arousal.

Effects on behavior. Simpson and Nelson (1972a, 1972b) were apparently the first to report on biofeedback training in the treatment of hyperactivity. In their studies they trained three male subjects (ages six-eight) in a private school for disturbed children, matched with three non-hyperactive classmates, to control their respiration rate. This technique was coupled with unspecified training in attention maintenance. A visual feedback display with examiner praise was used as an additional reinforcement condition in the experiment. The hypothesis was that control of breathing would reduce unwanted movement and encourage increased attention.

The results of this early experiment were split. In the experimental condition, subjects reduced overt hyperactive behavior (p.<.05) when compared to controls but were not able to translate this improvement to the classroom setting. The significance of this research lay in its implication that hyperactive children may be able to learn some degree of self-regulatory control, as well as its attendant focus on the need to establish generalized, across-setting results.

Another early study by Braud, Lupin and Braud (1975) authors used an EMG technique paired with relaxation training to reduce muscular tension in a young (6.5) black male. After eleven training sessions they reported general behavioral improvement. Parents and teachers reported a reduction in psychosomatic symptoms and, through subjective ratings, a reduction in emotional lability and frustration were noted. The improvement was maintained seven and a half months following the training.

Both Braud et al.'s (1975) and Simpson and Nelson's (1972a, 1972b) experiments were limited by several problems. In both cases the subjects' hyperactivity might have been due to other factors than attention deficits; some children were in a 'special' school (Simpson and Nelson, 1972a, 1972b) and one subject was soon to be removed from school for uncontrollable behavior (Braud et al., 1975). In both studies the biofeedback training was paired with another treatment, and in the Braud et al. experiment home practice and parental reinforcement were also employed; thus, it was impossible in both to differentiate among treatment effects. Moreover, both studies often employed sujective impressions as an evaluatory mechanism.

More recent studies exhibit better control procedures. Yet the results concerning the effect of biofeedback on activity level remain mixed. Results by Gould (1978) and Bhatara (1979) in laboratory experiments did not translate to other settings, according to parent and teacher ratings. Bhatara (1979), using EMG training paired with progressive relaxation training, found that after eight weeks of training his five subjects regressed to their former baseline behavioral levels. The experimental group was able to lower frontalis EMG levels more than the control group, but both groups showed a non-significant worsening of behavior as measured by the Davis Rating Scale. The fact that both groups varied in the same direction implies that some unspecified environmental variable may have affected the rating scale scores. This possibility becomes somewhat more plausible since the parents of the children in the experimental group noted improved behavior. Gould (1978) noted that his experimental group experienced an increase in skin temperature when he used a ST procedure. Parent and teacher ratings on the Conners Scales indicated no significant behavioral improvement in the experimental group.

Haight, Irvine and Jompolsky (1976) reported mixed results, using an EMG technique with eight 11 to 15-year old males randomly assigned to either control or experimental conditions. Noted was a non-significant (p.=.10) reduction of EMG tension. However, on the Connors' Parent and Teacher Scales (1969, 1973) a significant improvement (p.<.05) was identified with the strongest gains made on the Conduct and Hyperactive Indexes. The authors raised the question of whether the EMG training had any effect. Another possibility may be that when small groups (N= 14) are used, the treatment effect would have to be quite large in order to register any significant group effect. Given individual variation on EMG measures (Hasting and Barkley, 1978), suggest significant individual effects may be lost in group data but reflected in the parent ratings. The above experiments do not provide sufficient evidence to reject the use of biofeedback training as a tool for reducing hyperactive behavior. Rather, additional research indicates that this treatment can be effective in reducing hyperactivity.

Several investigations have found biofeedback effective in reducing hyperactive behavior identified by rating scales (Braud, 1978; Childress, 1979; Hampstead, 1979; Omizo and Michael, 1982) and through direct observation (Hampstead, 1979; Lubar and Shouse, 1979a, 1979b; Moore, 1977; Schulman, 1978). Braud (1978) studied the relative effects of EMG biofeedback and muscle relaxation training on ten children diagnosed or confirmed to be hyperactive by a physician. Fifteen hyperactive children (6-13 years) were randomly assigned to either EMG biofeedback (visual feedback), relaxation (auditory tapes), or hyperactive control conditions; another sample of non-hyperactive children was included as an additional control. Children in the relaxation and biofeedback conditions each had a total of twelve, approximately one-half hour, sessions. In addition, all subjects were pre- and post-measured on EMG and ST levels, the biofeedback group receiving four additional monitoring sessions.

In terms of EMG and ST results, the biofeedback group showed the greatest reduction in EMG frontalis tension when compared to the relaxed ($p. < .008$), the normal ($p. < .002$), and the hyperactive ($p. < .008$) control groups. The subjects were able to demonstrate a lower ST level than the other groups (no statistic provided). This data would indicate that EMG training was able to produce significantly more frontalis relaxation and lower levels of general arousal than other treatment. This pattern was repeated on parent rating measures. The study used the combined scores on four rating scales (Davids, six items; Connors; Lupin and Cowgill and "at home" parent ratings). The EMG conditions produced the most significant change in the biofeedback group ($p. < .008$) as measured by rating scales and "at home" measures ($p. < .008$) when compared to the hyperactive control group. Both biofeedback and relaxation groups showed significant (p.<.01) differences from pre- to post-parent ratings.

It is interesting to note that in her conclusion Braud (1978) claims equal efficacy between the biofeedback and relaxation techniques as reflected in behavior ratings. While it is true that both biofeedback and relaxation treatments resulted in significant (p.<.01) pre- and post-differences, the biofeedback treatment demonstrated twice the level of significance when compared to the hyperactive controls.

Moore (1977) and Shulman (1978) used biofeedback training combined with operant procedures to treat hyperactive children in a special class and hospital setting. In both cases, an ABAB design was used and the subjects were able to reach criterion levels successfully. Omizo and Michael (1982) using a matched control design (N=32) noted a significant decrease (p.<.01) in impulsive behavior after four EMG/relaxation tape sessions. However, the results of these experiements are confounded by the authors lack of differentiation between treatment techniques.

Hampstead (1979) reported on two experiments using EMG biofeedback combined with an auditory mode. In his experiment, were used six subjects diagnosed as hyperactive by a multi-disciplinary team which included a child psychiatrist. The subjects were required to demonstrate a developmental history of hyperactivity and at least average performance on the WISC-R. In one experiment the subjects were told to keep the rate of clicks (EMG feedback) as low as possible, and to practice achieving feelings associated with click reduction at home and at school. In another experiment all conditions remained the same except EMG auditory feedback was replaced by verbal feedback.

Behavioral change in subjects was measured by the Abbott Hyperkinesis Index developed by Abbot Laboratories for use with drug research (no reliability or validity information given). Parents completed the ten-item scale daily. Teachers and an independent observer completed the scale the day after a treatment session for a total of fifteen ratings (reliability .75). Using these measures, Hampstead found that improvements in behavior correlated with a decrease in EMG activity (p.<.05). In the experiments, five subjects demonstrated significant reduction of hyperactive behavior in the home setting. The pattern at school was mixed, four subjects demonstrating improvement while two showed no behavioral changes.

The follow-up condition included in Hampstead's report offers interesting data which is unelaborated. Half of the experimental group was reassessed after two and one-half months or four months, the second half six months after the experiment. At home and at school the subjects maintained

EMG levels and behavior patterns equivalent to those achieved at the end of training. The school ratings were actually somewhat improved; however, this result may be due to a change in teacher. Even though the use of a behavioral rating scale limited its descriptive value, the evidence from the follow-up study indicates that subjects can maintain EMG self-control over time and in settings which may have an effect on maintenance of appropriate behaviors, a finding supported by Braud (1975).

Effects on attention. The effects of biofeedback on attention in hyperactive children has received limited research. Two studies utilized Detroit Test of Learning Aptitude subtests (Childress, 1978; Haight, 1976) as measures of attention. Both authors claimed significant improvements in attention as measured by this test. The Detroit subtests used were the Auditory and Visual Attention Span Tests, and they have doubtful use as tools for assessing attention. Stimuli are presented at a rate of one per second up to a total of eight, and after a brief delay subjects must name the stimuli presented. While there may be an effect attention factor involved it is difficult to see how it can be separated from other factors, such as memory.

Martin (1976) and Lubar and Shouse (1979a) noted that observation of classroom behavior indicated an increase in classroom attending due to the feedback training. Martin noted that as finger temperature increased, attending behavior (non-specified) proportionally increased. The finding of Lubar and Shouse offers somewhat more detail. After extensive observation they noted that SMR training could account for an increase in sustained attention, that is, attention directed toward the appropriate source of instruction. This was differentiated from sustained school work, or uninterrupted task application, which was improved by the drug condition. The distinction between the two is important, since their measure of sustained attention actually looked at the child's ability to shift attention between several competing demands and, in a broad sense, can be seen as a selective allocation of attention.

Omizo and Michael (1982) identified a significant improvement ($p. < .01$) on attention as measured by the Matching Familiar Figures test. The difficulty with their conclusion is the assumption that increased accuracy equals improved attention. Kinsbourne and Kaplan (1979) suggest that improved scores on this test actually reflect an increase in response latency, essentially, begging the question whether there is a separate effect on attention.

At present there is no meaningful research on the effects of biofeedback training on attention in hyperactive children. Research with adult subjects demonstrates that attention, at least in a vigilance task, can be controlled by biofeedback training.

Beatty and O'Hanlon (1979) divided forty-eight undergraduates randomly between three conditions -- control, EEG Theta Rhythm-increase training, and Theta-decrease training. Theta rhythms are associated with low states of arousal seen in light sleep conditions (4-8 Hz). In the experiment the effects of biofeedback training were studied on the production of rhythms in a 3-30 Hz range. The Theta-increase condition produced drowsiness and Theta-decrease produced alertness. Subjects were assessed on performance of a radar-vigilance task over a one hour period. During pre-training, the detection efficiency of the three groups was not significantly different. However, between the two experimental conditions there was a significant difference ($p.<.001$), the Theta-decrease group showing greater detection efficiency. In other experiments of longer duration the authors found the main effect of treatment was to prevent a vigilance decrement and to allow an individual to achieve maximum performance.

There is at best only the implication that biofeedback training can result in improved attention. Beatty and O'Hanlon's research demonstrates that adults can improve performance on a vigilance (sustained) attention task. However, the effect of biofeedback training on specific aspects of attention in hyperactive children is yet to be established.

Effects on learning. The next question is, if biofeedback treatment is able to improve hyperactive behavior and to affect attention, does it also result in any measured academic improvement?

Only three studies (Carter and Russell, 1980; Childress, 1978; Watson and Hall, 1977) in the literature reviewed have directly examined the impact of biofeedback on academic achievement. Watson and Hall (1977) studied eight hyperactive children treated with biofeedback matched to untreated hyperactive controls and normal controls over a three-month period. The experimental group received twelve half-hour sessions of EMG biofeedback. The groups were pre- and post-tested on the Peabody Individual Achievement Test. The authors noted significant ($p.<.05$) improvement of experimental subjects over hyperactive control subjects on measures of reading comprehension and arithmetic. In the case of reading, the authors reported an average growth of 1.3 years in instructional level. This finding was also supported by Childress (1978), who found that his subjects made gains on school achievement scores after a six-week training period.

Carter and Russell (1980) analyzed the effects of EMG forearm relaxation, visual feedback, on four learning disabled boys who demonstrated hyperactive behaviors. In particular, they assessed the effects of EMG on handwriting and pre- and post-WRAT scores. In terms of handwriting, they reported substantial increases in both quality and speed, as assessed by teachers and parents. Parents of children in the experimental group identified a greater degree of conscientiousness in school work, and teachers reported a dramatic imporovement in school behavior. According to the WRAT data Carter and Russell's (1980) subjects made average gains in reading of 6.5 months, spelling 6.8 and arithmetic 5.3. Initially these results seem encouraging, but since training lasted two and a half months the amount of gain measured is less than it might seem. The remaining gains could be accounted for by the particular instrument employed. The data certainly does not warrant their conclusion that the training resulted in a cognitive reorganization which facilitated learning (p. 486).

Other studies have reviewed the effects of biofeedback treatment of various psychological measures. Gould (1978) reported gains on the WISC Coding subtest, and Braud, Lubin and Braud (1975) saw gains on the ITPA Visual and Auditory Association subtests. Hampstead (1979) reported significant gains on three unspecified psychological measures when compared to the control group, but offered no further information. Braud (1978) offered more detailed information. On the Bender-Visual Motor Gestalt Test the biofeedback group made significantly more progress than the hyperactive control group ($p.<.02$) and the normal control group ($p < .01$). The experimental group also demonstrated significantly greater improvement than that of the hyperactive control group ($p < .01$) and the normal group ($p = .05$) on the Visual Sequential Memory subtest of the ITPA. She did not find significant improvement on the WISC Digit Span or Coding subtests.

Only a handful of experiments have reviewed the effects of biofeedback on measures of learning. However, there is evidence that EMG training can improve performance on tasks involving fine motor control. The effects of biofeedback on general academic achievement are more difficult to evaluate given the instruments used in the study, but there seems to be a trend towards improved academic performance on the part of children treated with biofeedback.

Effects on attribution. A most telling comment on the effect of biofeedback training on the child's sense of control was made by C. Keith Connors (1979):

> It may well be that one of the most important implications of the striking degree of self-regulation possible with biofeedback is an increase in the child's sense of autonomy and self-sufficiency in a world where his general helplessness is all too frequently fostered by malign environments and a history of inability to control events around him. (p. 149).

Only three biofeedback experiments have reviewed its effects on the control orientation of children (Omizo, 1980; Omizo and Williams, 1981; Omizo and Michael, 1982).

Omizo (1980) investigated the effects of EMG biofeedback on the measured locus of control orientation of fifty-six hyperactive adolescent males. The subjects in this study were selected on the basis of Connors' Teacher Rating Scale and randomly assigned to treatment (thirty-nine biofeedback sessions) or control conditions. The results of his study indicated that subjects receiving biofeedback training showed a shift to an internal locus of control as measured by the Nowicki-Strickland Scale and showed a higher level of Aspiration score of the Dimensions of Self Concept Scale. Omizo's findings are consistent with those of Carlson's (1979) with college students, a fact which indicates successful achievement of self-regulatory behavior can alter the measure locus of control of subjects.

Omizo and Williams (1981) found after eight sessions of EMG treatment that their three hyperactive subjects stated they felt in greater control of their behavior than previous to the treatment. The subjects' teachers verified that they had to exert less control over the children's behavior.

In the third experiment sixteen hyperactive subjects, mean age 10.9, received four EMG sessions over a two month period (Omizo and Michael, 1982). The authors failed to note any alteration in the subjects measured locus of control. Given the results of previous research the authors suggest that the result was due to an inadequate number of training sessions.

The above experiments imply that effective biofeedback treatment may alter hyperactive children's measured and reported locus of control. However, it remains a question whether biofeedback effects are maintained over time and whether there is an effect on academic achievement and whether it depends on the established degree of self-control.

<u>Effects on behavior: biofeedback and drug treatment comparison</u>. The comparison of drug and biofeedback treatments in the control of hyperactivity has received little attention in the literature. This situation may be due to the relative novelty of biofeedback treatments. The limited information which is available implies that the two interventions may have generally equivalent effects on the control of hyperactivity.

Perhaps one of Braud's (1978) most interesting findings relates to the performance of the six medicated subjects in her study (no dosage level reported). Two medicated children were in treatment group and two in the hyperactive control group. Braud looked at the effects of treatment on these children's tension levels and behavior. She found no significant differences in post-treatment tension levels between medicated and non-medicated hyperactive children. However, as measured by the combined rating scales, the non-medicated group made significantly more improvement (p.<.002) than the medicated group. It is a pity that Braud did not differentiate between the two treatments (biofeedback and relaxation) in this particular analysis.

Hampstead (1979) noted that the two children who did not improve in behavioral rating scales were taking 15 and 20 mg/day of methylphenidate. When looking at EMG training effects, Hampstead suggested that the training may have been responsible for the lowering of the dosage in one case, and in the other for increasing appropriate behavior. Hampstead offers no data supporting the idea that biofeedback training was responsible for reducing dosage level. In fact, he offers some evidence that suggests that the reduction was due to the appearance of side effects. His second suggestion is supported by the increase in desirable behavior from drug baseline levels.

Both Braud's (1978) and Hampstead's (1979) statements concerning drug and biofeedback treatments were based either on a second data analysis or incidental information and were not the primary focus of their investigations.

Three reviewed experiments have directly studied the relationship between stimulant and biofeedback treatments (Childress, 1979; Lubar and Shouse, 1979a, 1979b). In the first, Childress (1979), using a within subject design, compared the performance of 28 physician-referred hyperactive children in six areas after a drug treatment program and after six weeks of EMG biofeedback training. In the areas of impulse control, interpersonal relationships and emotionality he found no significant difference resulting from the two treatments. In the area of motor behavior, 27% showed improvement after medication and 15% after biofeedback treatment. Thus, both treatments produced significant (p.<.01) improvements in the above four areas, drug treatment being somewhat more effective in the control of motor behavior. Lubar and Shouse (1979a, 1979b) found similar results.

Lubar and Shouse's experiments employed a within subject ABA type design under five conditions: control, two drug conditions; no drug; SMR feedback (1979a) and then with the addition of SMR feedback alone (1979b) as the sixth. In the Lubar and Shouse study (1979a), their single subject met criteria equivalent to the DSM III (1980) diagnosis of Attention Deficit Disorder with Hyperactivity. This experiment examined the effects of methylphenidate (10 mg/day) alone and when combined with SMR feedback on twelve behaviors. In the drug only phase, six behaviors (object play, non-interaction, compliance, opposition, sustained school work, out of seat) improved, and in the combination phase these six and two others, sustained attention and self-stimulation. On reviewing the chart data offered

(1979, p. 303) one finds an indication that the drug only condition reduced sustained attention. The results of this experiment do not fully support Bruad (1978) or Childress (1978), but tend to indicate an enhancement effect between the two treatments.

In order to examine further the effects of biofeedback, Lubar and Shouse replicated the above experiment and added a biofeedback alone condition. Also included was a GSR measure in order to examine treatment effects on arousal level (1979b). In this experiment four children in the experimental group (same subject selection criteria) were compared to eight hyperactive controls receiving medication and who were matched by age, sex and I.Q. to twelve normal controls. The data from the first five treatment phases supported the results of the earlier experiment (1979a). However, when medication was withdrawn, the subjects maintained the levels achieved with the combined treatments. When compared to the hyperactive controls the SMR group showed a higher level of improvement in behaviors which reflected motor disturbance.

For many reasons it is difficult to assess the findings of Braud (1978), Childress (1979) and Lubar and Shouse (1979b) since Braud does not differentiate treatments and uses a visual rather than an auditory feedback mode. The other two experiments used different feedback training techniques, as well as general differences in subject selection, numbers and treatment length.

The minor discrepancy concerning the effects of treatment on motor behavior between the Childress (1978) and the Lubar and Shouse (1979b) studies could be explained in terms of feedback techniques. EMG and SMR feedback training may result in different effects on motor functioning. This possibility is given some support from Lubar and Shouse (1979a). In this experiment they compared EMG and SMR measures and noticed that as SMR levels increased EMG decreased, but only after ninety-two sessions and not to a significant level. The two activities do not appear to be totally reciprocal. Lubar and Shouse's (1979b) finding also casts doubt on Stoyva's (1979) contention that neuromuscular and autonomic arousal are directly related.

Research limitations. The biofeedback treatment of hyperactivity is limited by many of the issues present in the drug treatment literature such as criteria for subject selection, diagnostic uncertainty and overreliance on rating scales. However, there are some issues which concern this body of research specifically.

Hastings and Barkley (1978) suggested that because of the idiosyncratic nature of physiological responses, biofeedback experimentation should utilize single-subject research design since in a group design significant individual changes could be lost. The majority of the experiments reveiwed used a single-subject or within-subject design. However, only three of these experiments (Braud, 1978; Lubar and Shouse, 1979a, 1979b) reported using a running baseline (Van Kalmthout, 1979) which would allow for even greater control of individual variation.

Perhaps a serious concern is the dearth of general information concerning the biofeedback treatment of children. The bulk of the data relating to treatment techniques, methods and hypothesized action is based on physiologically mature individuals. For instance, groups of adults showed wide variations among individual physiological responses to a stimulus, the most stable measures across time being EMG, EEG and skin conductance response (SCR) (Meldman, 1970). However, in the case of developmentally immature individuals, even greater variability may occur. Another example of uncertainty regarding treatment methods relates specifically to hyperactive children.

The predominant treatment of hyperactive children employed is EMG training which focuses on reducing muscular tension levels. However, Gargialo and Kuna (1979) suggested that if the CNS of hyperactive children is immature in terms of cortical inhibition, then relaxation training may worsen the situation by weakening the inhibitory mechanisms the child already possesses. At this time Gargialo and Kuna's concern is not verified by the available literature.

A related issue is that none of the experiments used a physiological profile as an aid in selecting biofeedback treatment. The physiological profile identifies the biofeedback training mode which would be most effective with a given individual (Gardner and Montgomery, 1977). Consequently, the selected training may not have been effective for some children resulting in a reduction of the magnitude of experimental effects.

Another serious design problem is that approximately half the experiments reviewed did not differentiate between biofeedback and other applied treatments. Therefore, in many cases it is impossible to determine what experimental effect can be attributed to biofeedback treatment.

Besides individual characteristics, which can produce variability in biofeedback measures and consequently in training criteria, environmental conditions must be controlled. Some environmental factors associated with measurement differences are fluorescent lighting (Childress, 1979), temperature and humidity (Gould, 1978; Lynch, 1976) and visual distraction (Stoyva, 1979). Care must be taken to ensure adequate sensor contact (washing and abrading) in order to produce accurate feedback measurement (Childress, 1979; Luthe, 1971).

In the experiments reviewed, only three researchers (Childress, 1979; Gould, 1978; Hampstead, 1979) reported on procedures used to control environmental conditions. It could be argued that the clinical utility of the treatment is not necessarily diminished by possibly imprecise measurement; however, it does reduce the confidence with which results between experiments can be compared.

Luthe (1971) suggested that age was a significant subject variable. In his experiment children ages six to twelve responded more successfully to ST treatment than did adolescents, a finding not supported by Peper and Grossman (1974) and Omizo (1980), whose adolescent subjects responded very successfully to ST and EMG methods. However, at this time there is simply insufficient evidence to accept or reject age as a critical variable.

There are some clear limitations on the experiments designed to assess the efficacy of biofeedback treatment of hyperactive children. The two issues which most seriously affect generalization drawn from this literature are undifferentiated treatment effects and insufficient control of the variables which affect accurate measurement. However, the most recent research used more adequate control procedures which, if the trend continues, will allow for more confident assessment of biofeedback treatment of hyperactive children.

Concluding remarks. The research literature on biofeedback treatment of hyperactive children is generally plagued by the problems attendant to drug research. The research population is vaguely defined, although the DSM III criteria is employed most frequently; many of the measures have questionable reliability; and multiple treatments are frequently used without differentiation of effects. What can be said generally about treatment effects is that: behavior appears improved as measured by rating scales; fine motor control seems enhanced; academic achievement in handwriting and reading comprehension may be improved; and there is no clear documentation of improved attention processes in children. The literature does identify several exciting possibilities: the training may alter locus of control perception; the training may result in improved academic achievement; and from the research on adults there is the possibility that some attentional processes can be self-regulated.

Conclusion

The main purpose of this chapter was to review the current research on stimulant drug and biofeedback treatments of hyperactive children. A secondary goal was to identify factors which may have an effect on the conclusions drawn within the treatment research.

The results of this research review indicate that both biofeedback and drug treatments are efficacious in the regulation of hyperactive behavior. However, difficulties arise when an attempt is made to provide greater specificity to the effect of each treatment. For example, how are attention, academic achievement, social relations, self-perception, etc. affected by the two approaches? The research gives mixed and occasionally contradictory answers to these specific questions.

A number of factors account for the equivocal findings of the research literature including the heterogeneous nature of the research population, as well as design and measurement problems. Thus, many of the findings are not consistent across experiments.

In the area of attention the most robust experimental finding is that medication inhibits a performance decrement across time on tasks requiring continuous performance. However, parameters and aspects of attention have yet to be fully investigated. Within the vigilance model the effects of monitoring highly meaningful material on performance have yet to be comprehensively assessed. Nor are the effects of treatment on selective attention or the ability to rapidly shift the focus of attention truly understood, skills which are both necessary for successful academic achievement.

The effects of treatment on memory and attribution of control are even less well-known. There appears to be a state dependent effect on memory, but as to its degree and the implications for learning, there is little useful information. Medication effects on the attribution of control are simply not known. Biofeedback treatment appears to have some effect on measured locus of control, but the perseverance of the resulting change is not known.

Following decades of research various techniques have been identified for controlling overactive behavior. The effect of those treatments on skills and attitudes necessary for efficient learning is just now beginning to be studied and demands further research. The control of behavior is only a means toward the achievement of optimal learning of individuals, and if our treatments do not facilitate that end, then alternatives must be found.

CHAPTER III

PROCEDURES USED IN COLLECTING AND TREATING DATA

Introduction. Any experiment which intends to study the effects of two different clinical treatments on the cognitive processes of handicapped children is fraught with difficulties. These problems become legion when reviewing the effects of stimulant medication and biofeedback treatments on children diagnosed as Attention Deficit Disordered with Hyperactivity. However, the issue of treatment affect is sufficiently important to require that this type of research be undertaken despite difficulties inherent in the project.

There are three general problems that must be confronted by experiments on hyperactive children: subject selection, task selection and instrumentation and methodology. Due to a state of confusion about diagnosis experimental subjects tend to represent a heterogeneous rather than a homogeneous population. Consequently, it becomes difficult to compare the results of one experiment with another preventing the practitioner from clearly deciding whether experimental results are applicable to an individual client. A second major difficulty in researching the attention disordered, hyperactive population is the selection of dependent variables. Until recently the primary research objective has been on measuring activity levels with only a cursory focus on attention and other cognitive and personality constructs. A possible reason for this is that cognitive processes cannot be directly measured. Yet, a deficit in attention is identified as a cardinal sign of the disorder thus making research on cognitive processes imperative to provide new information bearing upon diagnosis and treatment. A final area of concern is the selection of an appropriate and adequate experimental design given the subject population and treatments under study. The issue of importance is selecting a design that is ethical for experimentation on children currently receiving treatment and yields information for the clinician concerned with individual treatment response.

Hypotheses

The hypotheses are divided into three categories: attention, memory and measured locus of control. Each category contains general problem statements as well as specific hypotheses. All the hypotheses are written in the null form since the general question of interest is whether the two treatments effect a change from no treatment conditions.

Attention. The issues surrounding the attentional behavior of the hyperactive child are of major interest in this experiment. Within this area there are four major problems addressed: what is the hyperactive child's attentional performance without treatment? How do selected treatments affect task performance? Do the assigned treatments affect performance differently? And, is there a consistent relation among attention factors between and within subjects under no treatment and treatment conditions? In order to provide answers to these questions two aspects of attention (selective and sustained) were studied, each under two conditions.

The following hypotheses address selective aspects of attention as defined by a dichotic listening task:

1. There will be no statistically significant difference between stimulant drug and no treatments on the total number of hits, intrusions and false alarms as measured by performance on a dichotic listening task with identification.

2. There will be no statistically significant difference between biofeedback and no treatment on the total number of hits, intrusions and false alarms as measured by a dichotic listening task with identification.

3. There will be no statistically significant difference between biofeedback and stimulant drug treatment on the total number of hits, intrusions and false alarms as measured by a dichotic listening task with identification.

4. There will be no statistically significant difference between stimulant drug and no treatment on the total number of hits, intrusions and false alarms as measured by a Kahneman dichotic listening task.

5. There will be no statistically significant difference between biofeedback and no treatment on the total number of hits, intrusions and false alarms as measured by a Kahneman dichotic listening task.

6. There will be no statistically significant difference between biofeedback and stimulant drug treatment on the total number of hits, intrusions and false alarms as measured by a Kahneman dichotic listening task.

Definition of Terms:

Dichotic listening task. This involves the simultaneous presentation of a different message to each of a subject's ears. For example, the right ear hears the number "six" and the left, the word "dog."

Kahneman dichotic listening task. The same conditions occur as above plus the subject is required to switch attention from one ear to the other after hearing a specified tone.

Identification. The subject is required to repeat the identified stimuli heard from a specified ear and not to report stimuli from the alternate ear.

Stimulant drug. A physician-prescribed stimulant medication either methylphenidate or dextroamphetamine sulfate.

Biofeedback. A physiological feedback treatment including either electromyographic or digital skin temperature.

Correct Detections. In a dichotic task, the number of times a subject reports a correct message while monitoring the target ear.

Intrusions. In a dichotic task, the number of times a subject reports a message from the untargeted ear.

False Alarms. The number of times when a subject reports an incorrect message from the target ear.

The following six hypotheses address the sustained aspects of attention as defined by a continuous performance task.

1. There will be no statistically significant differences between drug and no treatment conditions on mean correct detections, and false alarms as measured by an auditory continuous performance task.

2. There will be no statistically significant differences between biofeedback and no treatment conditions on mean correct detections, and false alarms as measured by an auditory continuous performance task.

3. There will be no statistically significant differences between treatment conditions on mean correct detections, and false alarms as measured by an auditory continuous performance task.

4. There will be no statistically significant differences between drug and no treatment conditions on correct detections, and false alarms as measured by an auditory continuous performance task using a target embedded in a story.

5. There will be no statistically significant differences between biofeedback and no treatment conditions on correct detections, and false alarms as measured by an auditory continuous performance task using a target embedded in a story.

6. There will be no statistically significant differences between treatment conditions on correct detections, and false alarms as measured by an auditory continuous performance task using a target embedded in a story.

Definition of Terms

Continuous performance task. In this task a subject listens to a stereophonic recording for a specified stimulus embedded in an array of similar stimuli and indicates when the target is heard.

Correct detections. The number of target stimuli correctly reported.

False alarms. Reporting a stimulus when the target has not occurred.

Memory. Memory is a skill closely related to attention since we remember only that which has captured our attention. There are two problems of interest with regard to memory: Is there a similar memory recognition strategy used by hyperactive children under no treatment conditions? And, does treatment affect the employed recognition strategy? Incidentally, information may also be gathered on the stimulus dimensions attended to by hyperactive children.

The following hypotheses are given:

1. There will be no statistically significant difference between drug and no treatment conditions on total correct recall and types of recognition errors as measured by a false recognition task.

2. There will be no statistically significant difference between biofeedback and no treatment conditions and total correct recall and types of recognition errors as measured by a false recognition task.

3. There will be no statistically significant difference between drug and biofeedback conditions and total correct recall and types of recognition errors as measured by a false recognition task.

Definition of Terms:

False recognition task. Subjects must recognize a previously presented word when included in a field of three additional words.

Correct recall. The number of learned words correctly identified.

Types of errors. The relationship between recognition errors and its foil, i.e., rhyming, category and subject-generated words.

Locus of control. Recently there has been some interest concerning the effects of treatment on children's attribution of control. The general problem of interest is whether biofeedback treatment does produce a change in measured locus of control.

1. There will be no statistically significant measured change in locus of control orientation between drug and no treatment as measured by the Nowicki-Strickland Locus of Control Scale for Children.

2. There will be no statistically significant measured change in locus of control orientation between biofeedback and no treatment as measured by the Nowicki-Strickland Locus of Control Scale for Children.

3. There will be no statistically significant difference between treatments on measured locus of control between biofeedback and drug treatments as measured by the Nowicki-Strickland Locus of Control Scale for Children.

Definition of Terms:

Measured locus of control. This will be defined by scores obtained on the Nowicki-Strickland Locus of Control Scale for Children (Nowicki and Strickland, 1973).

Design

Model. For the last fifty years the model for investigating human behavior has been the group comparison model. Despite its many advantages the group approach may not be the most suitable for studying drug and biofeedback treatment effects.

There are several reasons why the group method is contraindicated including the ethical, practical and clinical utility of results. Due to the above factors, there is a growing tendency to view single case experimental designs as preferable to group methods when evaluating the effect of medication. (Dykeman et al., 1976; Hersen and Barlow, 1976; Liberman, Davis, Moon and Moore, 1973; O'Leary, 1980; Sulzbacher, 1979; Wolraich, 1977). Sulzbacher (1979) states "The single case design should probably be used for all studies of drug effects because of the tremendous differences known to exist in drug response." (p. 64). The same can also be said for biofeedback treatment due to the highly idiosyncratic nature of physiological responses (Hersen and Barlow, 1976; Kiesler, 1971). However, the single case approach also has attendant difficulties. Foremost among these is the need to ensure control of variables affecting internal and external validity and that direct comparison between treatments can only be done under certain circumstances.

Despite its inherent weaknesses, a well-developed single case design still has some clear advantages over group designs when studying the results of drug and biofeedback intervention.

A primary advantage is that the ethical issue of withholding treatment from a no treatment control group is avoided. Also the random assignment of subjects to an untried treatment may also be avoided. Single case design also eliminates the possibility that a control or biofeedback group might experience substantial harm due to the withdrawal of a successful treatment. Related to the issue of treatment substitution is some evidence that successful drug treatment may create an unwillingness to attempt an alternative intervention (Krippner et al., 1974; Sroufe and Stewart, 1973; Stableford et al., 1976). Consequently, parents willing to make a transition may have children who are poor drug responders which, in turn, could bias the experimental results.

A second difficulty which is avoided is locating the number of subjects necessary for an adequate group comparison study. The need for a large experimental population may tend to dilute subject selection criteria, thus resulting in a heterogenous rather than a homogeneous population. Subject heterogeneity affects the generalizability of experimental findings. A single case design minimizes this difficulty by the small number of required sujbects and yet through direct replication can answer questions about generalizability of findings across subjects. Another related advantage of the single subject methodology is that it does not obscure individual performance by averaged group data, and therefore, experimental results may be more directly utilized by the practicing clinician. The ability of single case experiments to identify intra-subject variables which affect treatment response has obvious advantages over group study which may identify statistically significant but clinically insignificant results.

In the context of the present experiment the greatest weakness of the single subject design is its ability to determine the relative effectiveness of the biofeedback and drug treatments. The prototype of this experimental situation is the A-B-A-C-A model where A=no treatment; B=drug treatment; and C=biofeedback treatment. Hersen and Barlow (1976) pointed out that this design allows for statements concerning the effects of B and C over A. However, this design, when comparing two treatment packages, violates the single variable rule which allows for a comparison of additive and sequential effects, but does not provide for analysis of comparative effects from nonadjacent phases (Hersen and Barlow, 1976; p. 85). The one exception to this is when either the B or C phase does not result in a change over baseline, creating a functional equivalency. In this condition the simple A-B-A design would be obtained and statements concerning the relative efficacy of treatments could be made.

As shown above the nature of the present experiment is complicated, yet its implementation will offer new information showing how drug and biofeedback interventions affect a variety of cognitive behaviors in an individual. Under certain circumstances it will offer data on how the two treatments compare in their effect on specific dependent variables. Results will also aid the clinician in selecting between the two treatments. Finally, the data generated by this experiment may offer new insights concerning the continued academic difficulties of hyperactive children despite ongoing and systematic application of stimulant therapy. Ultimately the value of any treatment evaluation weighs upon both the clear definition of experimental objectives and methodology presented in a manner which allows for direct replication.

Order of Phases. The duration of the experiment is three months. Included in this time span are five experimental testing sessions and four weeks of biofeedback training. The following is the schedule of events:

1983	May 21-22	-- A[1], No Treatment measurement phase
	June 6-11	-- B, Drug Treatment measurement phase

June 27-July 1 -- A[2], No Treatment phase

July 4-29 -- C, Biofeedback treatment administered. Reexposure to experimental tasks.

August 1-5 -- C, Biofeedback measurement phase

August 22-26 -- A[3], No Treatment measurement phase

This plan allows for a two-week time span between phases A[1], B, A[2], C and A[3] and a four-week interval between phases C and A[3]. The treatment order and time spans were selected for several reasons. The primary reason is that they offered no conflict between ongoing drug treatment and experimental treatments. The biofeedback training and the A measurement and C treatment phases all occur during periods which are drug-free holidays. The B phase happens when subjects are receiving active drug treatment and constitutes a minimal disruption of school attendance. The fact that the experimental sequence offers a moderate departure from normal routine may lessen experimental effects resulting from participation in an experiment. The span between measurement phases may also reduce effects due to client resistance. The experimental tasks are fatiguing and if measurement followed another in rapid sequence subjects could resist task demands. The fact that the measurement phases must be in a fixed order prevents any counterbalancing of treatments. Consequently, the time span and fixed order necessarily raise questions of experimental effects due to maturation and history.

Given the design of this experiment it is impossible to eliminate effects on experimental measures due to time. Thus the question becomes whether it is probable that the twelve weeks of this study are sufficient time to allow for growth or changes which would confound results due to experimental treatments.

Clearly the elementary school years are a time when there is rapid growth in all the areas under investigation, but it is unlikely dramatic change will occur over a twelve-week period. In an experiment by Gale and Lynn (1972) the auditory vigilance of 351 children (ages seven-thirteen) was analyzed for developmental changes. While the authors noted significant differences between younger and older subjects, increments of a year were not significant. Other studies of developmental changes in visual attention note significant changes occurring over two-year increments (Doyle, 1976; Dykman et al., 1976; Lane, 1979). A similar profile has been noted by researchers studying the development of auditory attention using dichotic listening tasks. Significant experimental differences are found when there is a two-year separation between subjects but not at one-year increments (Cherry, 1981; Doyle, 1973; Lane, 1979). Thus, while the evidence is limited, it seems probable that the course of normal development does not produce noticeable changes in attention over a three-month span as measured by auditory vigilance and dichotic tasks.

A parallel question is whether maturation can account for any measured changes in the subjects' locus of control. The subjects in this experiment will be measured three times over a span of approximately nine weeks with two weeks separating the first and second tests and about seven weeks dividing the second and third sessions. Obviously, a belief concerning behavior reinforcement contingencies changes or is strengthened as a child interacts with a social world, but how quickly does it change? Evidence from Nowicki and Strickland (1973) implies that such changes as measured by their scale may be the most dramatic between the fifth and sixth grades. They provided the following information regarding mean external responses of males:

Grade	Mean Response
3	18.0
4	18.4
5	18.3
6	13.7
7	13.2

An implication which may be drawn from this data is that males, ages eight-ten, have substantially the same measured orientation with only a minimal difference seen over a three-year span. Older male children, ages eleven and twelve, are similar to each other but quite different from younger children on measured orientation. The test-retest correlation reported by Nowicki and Strickland (1973) r=.63 (grade three) and r=.66 (grade seven) after a six-week span are moderately high. These scores imply that the scores obtained on this test are not overly susceptible to random daily changes in the subjects. While the evidence concerning changes in the measured orientation of children over brief time spans is quite limited it at least seems plausible that changes noted over nine weeks are not easily attributed to the sole effects of maturation. Pramat, Jones and Hampton (1979) studied the locus of control construct in the adolescent period. They found that there was no dramatic measured change on the Nowicki-Strickland Scale for their subjects (N=382) over the adolescent years.

It seems reasonable to assume that the memory of children changes over time. But, the question is whether the time of this experiment will produce dramatic changes in memory retrieval strategies. The memory task in this experiment is a simple recognition task using foils to structure the recognition responses. Experimenters who have studied the effects of time on foil recognition tasks have tended to look at time spans of two or more years (Cramer, 1972, 1974; Lindauer and Paris, 1976; Shepard et al., 1976; Sophlan and Stigler, 1981; Yussen and Berman, 1981). Consequently, there is no data on the effects of shorter time periods (one year or less) on the false recognition of words by children.

A second competing variable which could offer an explanation for the experimental results is history or life events. Once again the design of this experiemnt precludes the absolute control of historical events. Nor can the effects of day-to-day events over the experimental time be estimated by any reliable procedure. Yet it remains important to document events which may be most likely to affect experimental results.

Stressful situations would be the most likely to have an impact on experimental measures. Research supports this deduction by identifying the effects of stress on attention (Kahneman, 1973), memory performance (Baddeley, 1976) and locus of control scores on the Nowicki-Strickland Scale (Nowicki, 1978; Ollendick, 1979). Steps for controlling or minimizing stress in subjects due to participation in the experiment are outlined in the Treatment Description section. In order to document life change events which may have engendered a more enduring stress state the subjects' parents were requested to complete the Social Readjustment Rating Questionnaire (Coddington, 1971) (Appendix C).

The elementary form of the questionnaire consists of thirty-six items to be answered "yes" or "no" by the child's parents. A modification of this process required the parents to give the approximate date of any items answered "yes." Each of the items included in the scale represent life events calling for personal readjustment such as "birth of a brother or sister," "death of a parent" (Heisel, Ream, Raitz, Rappaport and Coddington, 1973). Coddington (1971) found the correlation between rater agreement on the significance of life events identified on the elementary form (N=243) to be between .891 and .960 (rank order correlations). On a British sample (N=58) Monaghan, Robinson and Dodge (1979) found the lowest correlation was .872 (Spearman's rank order).

Each life event is assigned a weighted score reflecting the degree of supposed readjustment caused by a particular life event. The elementary scale was normed on 887 subjects (male=453, female=434) during the summer of 1971 in Ohio (Coddington, 1971). The mean life events for the elementary sample was 2.63 with a mean life change unit score of 102.78 (Coddington, 1971).

The scale has been used to study life change events in pediatric patients (Heisel, 1972; Heissel et al., 1973; Padilla, Rohsenow and Bergman, 1976). These studies found children suffering from rheumatoid arthritis (Heissel, 1972; Heissel et al., 1973) surgical operations, psychiatric admission (Heissel et al., 1973) and accidents requiring physician attention (Padilla, Rohsenow and

Bergman, 1976) scored significantly higher on the life event inventory than healthy peers. The use of this scale does not provide a true control of effects due to history but will aid in establishing the significance of events occurring over the experimental period which would be likely to affect experimental results.

Measurement phase: order of presentation. Each measurement phase was approximately one and a half hours long divided into two sessions and separated by a five to ten-minute break. The average session length was one hour and 39 minutes. The division was included to prevent excessive fatigue in subjects due to prolonged concentration. Another factor connected with the length of time is that it approximates the instructional periods used in elementary schools. The order of tasks within each phase were random subject to the following restrictions: sustained attention tasks do not occur successively, and a dichotic task divides the memory task. These limitations are necessary to prevent an excessive performance decrement on the vigilance performance and to keep the time interval between the memory task constant.

The experimental tasks were randomized using a table of random numbers (Kerlinger, 1976). The appearance of the assigned task number (1-6) determined the sequence of tasks within a treatment phase. When a noted exception occurred, the process was repeated until the required sequence was achieved. To determine assignment to treatment phases the five groups of six tasks were randomized. Finally, the locus of control task was eliminated from phases A[1] and A[2] resulting in the following order of presentation:

A[1]

Memory	-- List 1
Dichotic I	-- List 2
Memory	-- List 1
Vigilance I	-- List 5
Dichotic II	-- List 3
Vigilance II	-- List 4

B

Dichotic I	-- List 4
Memory	-- List 5
Dichotic II	-- List 4
Memory	-- List 5
Vigilance II	-- List 1
Locus of Control	
Vigilance I	-- List 4

A[2]

Vigilance II	-- List 3
Locus of Control	
Vigilance I	-- List 3
Memory	-- List 3
Dichotic II	-- List 1
Memory	-- List 3
Dichotic I	-- List 5

C

Vigilance I	-- List 2
Dichotic II	-- List 5
Vigilance II	-- List 2
Memory	-- List 2
Dichotic I	-- List 1
Memory	-- List 2
Locus of Control	

A[3]

Dichotic II	-- List 2
Vigilance II	-- List 5
Memory	-- List 4
Dichotic I	-- List 3
Memory	-- List 4
Vigilance I	-- List 1

General instructions. On the day of the first measurement phase the experimental process was reviewed with the subjects. They were then told:

We are going to be doing a lot of different things together. When we are done you will have helped me find out things about how children pay attention and remember things. It is important to remember to do your best on the things I ask you to do. You may see me doing a lot of writing. I am writing down the things you say because they are important. Finally, if you have questions or need something, ask me when it is break time.

At the final meeting with the parents relevant information prior to the data analysis was shared as well as a review of the confidentiality of information agreement (Appendix D). Parents were also offered the opportunity to review the data on their child with the experimenter. Finally, parents were offered the opportunity to receive a copy of the dissertation abstract and access to the disseration.

Treatment description. Using a narrow definition of the word treatment there are two conditions in this experiment, drug and biofeedback. A broad interpretation of the word is simply any interaction. Consequently, there are an uncountable number of treatments included in this experiment. The purpose of this section is to identify the major treatments, broadly defined, and to describe how they will be structured.

Expectancy effect. It has been shown that the expectancy of individuals concerned with an experiment can affect results in a variety of ways (Rosenthal, 1966). In this experiment there are two major ways expectancy may be communicated to the subject: through their parents and through the experimenter. In the first case, there is no certainty that the communication of parental expectation can be controlled, short of illegal and unethical means. However, in the initial contact with parents they were requested not to tell their children that they were participating in an experiment. They were also requested not to tell others until the experiemnt was over. Instead it was suggested that they tell the children that they will have the opportunity to learn some new things about themselves over the summer and taught how they can be in control of their muscles or temperature. While this is the general tone which was encouraged, the language and specific detail varied given the individual child and parents. The parents reported that they complied with this request.

During the initial family meeting the examiner met with the entire family to explain the experiment. This served to provide a model for the parents, as well as provide an initial contact between experimenter and subject in comfortable surroundings. At this time the details of the experiment were reviewed with the parents and child and a demonstration given of ST feedback. Questions raised by the child were answered. This procedure should have reduced affects due to evaluation apprehension.

The question of experimenter effect can not be optimally controlled given the design of this experiment. However, precautions were taken to minimize the experimenter as a source of bias. The most basic precaution was that all experimental tasks, initial instructions and trials were taped to ensure evenness of presentation. In the cases of the attention and memory tasks, where the experimenter recorded responses, the experimenter was seated so as to be not readily visible to the subject. This procedure restricted cues available to the subject and reduced the effects of experimenter expectancy (see Appendix E). Since this was not a blind experiment and the testing phases involved person-to-person contact with the experimenter, he maintained consistent behavior towards subjects, in order to further minimize any communication of expectancy. All subjects were greeted cordially and, in a similar fashion, at the conclusion of tasks and sessions they were complimented on their effort. All other communication was neutral and factual. The maintenance of a cordial rather than neutral contact was demonstrated to be a variable which can improve subjects performance on a signal detection task (Ware, Kowal and Baker, 1963).

There is also evidence that the environment may affect both subject and experimenter expectancy (Rosenthal, 1966). During the experiment the testing and training environments were kept reasonably constant. The biofeedback training sessions were held in the subject's homes. The children sat in chairs with armrests and footstools. With a single exception (see Biofeedback Training, Subject 1), the families' schedules allowed the sessions to be free from distractions.

The testing sessions were held in a private office within forty minutes commuting time from the subjects' homes. The office was furnished in a living room style. The office was illuminated with incandescent lighting and the wall facing the subjects was free of visual distractions (see Figure 6).

In this experiment control procedures such as double blind and expectancy control groups can not be used due to the ongoing treatment requirement and subject availability. Consequently, less stringent control measures must be employed. The data resulting from the experiment is presented with due regard to biases resulting from expectancy effects.

No treatment conditions. As noted above, this is actually a treatment condition where something is done to the subject. Of particular concern during the no treatment conditions (A[1], A[2], A[3]) was that the subjects were not engaged in active drug or biofeedback treatment. The parents were made aware of this condition and were requested to note the date and time of the most recent medication administration. During phases A[1] and A[2] the average elapsed time was 21.6 hours, the range being 12 to 24 hours. Since the active drug life of amphetamines appears to be six hours the subjects were effectively "drug free" during these phases.

During the A[3] phase the time between medication administration and testing ranged from 12 hours to two weeks negating the possibility of medication influence. Biofeedback treatment was discontinued two weeks prior to the A[3] phase. However, due to the nature of biofeedback training -- the learning of self-regulation -- treatment effects were not "washed out." In experiments reported in the literature on biofeedback treatment of children using a withdrawal design, a reversal trend was noted in the no treatment conditions but not a return to baseline measures (Hampstead, 1979). Thus, while active training will not be in place some treatment effects for children who have achieved independent self-control were expected in the A[3] phase.

Drug treatment. Measurement during the drug treatment phase (B) occured while the child was actively treated with physician prescribed stimulant medication -- methylphenidate (N=1) and dextroamphetamine sulfate (N=4). The averaged elapsed time between testing and drug administration was two hours and 20 minutes with a range between two and three hours. This condition ensured that the medication was active and its effects had not worn off.

The parents recorded the time of the most recent medication administration. A necessary condition for this experiment is that the subjects be considered "good" drug responders (see Subject selection). Consequently, the specific drug type and dosage level is not considered absolutely critical, provided the subjects are taking stimulant medication.

Biofeedback treatment. Each subject was scheduled for twelve half hour sessions distributed over four successive weeks during the summer. Subjects 1 and 3 were scheduled for two weeks of four sessions and one three session week. The remaining subjects were scheduled for three sessions per week for four weeks. The measurement phase (C) was held on the day of the last training session.

The first biofeedback session was composed of two parts: a physiological profile and a training phase. The purpose of the physiological profile is to aid in determining the type of biofeedback used for training. Individual physiological reactivity to various stimuli is somewhat idiosyncratic, and consequently not all individuals achieve self-control as effectively using the same biofeedback training techniques (Gardner and Montgomery, 1977). In this experiment, the physiological profile was measured using electromygraphic (EMG) and skin temperature (ST). Both EMG and ST machines were attached to the subjects with the feedback option turned off. A resting measure was taken (in both microvolts and Fahrenheit degrees) in order to identify a baseline response level. The next phase involved tasks which generate some degree of mental stress and/or effort. The final phase introduced the use of active relaxation facilitated by feedback. All instructions and explanations were given directly by the experimenter. The following is the sequence of events which occurred during the profile phase:

-- A review of neuromuscular electrical discharge and vasoconstriction in terms suitable for the subject's comprehension level.

-- A review of the equipment in the room and its function. Components of the equipment were explained as they were attached to the subject.

-- Baseline: the subject was asked to think about a "quiet place" they would like to be (six minutes with readings taken every two minutes and written by the examiner).

-- Task I: mental arithmetic problems were presented at a rate of one every forty seconds. Problems were taken from the Key Math Diagnostic Arithmetic Test -- Mental Arithmetic (Appendix C) at the subject's grade level; (six minutes with two minute recordings by the examiner).

-- Task II: a guided fantasy was presented to the subjects describing a white water canoe trip (six minutes with two minute recordings written by the examiner).

-- Biofeedback: the subjects were asked to return to the first "quiet place" and listen to the audio feedback and to make it slow down by relaxing; (six minutes with two minute recordings by the examiner).

After this phase there was a pause of approximately five minutes in order for the examiner to determine the appropriate training machine for the experiment. As soon as the area of greatest reactivity was determined, the undesired machine was disconnected and training began.

The training sessions lasted approximately thirty minutes. In all sessions the subject was seated in a comfortable chair, arms resting on chair arms or lap, and feet were raised if the subject so desired. Subjects were also asked to close their eyes during the training sessions and listen to the audio feedback. The examiner was seated a comfortable distance from the subject, out of the subject's sight. The equipment was also removed from sight but accessible to the examiner for monitoring and adjustment purposes.

Subjects were told that when the tone they heard "gets lower" they are relaxing and when the tone "gets higher" they are less relaxed, and they were to keep the tone "low or off." They were also told to start to think about the "quiet place" they were at earlier. The first six minutes were used with no feedback to establish a baseline reading for each session. Recordings were written at two-minute intervals by the examiner. In order to avoid confounding biofeedback training with progressive relaxation training the subjects did not receive any systematic relaxation instruction. On occasions when subjects appeared "stuck" (an ascending tone indicating increased arousal) for more than two minutes, the examiner intervened, instructing subjects to control their breathing or to think again about their "quiet place."

ST procedure. Based on their physiological profile three subjects received ST training (see Figures 1, 2, and 3). Initially, the machine was set at a sensitivity of .1 degree F. until the subjects reached a "plateau" where the temperature stabilized at ±.1 degree F. from a base temperature. When this was attained the sensitivity was changed to .01 degree F. The goal for subjects was to raise their temperatures approximately 3 degrees in a session. When the subjects reached this level they were instructed to introspect on their feelings, particularly "warmth" and "heaviness," and to try to maintain that "state." All subjects were encouraged to practice achieving this "state" outside of the training sessions. Auditory feedback was used until the subjects were able to raise their temperature at least 3 degrees above their session baseline and maintain it for five minutes. The auditory feedback was progressively discontinued until the subject was able to maintain this level, (±1 degree F.) for approximately fifteen minutes for three sucessive sessions. The three subjects having ST training reached criteria at the end of the eleventh session.

ST instrumentation. The ST training was conducted with a

Cyborg P 642 feedback thermometer with the following specifications:

Temperature range:	23 degrees -113 degrees F.
Accuracy:	±.3 degrees F.
Audio frequency range:	200 Hz - 1 kHz
Thermistors:	YSI 700 series
Power source:	Line powered 110 V.

The thermistors were placed on the flange of each index finger by a Velcro tape so that the probes were centered on the fingertip pads. The audio feedback was a pulsed tone with the actual temperature displayed on the face of the monitor. To maintain the machine's accuracy, the training rooms were maintained at a temperature between 70 degrees - 80 degrees F. (average temperature was 74.03 degrees F). The accuracy of the probes was verified at the end of every second session and they maintained a constant 32 degrees F. (±.3 degrees F).

ST subject performance. Subjects 1, 2, and 3 received ST biofeedback training (see Figures 1, 2, and 3). The three subjects' physiological profile showed EMG levels already below criterion level; consequently, ST training was the treatment of choice.

The training course for all three subjects was consistent with the above procedures. Each subject reached the training criteria by the eleventh session. On two occasions each subject demonstrated the ability to lower their temperature on demand; indicating conscious control over their temperature. All subjects reported an awareness of temperature changes and relaxed feelings (mean 93.5 degrees F., S.D. 1.57). Also, all subjects experienced muscle spasms and reported feeling warm (mean 97.1 degrees F., S.D. 2.0), both being indicative of relaxation.

The effect of environmental stress on learning self-control was also evident in the subject's performance. Research indicates that increased arousal results in a lowering of body temperature (Zahn, Little and Wender, 1978). In each case low overall training performance coincided with a stressful event. The most instructive sequence occurred for Subject 1. Sessions 3, 5, and 7 were immediately preceeded by a request to attend an unanticipated baseball game. During each of these sessions the subject was able to exert progressively greater control over his temperature.

The three subjects were able to demonstrate self-control over their temperature and spontaneously stated feelings of relaxation and warmth.

EMG procedure. Based on their physiological profile, two subjects, 4 and 5, received EMG training (see Figures 4 and 5). For the initial training the machine's sensitivity was set for a range between 1-100 microvolts. Since each subject was able to maintain a level below 10 microvolts for ten minutes the sensitivity was changed to the .1-10 microvolt range. The goal of the training was to have the subject maintain a 3 microvolt or lower level for fifteen minutes or longer without audio feedback or the completion of twelve sessions. When the 3 microvolt plateau was maintained for five minutes the two subjects were asked to introspect on their feelings, particularly any feelings of weightlessness. The subjects were encouraged to practice achieving this state outside the training sessions. Since electrodes were placed over the frontalis muscle, subjects were instructed to keep head and jaw movements to a minimum to control for recording of muscle artifacts. In order to minimize environmental interference with EMG measures fluorescent lighting was not used in the training room nor were high frequency appliances in operation during training.

EMG instrumentation. The EMG training was conducted using a Biologic Myosone 409 EMG/processor. The specifications for the Myosone 409 are:

EMG range	.1 - 1000 microvolts
Power source	alkaline "D" rechargeable batteries
Electrodes	silver-chloride cup sensors, 15 mm. diameter
Processor	light (LED) display, three digits

The electrodes were placed over the frontalis muscle with the signal sensors equidistant from the ground sensor. All sensors were applied with adhesive disks and saline-based conductive gel. The sensor sites were cleaned with denatured alcohol and slightly abraded then covered with a small amount of electrode paste to ensure maximum contact sensitivity. The effective contact of electrodes is controlled by an artifact display light which remains lit if impedance is greater than 60 Hz. The processor displayed for fifteen seconds the average EMG level for two minute intervals.

EMG subject performance. Subjects 4 and 5 received EMG biofeedback training (see Figures 4 and 5). Subject 4's physiological profile indicated that either approach could be used. However, the subject strongly rejected ST training so EMG training was used. Subject 5's profile indicated that EMG training, due to its variability, would be the treatment of choice.

The training course for the two subjects was somewhat variable. Subject 4 reached the experimental criteria after twelve sessions while subject 5 reached it by the eleventh session. Subject 5 was able to develop consistent control and on several occasions approached a deep relaxation level (.5 4v). Subject 4's performance offers some insight on the effects of attribution and motivation on learning self-control.

Due to an oversight the subject's mother administered medication on the morning of the fourth session, and, like the previous session, he was able to stay below the criterion level. However, for the next three sessions he said he could not stay below the threshold without his medication. At the beginning of the eighth session he announced, "I'm going to keep it (the audio feedback) off the whole time," which he was able to do. After the session the parents said they had not intervened but that the subject talked about his being in competition with the machine. When the subject attributed control of his EMG level to an external agent he was unable to demonstrate self-control. However, when he defined the training as personally competitive, he was able to regain control over his EMG performance.

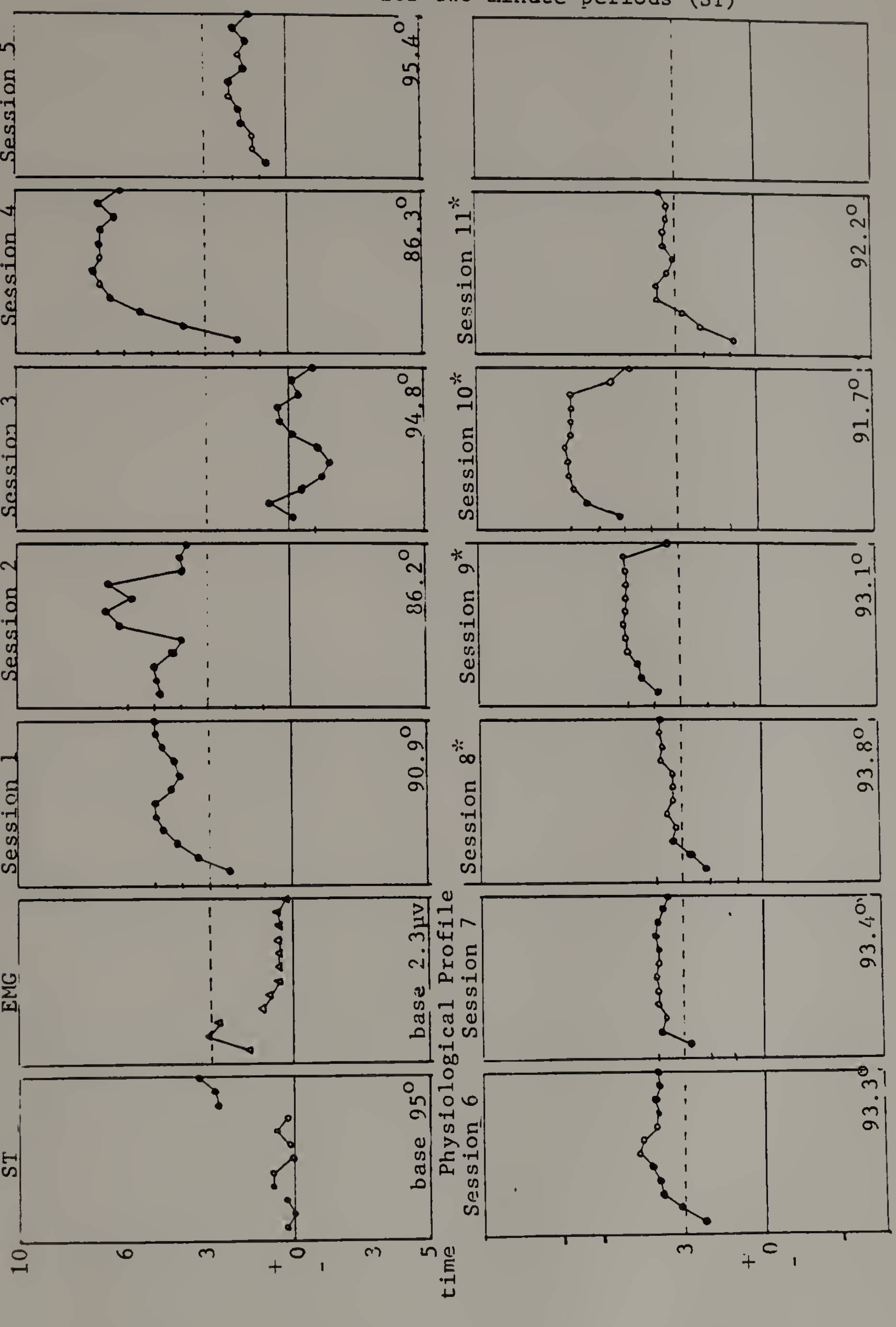
An implication which may be drawn from this subject's behavior is that attribution of control is a variable which affects the ease of learning biofeedback self-control. Subjects with an external control orientation may require a longer learning time with audio feedback or more active demonstrations of their ability to achieve self-control.

Biofeedback measurement phase. Experimental measurements were taken on the day of the last feedback session to ensure the optimal influence of the biofeedback training.

FIGURE 1

Biofeedback Training: Subject 1

Units above and below baseline
for two minute periods (ST)



o Skin temperature with feedback
● Skin temperature without feedback
△ EMG with feedback
▲ EMG without feedback

* ± 1°F for 15 minutes

Reversal
Average Room Temperature = 75°

FIGURE 2

Biofeedback Training: Subject 2

Units above and below baseline
for two minute periods (ST)

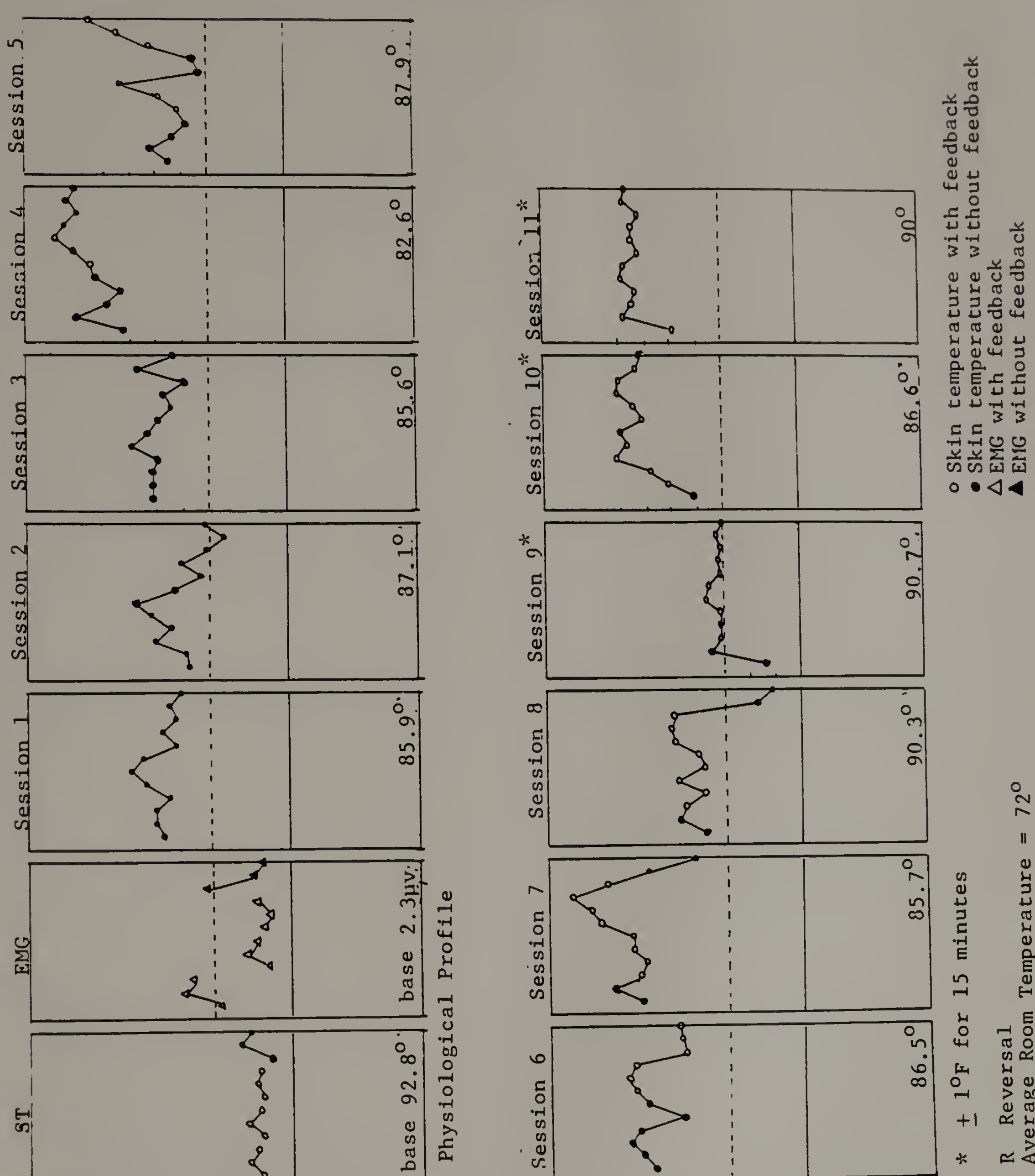


FIGURE 3

Biofeedback Training: Subject 3

Units above and below baseline
for two minute periods (ST)

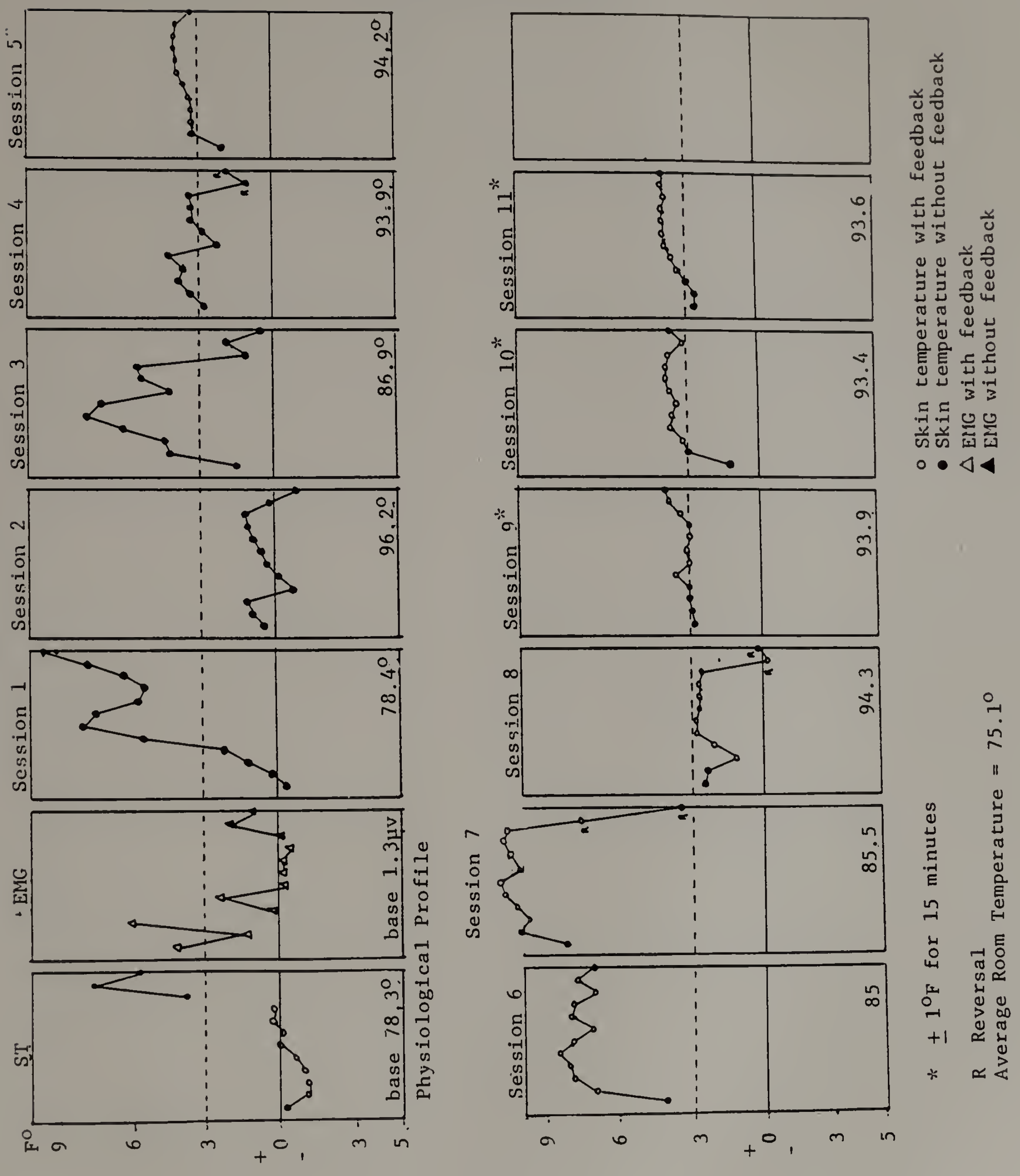


FIGURE 4

Biofeedback Training: Subject 4

Units above and below baseline
for two minute periods (EMG)

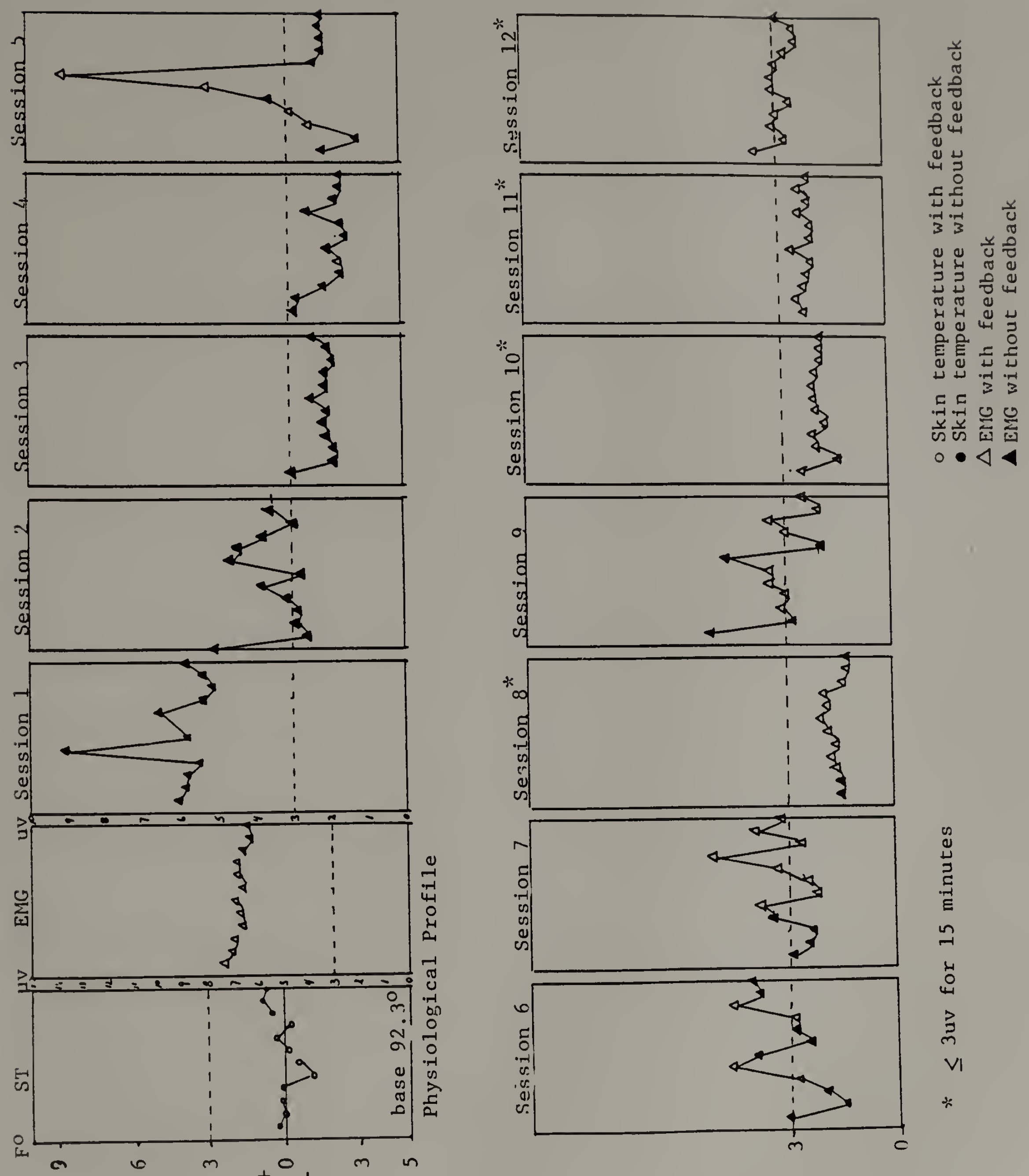
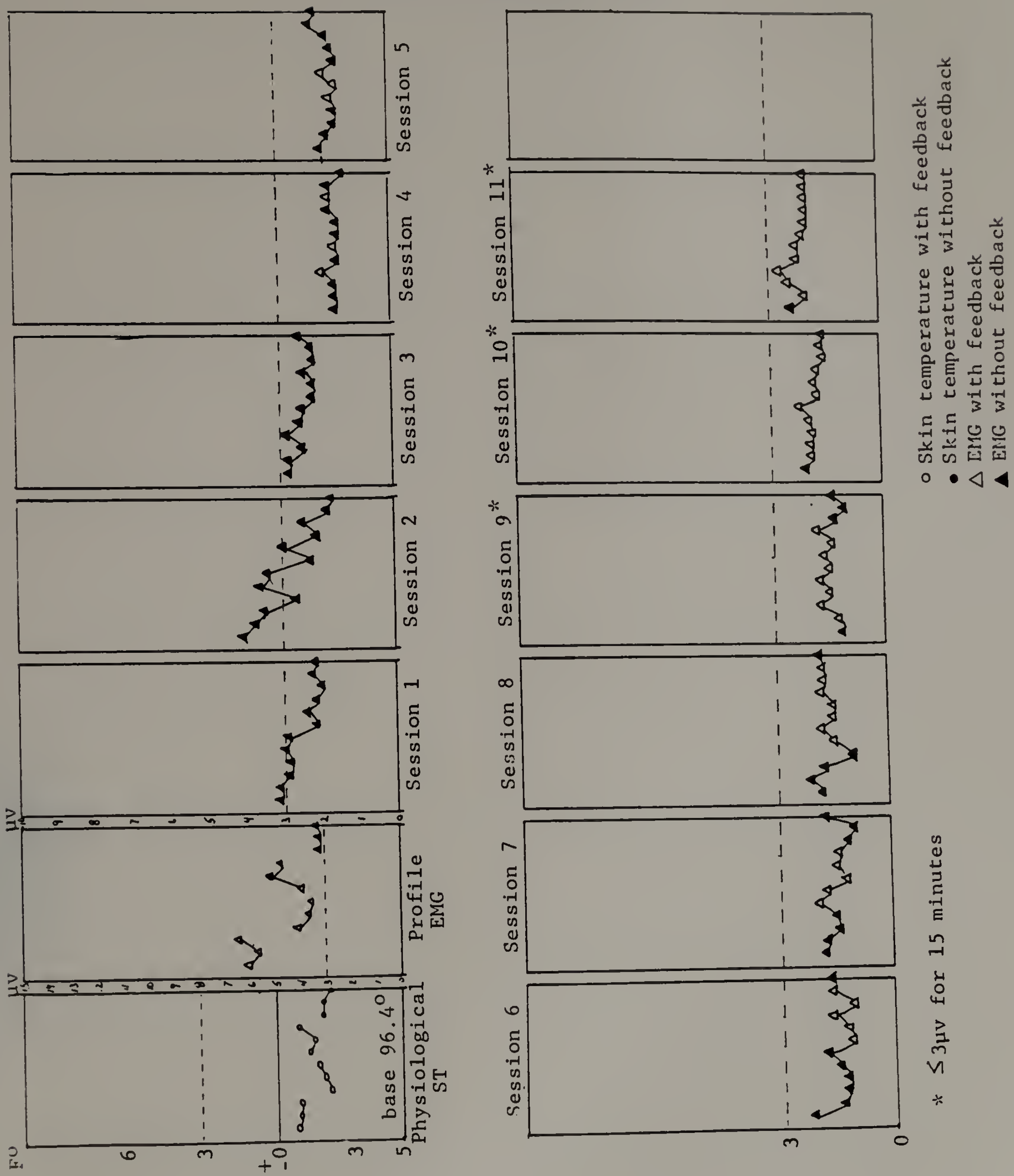


FIGURE 5

Biofeedback Training: Subject 5

Units above and below criteria
for two minute periods (EMG)



At the beginning of the testing session subjects were instructed to actively relax and to inform the examiner when they had achieved this state. Their condition was monitored by the examiner via the individual's biofeedback readings; however, no audio feedback was used during the session. During the testing the examiner did not provide any information on the subjects' state, but focused attention on the experimental tasks.

Experimental Tasks and Instrumentation

Six experimental tasks and instruments were used in this study. These included two continuous performance, two dichotic listening, a memory recognition and administration of the Nowicki-Strickland Locus of Control Scale for Children (Appendix E).

Continuous performance. The tasks used in this experiment are of the watchkeeping type requiring continuous attention to a specified stimulus presentation over time. There were two tasks used to measure this variable. The first was a modification of a procedure developed by Rosvold et al. (1958) to test the ability of known brain-damaged individuals to maintain alertness over time, as measured by the accurate detection of a letter sequence. Modifications of this task have been applied to the study of medication effects on children (Conners and Rothschild, 1968; Dykeman et al., 1976; Doyle, 1976; Rosenthal and Allen, 1980). In the original Rosvold task the subjects were required to indicate when the letter A or sequence AX appeared on a visual display. The AX detection rate was found to be the best discriminator between brain-damaged and non-brain-damaged individuals. The modification transferred presentation from the visual to the auditory mode and only used the AX sequence. The second task embedded the target stimuli (a word), within the context of a narrated story. This task was designed to measure whether the meaning of the material affects performance differently than a simple signal detection task. There is some evidence that children with attentional disorders may have difficulty inhibiting their attention to meaningful stimuli thus interfering with the correct detection of the target stimuli (Doyle, 1976; Rosenthal and Allen, 1980).

Task I. The subjects were presented with 1,200 letters at a rate of one letter per second (see Appendix E). The subjects depressed a telegraph key each time the letter X was heard only if it had been preceded by the letter A. There were 200 AX combinations distributed across the total presentation. The twenty-minute duration of the task was divided into ten two-minute phases with 20 AX combinations appearing in each trial. There was no indication to the subject that there was a separation between phases. The letters were selected randomly with the exception of the AX sequence which was randomly distributed across each two-minute phase so that the correct combination appeared 20 times. Randomization was ensured by assigning a two-digit number to each letter of the alphabet and sequencing the letters using a random table of numbers (Kerlinger, 1973). The letters were then examined to determine whether A and X appear in isolation for at least ten presentations. This precaution ensured that the subjects attend to letter sequences, since if these letters do not occur alone, the subject need only respond to one letter in order to achieve a correct detection. The process was repeated five times resulting in a separate experimental tape for each measurement phase. The possible range of scores is: correct detections, 0-200; false alarms, 0-1000.

Apparatus I. The stimuli for this task were recorded by the examiner at 70dB on 3M[R] 208 audio reel-to-reel tapes at the University of Massachusetts Communication Disorders Laboratory. The rate of presentation was controlled by an audio cue fed to the examiner through headphones. The stimuli were initially recorded on an Ampex ATR-700 reel-to-reel recorder then dubbed to Realistic[R] chromium oxide cassette tapes via a Marantz Superscope with a Dolby[R] system. The tapes were judged by two independent raters (Appendix F) as being functionally equivalent. The experimental tapes were played to the subjects on a Realistic[R] SCT-29 tape deck controlled by a Kenwood KR-2090 stereo receiver. The subjects heard the tapes over Realistic[R] Nova' 40 stereo headphones. The examiner monitored the tapes through Realistic[R] lightweight stereo headphones.

The subjects' responses were recorded by an Esterline Angus Minigraph recorder on pressure sensitive tape. Each time the subjects depressed the telegraph key, the event was recorded on the tape. The key was located near the preferred hand of the subject. The examiner also recorded responses on a typed copy of the stimulus tape.

Procedure I. For each of the five testing sessions the subjects were given the following taped instructions:

> What I would like you to do is press this button each time you hear the letter A followed by the letter X. Don't press the button for any letter following A except X, and always press it when you hear the letter X after an A. Remember, when you hear the letter A, get set; if you hear an X press the button as soon as you hear the X.

Following these instructions the subjects were asked if they had any questions. The subjects had a one-minute trial when the AX combination occurred ten times and A and X five times in isolation. All subjects correctly identified the AX combinations by the second trial on the first session and on the first trial for the remaining four sessions.

Throughout the test phase subjects were seated facing a blank wall. The recorder was placed on an Ensolite[R] foam pad (to prevent sounds resonating from the table) approximately two feet to the left rear of the subject. The examiner was seated behind and to the right thus avoiding visual distraction (see Figure 6). Upon completion of the task the subjects were complimented on their effort.

Task II. The subjects listened to a story of 3500 words, for approximately twenty minutes (Mean=19 min., 30 sec.; S.D.=12 sec.). The subjects depressed a key each time the word "the" was heard. The article "the" was selected since it appears in written English approximately 210 times per 3500 words (the actual estimate is 205) (Carroll, Davies and Richman, 1971). The listening selection was divided into ten approximately two-minute intervals with "the" occurring 21 times in each interval. The stories for this task were within a half year of the subjects' potential reading level as measured by the Spache Diagnostic Reading Scales (Appendix C). The stories for subjects 2 and 5 were taken from Iggy's House (1970) by Judy Blume. Based on the Spache readability formula (1953) the selections were at the 4.8 grade level. The stories for subjects 1, 3 and 4 were taken from C.S. Lewis' The Lion, the Witch and the Wardrobe (1950). Based on the Flesch readability formula (1948) the selections were at the "easy" reading level for the measured 6.5 potential level of the subjects.

All of the above selections had to be modified so that "the" appeared 21 times within each unit of 350 words (Appendix E). The initial modifications were verified by two individuals who also made necessary corrections. The above process was repeated five times for each subject yielding a different tape for each experimental phase. The possible range of scores are: correct detection, 0-210; omissions, 0-210; false alarms. 0-3290.

Apparatus II. The stimuli for this task were recorded by the examiner at 70dB on Realistic[R] chromium oxide cassette tapes. A Realistic[R] SCT-29 tape deck with a Dolby[R] system and a Realistic[R] stereo electret condenser microphone were used to record the tapes. The rate of reading was controlled by a Micronta[R] LCD quartz stopwatch. Two independent raters judged the resulting ten tapes to be functionally equivalent (Appendix F). The remaining conditions obtained for this task as were noted under Apparatus I.

Procedure II. For each of the five measurement sessions the subjects heard the following taped instructions:

> For this activity I would like you to press this button each time you hear the word "the." Don't press it for any other word and always press it when you hear "the."

The subjects then heard a three sentence trial where "the" was stated nine times. Errorless performance was achieved by all subjects on the first trial. The remainder of this procedure is the same as noted under Procedure I.

Dichotic Listening. The basic paradigm of the dichotic listening tradition is that the subject must attend to the message on one ear and ignore a second message heard in the other. The fundamental assumption in dichotic tasks is that they require the selective allocation of attention.

Task I. The subjects were presented with 120 stimulus pairs consisting of the most frequent one syllable words (Carroll et al., 1971), paired with a digit from 1-10, excluding the number 7. The subjects heard a digit and a word simultaneously, their task was to report the digit heard in a specified ear and to ignore all other messages. The pairs were presented at a rate of one pair every three seconds. This rate avoids interference between the subjects response and the onset of the next stimulus pair (Witelson and Rabinovitch, 1971). Each block of 60 presentations was separated by a minute of recorded silence to allow for rest and the switching of target ears. For the purpose of analysis the stimuli were divided into ten twelve-second intervals with a target digit occurring six times in each.

The messages were a random mix of digits and words so that each ear heard a mixture of both over the experimental time. The stimulus words and digits were randomly paired and sequenced by a computer program developed by the Haskins

Laboratories, New Haven, Connecticut. There were five dichotic tapes made in this fashion with the stimuli rerandomized for each tape.

Apparatus I. The words and digits for this task were recorded at the Communications Disorders Laboratory at the University of Massachusetts, Amherst. The stimuli were recorded in a sound-proof recording booth at an average level of 70dB. The resulting word and digit lists were made into dichotic listening tapes at the Haskins Laboratories under a National Institute of Health A51 Grant. Using a Digital Virtual Address Extension 11/780 operating system each stimulus signal was adjusted to 500 msec. duration and an equivalent intensity level. The word-digit pairs were then adjusted for simultaneous onset time and 3 seconds of silence inserted between each pair. Each sequence of 120 pairs was preceeded by a 1000 Hz tone to allow for comfort adjustment.

The master 3M[R] 208 audio tape was transferred onto Realistic[R] chromium oxide cassette tapes via a Marantz[R] superscope. The resulting dichotic tapes were played to the subjects over a Realistic[R] SCT-29 recorder with Realistic[R] Nova '40 stereophonic headphones. The average intensity level for each channel was adjusted to the subject's comfort level.

The subjects' responses were recorded by the experimenter on a score sheet. Stimulus pairs were typed on a sheet. The examiner underlined the subjects' responses. The subjects' performance was also recorded using a cassette recorder to ensure the accuracy of the experimenters' scoring. The possible range of scores is: correct report, 0-60; intrusions, 0-30, false alarms, 0-30.

Procedure I. For each of the measurement phases the subjects heard the following taped instructions:

> What you are going to hear now will be a mixture of words and numbers, a word in one ear and a number in the other. Your job is to listen to what you hear in one ear and ignore what you hear in the other. For instance, if I tell you to listen to your right ear listen closely and say outloud only the numbers you hear in that ear. Remember you will hear numbers and words only tell me the numbers you hear in the ear I tell you to listen with.

Following these instructions the subjects were asked if they had any questions. After questions the subjects had a ten-second trial with attention focused on the right ear and three digits presented. All subjects achieved errorless performance within two trials.

During the test phase the subjects were requested to look straight ahead in order to minimize interference between direction of eye gaze and attention to the target ear (Gopher and Kahneman, 1971; Morais, 1978). The tape player was positioned so as to minimize distraction from the earphones but within easy reach of the examiner. The second recorder was placed out of the subjects' sight with the microphone no more than two feet away from the subjects.

Task II. This task was a modification of the Gopher and Kahneman (1971) experiment reported on above. The specific modifications included reducing the total time by fifteen minutes, adjusting the rate of presentation for children and increasing the number of times the subjects switched target ears. In this task subjects reported digits heard in the target ear, however, it was uninterrupted and subjects changed target ears at the sound of a tone. The subjects heard a total of 120 stimulus pairs at a rate of one every three seconds. They also heard ten tones lasting 500 milliseconds which indicated the relevant ear. A tone of 2500Hz indicated the right ear is to be reported while a tone of 250 Hz indicated the left ear. A switching tone rather than another indicator was used in order to keep the task modality specific. The tone also introduced another form of information which must be monitored thus increasing the demands placed on the subjects' attention.

For the purposes of analysis this task was divided into ten, twelve-pair intervals with a switching tone occurring once and target stimuli six times. The stimuli were randomized by the procedure identified in the preceeding task with one modification. Each tone was followed by two digits that must be reported. The tone was randomly distributed so that each ear was monitored ten times at irregular intervals. The task also started with a tone indicating the right ear. Within any twelve pair span there was one of four possible attending conditions; right-right, left-left, right-left and left-right.

Apparatus II. The same apparatus was used in this activity as in the first dichotic task. The one difference was that the letters R and L appeared on the recording sheet indicating a switch in target ears.

Procedure II. For each of the five testing situations the subjects were given the following instructions:

> What you are going to hear now will be a mixture of words and numbers, a word in one ear and a number in the other. Your job is to listen to what you hear in one ear and tell me the numbers you hear. You have to ignore what you hear in the other ear. You will also hear a special sound which will tell you the ear to listen to. When you hear this sound (tone) pay attention to your right ear and when you hear this sound (tone) pay attention to your left ear. Remember, when you hear this sound (tone) tell me only the numbers you hear in your right ear. When you hear this (tone) tell me only the numbers you hear in your left ear.

Following these intructions, questions from the subjects were answered. The subjects then had an 18-second trial with one of each switching tone. The instructions and trial were repeated until the subjects reported all target stimuli without error. Before beginning the task the last two sentences of the instructions were repeated. The remainder of the procedure was the same as that for the first dichotic task. The range of possible scores is: correct report, 0-60; false alarms, 0-30; intrusions, 0-30.

Locus of Control. The subjects' measured locus of control was determined by their scores on the Nowicki-Strickland Locus of Control Scale for Children (1973). This instrument was given three times during the experiment in phases B, A[2] and C.

The Nowicki-Strickland Scale is a forty-item questionnaire requiring a yes or no response to questions sampling children's belief concerning control over life events. The original 102 items were evaluated by elementary school teachers for readability and were answered by nine clinical psychology staff members in an external dimension. Fifty-nine items had a hundred percent agreement; these items were then used in a pilot study (N=152) which reduced the items to the current number.

The initial sample consisted of 1,017 children from four communities adjacent to a metropolitan center. The majority of the students were Caucasian and were drawn from all socio-economic conditions with the exception of the highest as measured by the Hillingshead Index of Social Position (Nowicki and Strickland, 1973). The authors report an internal consistency of r.=.63 (grades 3-5) and r.=.68 (grades 6-8) as calculated by the split-half method corrected by the Spearman-Brown Prophesy Formula. Test-retest reliabilities at six weeks apart are .63 (grade 3) and .66 (grade 7). The scales construct validity was determined by comparing it to the Intellectual Achievement Responsiblity Scale and the Bialer-Cromwell Scale. The correlations were low, r.=.31 and r.=.41 respectively, but significant at the .01 and .05 levels (Nowicki-Strickland, 1973).

Apparatus. The subjects were provided with a typed copy of the Nowicki-Strickland Scale (1973). Each question was followed by the words yes and no and each subject had a #2 hardness pencil for recording responses.

Procedure. At each testing session the subjects heard the following instructions:

> I am going to ask you some questions about what you feel and think about things in general. I am going to read each question out loud twice after the second time put an X (demonstrate) on your answer, either a yes or a no.

The first item read was a trial question developed by the examiner requiring a no response. In no case did the subjects fail the trial. This experimental task required ten minutes for completion.

The questions were played to the subjects on a Realistic[R] SCT-29 cassette tape recorder, the stimulus tapes were recorded by the examiner on Realistic[R] chromium oxide cassette tapes using a Realistic[R] electret condenser microphone and SCT-29 tape deck. The resulting tapes were reviewed by two independent raters (Appendix F) to ensure evenness of presentation and a sufficient pause between questions to allow for subject response. The tapes were judged to be adequate by both reviewers.

Memory Task. A recognition memory task was given to the subjects. In recognition memory experiments a subject is presented with a series of stimuli and is asked to recognize those stimuli from a group of similar stimuli. The specific technique used in this experiment was an amalgam of other experiments that employed the false recognition model (Cramer, 1972, 1974; Shepard, Cohen, Gold and Orbino, 1976; Yussen and Berman, 1981).

The basic technique introduced by Cramer (1972) involved two auditory presentations of twelve target words preceded and followed by one buffer word to control for primacy and recency effects. Cramer's (1972) recognition phase included the target words with twelve control words, six antonyms and six synonyms. Since the original experiment by Cramer (1972) several modifications have been suggested: reducing the initial presentation to one; increasing the number of buffers and foils (Lindauer and Paris, 1976); having subjects generate their own foils (Shepard et al., 1976) and using a forced choice response format (Sophian and Stigler, 1981). The above changes were designed to increase the number of false identifications, control for ceiling effects (Lindauer and Paris, 1976; Shepard et al., 1976) and to control for shifts in decision factors (Sophian and Stigler, 1981).

In this experimental task subjects were presented with forty target words (nouns) randomly selected from the most frequently occurring nouns in elementary school texts (Carroll et al., 1971). The presentation list was preceded and followed by three filler words to control for primacy and recency effects. Words were presented at a rate of one every three seconds with subjects repeating each stimulus word. The repetition requirement served to ensure the subjects attended to the words and can also be considered a second trial, since repetition was be considered a form of overt rehearsal.

The recognition task required that subjects state the name of the word they heard in the presentation after hearing four possible choices, the words selected for the response task were chosen based on the following process. Each set of words contained a target word plus three foils from these categories; subject-generated associates to the target words, rhyming words and a word which was selected from the semantic category containing the target word.

The subject-generated foils were gathered at a meeting with the subject two weeks prior to the first measurement phase. At that time the examiner presented the selected target words and asked the subject to state the first word he could think of. When subjects responded with more than one word the instructions were restated at the end of the list and the target word said again. The rhyming foils were selected from words which appeared in Carroll, et al. (1971). When no appropriate rhyming foil was located the examiner selected one approximating the syllabification of the target word. The category foils were selected by the examiner in reference to the target and student-generated foil. For example, if the target was a basic category noun (chair) and the subject foil is a subordinate concept (rocker) the foil could be a superordinate concept (furniture). The validity of examiner-selected responses was judged by four independent raters (Appendix F), inclusion of the foil required 100% agreement among raters. Prior to their review the raters were familiarized with the category structures outlined by Mervis (1980). Based on the raters' assessment two foils were rejected (see Appendix E).

In the recognition task, the four choices were presented in the following manner: did you hear target, foil, foil, foil? The subject then stated the name of the word recognized. Each set was presented over a five-second phase with a five-second response time. (A survey of twenty-two Detroit Test of Learning Aptitude protocols demonstrated that moderately handicapped children can recall up to four items presented at this rate). The first response was noted as well as any self-corrections. The position of the various type of foils was decided by a random process.

Each type of response choice was assigned a number (1-4) and using a table of random numbers (Kerlinger, 1973). For example the following series of numbers: 1, 8, 3, 3, 6, 4, 2 would result in the presentation order 1, 3, 4, 2: target (1); subject associate (2); rhyme (3); and category associate (4). For all categories the scores may range from 0-40.

Apparatus. The initial presentation and recognition memory tasks were recorded and presented via a Realistic[R] SCT-29 tape deck. The material was recorded by the examiner on Realistic[R] chromium oxide cassette tapes. The list of target words was read at a rate of one word every three seconds, controlled by a Miconta[R] LCD quartz stopwatch. The recognition tape presented each set over a five-second span with a five-second pause. The combined presentation time was approximately six minutes. The five tapes created in this fashion were evaluated by two independent raters for rate of presentation and accuracy of phrasing (Appendix F). The tapes were judged to be functionally equivalent.

The subjects responses were recorded via a cassette recorder and by the examiner using a pencil and a response sheet containing a transcription of the tape.

Procedure. For this task each subject received the following instructions:

> I am going to play a tape for you. You will hear just words. After you hear the word repeat it out loud. Later I am going to play you another tape and ask you to tell me if you hear any of these words. Let's practice: If you hear "dog" you will say ; "cat" .

After clarifying any questions the tape was played. After this presentation subjects performed one of the two dichotic listening tasks. The recognition phase was preceded by the following instructions:

> I am going to play another tape for you. This time you will hear four words. I want you to tell me the name of the word you heard from the list you repeated earlier. For example if you hear the words dog, log, collie, pup you would say "dog" since you heard it on the first list.

After answering any clarifying questions the task began.

Since this task is separated by one of the dichotic tasks which also involve words it was crucial the subjects knew which list they were to recall. The memory task was denoted as the "repeating tape." A second precaution taken was to ensure that none of the memory task words were part of the intervening dichotic activities.

SUBJECT SELECTION

A major problem is defining the experimental population in a manner that will be clinically useful. Criteria which are too broad include children whose attentional deficits may be the result of a primary disorder other than Attention Deficit Disorder with Hyperactivity. Overly exclusive criteria limit the applicability of results to a narrow subgroup of children diagnosed as Attention Deficit Disorder with Hyperactivity, children which a given practitioner may never have occasion to meet.

Five subjects; four males, ages 9.2-12.1 (mean age = 10.3), and one female, age 10.9 were used in the experiment. One subject was experimental; the remaining four were replications since one successful experiment and three successful replications are considered the minimum base for systematic replication (Herson and Barlow, 1976).

Diagnostic Criteria. The subjects included in this study were diagnosed as having Attention Deficit Disorder with Hyperactivity according to the criteria established by The Diagnostic and Statistical Manual III of the American Psychiatric Association (1980, pp. 43-44; Appendix A). The initial diagnosis was rendered by a pediatrician within a year of the study and verified by the diagnosing physician as currently valid. In addition to a current medical diagnosis, the subject's parent(s) and primary teacher agreed that the child demonstrated before treatment, the operationally defined behaviors in The Diagnostic and

Statistical Manual (Appendix A). The above inclusion criteria ensured that the subjects were currently considered hyperactive and had not been rediagnosed. It also ensured that the diagnosis was seen as valid across settings.

In addition to the above criteria, the subjects were receiving stimulant drug treatment and were considered good drug responders by physician, parent(s) and teacher. The stimulant drug treatment was initiated at least two months before the experiment in order to ensure sufficient time for treatment response to have stabilized. The subjects also had drug holiday periods as part of their treatment program. The optimal dose level varied among individuals. Consequently, it was defined as the dosage at which the subject displayed the desired behaviors, increased attention to task, decrease in impulsive behavior and reduction in motor activity without the undesired effects being considered serious. Since dosage level was not subject to control in this experiment optimal levels were defined by the prescribing physician using individual titration.

The medication administered to subjects was of two types, methylphenidate HCl (Ritalin[R]) or dextroamphetamine sulfate (Dexadrine). These medications were selected due to similarity of effect (Bassuk and Schoonover, 1978), chemical action (Danish and Yaffe, 1979) and active drug life, four to five hours (Kinsbourne and Kaplan, 1979).

Another reason for limiting the study to the use of these two medications was that they are the most commonly prescribed for the treatment of hyperactivity (Murray, 1980). In addition to the above inclusion criteria there are medical signs which were considered sufficient for exclusion. A primary reason for exclusion was the presence of hard neurological signs. Examples of such signs would include abnormal electroencephlographic recordings and/or computer assisted tomography results or failure on a standard neurological exam. These criteria controls for children whose attentional problems were the result of clear brain insult or disease. Also excluded were children who have a history of auditory acuity difficulties, as defined by failure of a pure tone audiomoter test or have a recurring history of otitus media (middle ear infections). This condition prevented inclusion of subjects whose performance on the experimental tests may be the result of a hearing disorder. Children who were engaged in drug treatment, other than stimulant, or participating in psychotherapy were excluded from the study. This precaution prevented the inclusion of subjects whose experimental results could be explained by competing treatment effects.

The above criteria limited the initial subject pool to children who by current medical standards merit the diagnosis Attention Deficit Disorder with Hyperactivity, and who were successfully responding to drug treatment. It also included children whose attentional disorder was not obviously due to another medical or psychiatric cause and excluded children undergoing competing treatments. These conditions result in a group of subjects which is broadly representative of approximately 60% of the identified hyperactive school age population (Connors, 1973; Gittleman-Klein, 1978; Kinsbourne and Caplan, 1979; D.S.M. III, 1980).

Experimental Criteria. In addition to the diagnostic criteria presented above subjects were also selected based on certain experimental criteria. The age range for subjects was between 8-12.2 years old. The lower limit was selected for several reasons. The peak age for referral is highest around this age (D.S.M. III, 1980; Lambert et al., 1980; Schultz, 1974; Werry and Quay, 1971). Another reason for the lower limit is that stimulant drug treatment is not recommended for children under the age of six (P.D.R., 1983). A final reason for the selection of eight years as the lower limit is the suggestion that some brain centers controlling attention and myelinization may not have completed development at an earlier stage (White and Pillemer, 1979). The upper age limit was selected for two reasons. While attentional disorders continue through adolescence (Douglas, 1974) the hyperactive and impulsive behavior tends to decrease resulting in a modified diagnosis -- Attention Deficit Disorder - Residual Type (D.S.M. III, 1980). The change in diagnosis may also result in the modification or termination of stimulant drug treatment. Therefore including older subjects could result in diagnostic and treatment changes not in the purview of this experiment.

A second experimental criteria was that the measured intelligence quotient fall within the average range. This standard is more limiting than found in the diagnostic criteria which allows for a range beginning at 50 as measured by an individualized intelligence test (D.S.M. III, 1980). However, due to the complexity of experimental task instructions subjects with a measured intelligence less than 80 points could have difficulties comprehending task demands thus not offering a valid measure of attentional performance. The instrument used to measure this subject variable was the Wechsler Intelligence Scale for Children - Revised (Wechsler, 1974). On this scale selected subjects had a full scale score of at least 80 points. Subjects were retested in cases where the intelligence scores were not available from school or other records or when the data was gathered more than a year previous to the experiment.

Despite adequate auditory acuity and intelligence some children may have difficulty with experimental tasks due to difficulties with auditory discrimination, rather than a fundamental attentional disability. Consequently, subjects selected for inclusion scored above the 50th percentile on the "quiet subtest" of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination, 1970 (Appendix C). This test was selected since it covers the experimental age range and takes fifteen or less minutes to administer. The administration time prevents exclusion of subjects who may have difficulty sustaining attention on a discrimination test of longer duration. The score standard prevented inclusion of subjects who may have serious discrimination problems. Subjects were also administered the Harris Test of Lateral Dominance (Appendix C) to ensure they could differentiate right from left, a critical factor for the dichotic tasks.

Subject Selection Procedure. The procedure for selection followed a four-step process beginning with initial identification and concluding with a final screening. The first step in the process was identifying area physicians who would be treating children diagnosed as Attention Deficit Disordered with Hyperactivity.

The identification of physicians was done through compilation of a list of pediatricians, family practioners and psychiatrists practicing in the Franklin-Hampshire County area of Massachusetts. This list was generated by contacting the Physicians' and Surgeons' Information Bureaus at Franklin County Public and Cooley-Dickenson Hospitals in Greenfield and Northampton, Massachusetts. After the potential list of participating physicians was developed, a letter of introduction and explanation was mailed, including a self-addressed response letter, to physicians in the Franklin-Hampshire County area (see Appendix D). Two weeks after the initial request was mailed, a telephone call was made to non-responding physicians. The letter requested that physicians who are treating hyperactive children who meet the identifying diagnostic criteria and whose family may be willing to have them participate in this experiment return an enclosed response letter. Once physicians willing to participate were identified they were provided with further experimental information and a letter of introduction and explanation for parents with a self-addressed response form (see Appendix D) for the physician to forward to potential participants. Parents who indicated an interest in participating were contacted and a subsequent interview was arranged.

Based on the above procedure thirty potential subjects were identified by six cooperating physicians. The parents of the potential subjects were contacted and were requested to sign release of information forms and a release form for participation in the experiment (see Appendix D). At that time parents were also informed of possible reasons for exclusion from the study. After the parent release of information was provided, the physician and the school were contacted for review of relevant records and were provided with a photocopy of the release form. Based on the record review twenty-four subjects were excluded from the study. Twelve were excluded due to full-scale intelligence quotients lower than 80, five due to hard neurological signs, four subjects were younger than the age cutoff and three were receiving competing treatments. The parents of the six subjects who met the criteria necessary for inclusion were notified by telephone and a written note and another interview arranged. The purpose of the final interview was to gather developmental information, perform additional testing and develop the word association list and to provide a time line for the experiment. Due to a conflicting summer schedule one additional subject was dropped from the experimental group. The parents were reinformed of their right to withdraw their child at any time and their right of access to any experimental data referring to their child. The children were also included in a portion of this meeting in order to outline the experiment, answer any questions concerning their participation and to demonstrate biofeedback. The remaining five subjects were all patients of the same pediatrician.

SUBJECTS

Subject 1. Subject 1 was a 9-year, 3-month-old right dominant male with high average intelligence (Full Scale = 116). He was initially diagnosed as hyperactive at age 7 and was treated with 5 mg. dextroamphetamine sulfate. The diagnosis was revised when he was 8.11 to Attention Deficit Disorder with Hyperactivity. His drug treatment was continued at a 15 mg. level. Record reviews and interviews indicated that the subject was considered a good drug responder, demonstrating improved behavior and school performance. Audiological testing indicated he had average hearing, passing a pure tone audiometer test at 20dB for each ear, and discrimination, 100 percentile on the Goldman-Fristoe-Woodcock test.

The subject's pre- and neonatal history was generally unremarkable. As a young child he had difficulty with ear infections and suffered several injuries requiring emergency room treatment. The subject's early functional history indicates that he had difficulty sleeping and eating throughout early childhood. He was first described as overactive when he was two years old.

Both of the subject's parents reported a history of overactivity and conduct problems as children.

In the school setting the subject is seen as having a short attention span and as verbally impulsive. However, he is able to achieve within the expected range for his age.

<u>Subject 2</u>. The second subject was a 9-year, 2-month-old right dominante male with average intelligence (Full Scale = 104). He was diagnosed as Attention Deficit Disorder with Hyperactivity at age 8.10. The initial diagnosis was made by a multidisciplinary team including a pediatrician. He was initially treated with 5 mg. of methylphenidate which was increased to 20 mg. prior to the experiment. While drug-free periods are part of the treatment the parents administer medication during vacations if a special event is scheduled. Record reviews and interviews indicated that the higher medication levels reduced the undesired behaviors to acceptable levels. Audiological testing indicated he had average hearing, pure tone audiometer 20 dB for each ear, and discrimination, 100 percentile on the Goldman-Fristoe-Woodcock test.

The subject's prenatal history indicated he was a high-risk infant. However, his neonatal history was unremarkable. As a young child he had persistent reported difficulties with unspecified allergies and evidence of delayed motor maturation. He was first described as overactive when he was four. The subject's father reported a history of academic problems.

In the school setting the subject is seen as having difficulties with impulse control and attention. He has generalized difficulties with school work and receives special education services.

Subject 3. This subject was a 12-year, 1-month-old right dominant male with average intelligence (Full Scale = 100). He was initially diagnosed as hyperactive when he was eight and treated with 5 mg. of dextroamphetamine sulfate. His diagnosis was revised to Attention Deficit Disorder with Hyperactivity when he was 11.4. At the time of the experiment he was treated with 15 mg. of the medication. The subject's mother stated that she rigidly follows the drug holiday regimen. Record reviews and interviews indicate that the subject was responding quite well to the higher medication dosage. The teachers commented on a dramatic behavioral improvement. Audiological testing indicated average hearing, pure tone audiometer -- 20dB for each ear and discrimination, 100 percentile - Goldman-Fristoe-Woodcock test.

The subject's pre- and neonatal history was unremarkable, as well as his early health history. An evaluation at a neurology clinic indicated a mild motor delay. He also had a history of accidents requiring emergency room treatment. The subject was first described as overactive when he was in second grade. There was no history of parental overactivity or learning problems.

In the school setting the subject was seen as having behavioral and academic problems. At the time of the experiment the school authorities felt that the subject's full-time special education services could be reduced.

Subject 4. The fourth subject was a 10-year, 7-month old right dominant male with average intelligence (Full Scale = 102). He was diagnosed as Attention Deficit Disordered with Hyperactivity by a hospital based multidisciplinary team when he was 9.8. He was initially treated with 10 mg. dextroamphetamine sulfate which was increased to 12.5 mg. at the time of the experiment. While drug-free periods are part of the treatment the parents administer medication if special events are planned. Record reviews and interviews indicate that the subject responded well to the drug treatment. The school especially noted improvement in attention and reduction of tantrum behavior. Audiological testing indicated the student had average hearing, pure tone - right 30dB, left 32dB, and discrimination, 96 percentile Goldman-Fristoe-Woodcock test.

The subject's pre- and neonatal history indicated he was an at risk infant. His early health history indicated persistent upper respiratory problems and a serious burn injury requiring hospitalization. He was first described as overactive when he was two years old. There was no parental history of overactive or learning problems.

In the school setting the subject was seen as having difficulties with attention to school work and peer relations. His teachers commented about the improvement with medication in these areas.

Subject 5. The last subject was a 10-year, 9-month-old right dominant female with low average intelligence (Full Scale = 80). She was diagnosed as Attention Deficit Disorder with Hyperactivity by a hospital based multidisciplinary team at the age 10.3. She was initially treated with 10 mg. of dextroamphetamine sulfate which was reduced to 5 mg. The parents report that they adhere to the drug holiday schedule. Record reviews and interviews indicate that her attentional behavior has been improved by the medication but that difficulties with peer relations continue. Audiological testing indicated that she had average hearing, pure tone audiometer 10 dB for each ear, and discrimination, 100 percentile on the Goldman-Fristoe-Woodcock test.

The subjects pre- and neonatal history was unremarkable as well as her early health history. As a young child she had difficulty falling asleep and in being comforted. She was always viewed by the parents as being overactive. Neither parent reported a history of learning or behavior problems.

In school her teachers reported her greatest difficulty was with arithmetic skills and she receives special education assistance in this area.

Life Change Units. The life change units for the subjects included in this study ranged from 183-435 units with a mean of 269.8. The mean for the elementary population is 102.8; indicating that the experimental subjects experienced significant social readjustment during the year included in the experiment. Three subjects' (1, 3 and 5) scores placed them one standard deviation above the mean. Subjects 2 and 4 fell two standard diviations above the mean. All subjects except one (subject 4) experienced a life change event during the experimental period. Subjects 3 and 5 experienced the most life event changes during the experimental period (May-August). One implication that may be derived from the subjects' life change scores is that the stress accompanying their life events may have lowered their overall performance level (Kahneman, 1973).

DATA ANALYSIS

There is a continuing discussion as to the most appropriate criteria for measuring change in single case experimental designs. The traditional clinical approach studies the social or treatment importance of the observed change while statistical methods look at the reliability of the consequent change in group performance. This study used both techniques: statistical methods are used for three reasons. First, the measurement phases, due to the nature of the experimental tasks, are brief and may fail to establish a stable baseline which is important for a visual analysis of the data. Second, the areas of investigation are relatively "new" and treatment effects may not be obvious. In both of these cases a simple visual analysis may fail to note a significant effect. Finally, the group analysis assists in establishing the external validity of the experimental results.

Statistical Analysis. The following techniques are used to analyze the data generated by the experimental tasks, median regression line and correlated t-tests.

Correlated t-Test. A nondirectional correlated t-test was selected, since for small numbers of subjects (N=5) departures from normality do not seriously affect probability estimation. The mean group performance on the correct detection and false alarm variables were analyzed for Continuous Performance Tasks I and II. For Dichotic Listening Tasks I and II the variables of interest were correct detections, false alarms and intrusions. Each of the above task variables were tested against the hypotheses:

$$H_o : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} = \mu B$$

$$H_1 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} \neq uB$$

$$H_0 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} = \mu C$$

$$H_1 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} \neq \mu C$$

$$H_0 : \mu B = \mu C$$

$$H_1 : \mu B \neq \mu C$$

For the Recognition Memory task the group means for correct detections and subject associate, rhyme and category errors were tested for the following hypotheses:

$$H_0 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} = \mu B$$

$$H_1 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} \neq \mu B$$

$$H_0 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} = \mu C$$

$$H_1 : \frac{\mu A_1 + \mu A_2 + \mu A_3}{3} \neq \mu C$$

$$H_0 : \mu B = \mu C$$

$$H_1 : \mu B \neq \mu C$$

For the Locus of Control task the mean number of external responses was tested for the hypotheses:

$$H_0 : \mu A_2 = \mu B$$

$$H_1 : \mu A_2 \neq \mu B$$

$$H_0 : \mu A_2 = \mu C$$

$$H_1 : \mu A_2 \neq \mu C$$

$H_0: \mu B = \mu C$

$H_1: \mu B \neq \mu C$

A post hoc analysis was also conducted on the experimental data to test whether there were differences between adjacent phases. Since multiple tests were performed on the same data there is an increased chance of making a Type I error (Dunn and Clark, 1974; Zwick and Marascuilo, 1984). To control for the Type I error possibility the experimental alpha was set at the .01 level. By applying a procedure outlined by Dunn and Clark (1974) to the experimental alpha an actual level of .07 is achieved. This means that for comparisons which are significant at .01 there is a 93 percent certainty that the difference is due to the experimental intervention. The critical t-score for the .01 significance level at four degrees of freedom is 4.604.

Median regression line. A median regression line was derived for the data from the continuous performance, dichotic listening and memory tasks (White, 1972, 1973). This technique describes the rate of performance change for an individual over time.

The statistical hypotheses for the median regression test are as follows:

Continuous performance tasks I and II:

correct detections,

$H_0: \pi_{A_1} = \pi_B, \pi_B = \pi_{A_2}, \pi_{A_2} = \pi_C, \pi_C = \pi_{A_3}$

$H_1: \pi_{A_1} \neq \pi_B, \pi_B \neq \pi_{A_2}, \pi_{A_2} \neq \pi_C, \pi_C \neq \pi_{A_3}$

false alarms,

$H_0: \pi_{A_1}=\pi_B, \pi_B=\pi_{A_2}, \pi_{A_2}=\pi_C, \pi_C=\pi_{A_3}$

$H_1: \pi_{A_1}\neq\pi_B, \pi_B\neq\pi_{A_2}, \pi_{A_2}\neq\pi_C, \pi_C\neq\pi_{A_3}$

Dichotic listening tasks I and II:

correct detections,

$H_0: \pi_{A_1}=\pi_B, \pi_B=\pi_{A_2}, \pi_{A_2}=\pi_C, \pi_C=\pi_{A_3}$

$H_1: \pi_{A_1}\neq\pi_B, \pi_B\neq\pi_{A_2}, \pi_{A_2}\neq\pi_C, \pi_C\neq\pi_{A_3}$

false alarms,

$H_0: \pi_{A_1}=\pi_B, \pi_B=\pi_{A_2}, \pi_{A_2}=\pi_C, \pi_C=\pi_{A_3}$

$H_1: \pi_{A_1}\neq\pi_B, \pi_B\neq\pi_{A_2}, \pi_{A_2}\neq\pi_C, \pi_C=\pi_{A_3}$

intrusions,

$H_0: \pi_{A_1}=\pi_B, \pi_B=\pi_{A_2}, \pi_{A_2}=\pi_C, \pi_C=\pi_{A_3}$

$H_1: \pi_{A_1}\neq\pi_B, \pi_B\neq\pi_{A_2}, \pi_{A_2}\neq\pi_C, \pi_C=\pi_{A_3}$

Recognition memory:

total errors,

$H_0: \pi_{A_1}=\pi_B, \pi_B=\pi_{A_2}, \pi_{A_2}=\pi_C, \pi_C=\pi_{A_3}$

$H_1: \pi_{A_1}\neq\pi_B, \pi_B\neq\pi_{A_2}, \pi_{A_2}\neq\pi_C, \pi_C\neq\pi_{A_3}$

The resulting median regression lines were compared by using a test of the difference between two correlated proportions (Fergerson, 1981). The computational formula was:

$$z = \frac{D - A}{\sqrt{A + D}}$$

where A and D are the proportions of above to below and below to above the line respectively. The actual numbers are taken from the following schema:

PHASE II

below	above
A	B
C	D

The experimental alpha for the median regression line is the .05 level where z = 1.96.

An additional requirement for the determination of treatment affect was that there must be adjacent significance levels. For example, the difference between A[1] - B and B - A[2] must be significant to claim treatment effect. This precaution was taken in order to ensure noted differences that could be confidently attributed to treatments.

Additional Analysis. The purpose of this analysis is to describe the performance of the subjects using nonstatistical techniques.

The first step in this analysis is the inspection of data for the no treatment phases: A[1], A[2] and A[3]. The purpose of this examination is to note whether the performance of the subjects is stable, that is, variability does not exceed a 50% level (Herson and Barlow, 1976). When excessive variability is seen its possible sources are identified and discussed. The data from the continuous performance and dichotic tasks are presented as a graph with frequency of error type and correct detections plotted across ten time intervals (Appendix G). This type of analysis was not possible for the locus of control task since it was administered during only the A[2] phase.

Following the analysis of the no treatment phases comparisons where warranted were made between drug and biofeedback phases with adjacent no treatment phases, and when indicated between drug and biofeedback performance. The purpose of this analysis was to identify patterns of variability between adjacent measurement phases. Particular attention was given to spontaneous improvements and cyclical variability. For instances of improved or unchanged performance the analysis focuses on the role of treatment intervention in effecting change, and the identification of other variables which may have a causal role. In cases of spontaneous or cyclical change the discussion focuses on possible sources of variability with particular attention to possible carry-over effects.

In the cases of the continuous performance and dichotic tasks the discussion focuses on the rate of performance decrement over time. The second dichotic task is also discussed with attention to the error rate immediately following the switching tone.

The data from the recognition memory task is discussed in terms of frequency of error type and any changes resulting from treatments.

The locus of control task is analyzed on two levels. The first analysis concentrates on overall changes in measured locus of control. The second analysis reviews changes in identified factors in the Nowicki-Strickland Scale, and how such changes relate to the locus of control construct.

CHAPTER IV

EXPERIMENTAL RESULTS

Introduction. The purpose of this experiment was to note whether stimulant drug and biofeedback treatments affected performance on selected measures of attention, memory and locus of control. Five children diagnosed as Attention Deficit Disorder with Hyperactivity participated in the experiment. The experiment was divided into five measurement phases, during each phase the subjects performed the selected tasks. Each phase was separated by two weeks except the second no treatment (A[2]) and the biofeedback treatment (C) periods. The separation between A[2] and C was four weeks to allow for the biofeedback training.

The results are presented in seven sections corresponding to each experimental area and the conclusion. The first six subtopics are divided in two parts; presentation of the statistical results, group and individual, and when indicated an additional data analysis. The conclusion summarizes the major results and identifies topics for further discussion.

Continuous Performance Task I. This task is a modified Rosvold (1956) procedure where the variables of interest are correct detections and false alarms. The mean performance of the subjects across the ten time intervals is presented in Table 1. Further data is presented in Appendix G.

TABLE I

Continuous Performance Task I: Correlated t-test Results of Drug (B), Biofeedback (C) and Averaged No Treatment (A) Comparisons (N=5)

Condition	Mean	Difference S.D.	t-value	2-tail probability
		Correct Detections		
A[1]	156.0			
A[2]	151.0			
A[3]	148.0			
ΣA's/3	151.4			
B	172.6	15.57	3.04	.038
C	151.6	13.70	.03	.976
B-C		-11.53		
		False Alarms		
A[1]	30.0			
A[2]	31.0			
A[3]	33.0			
ΣA's/3	31.4			
B	19.0	5.82	-4.77	.009
C	10.4	8.23	-5.71	.005
B-C		13.41	1.43	.225

A review of the data in Table 1 shows that the subjects no treatment performance was highly stable. The average percent chance for the correct detection variable was 2.9 and that for false alarms was 5.65. The stable no treatment performance highlights the subjects' treatment results. As can be seen from Table 1, the subjects' correct detections increased during drug treatment, and false alarms decreased during both treatment phases.

A post hoc analysis of adjacent treatment phases for both the correct detection and false alarm variables identified one significant difference. The decrease in false alarms from the second no treatment phase to the biofeedback phase was significant at the .01 level ($t=4.58$). The difference between the biofeedback and the last no treatment phase was large ($p=.017$, $t=3.96$), but did not reach the established experimental alpha level ($p \leq .01$).

The post hoc analysis also revealed that for correct detections the drug and adjacent no treatment phases were not significantly different: the relative probabilities were A[1] to B, $p=.118$ and B to A[2], $p=.089$. This weak relationship casts doubt on the possibility ($p=.038$) that drug treatment was significantly different from no treatment. The expectation would be that a strong treatment effect would show differences between treatment phases.

The following hypothetical results are obtained from the above analysis.

1. There was no statistically significant difference between drug and average no treatment on the mean number of correct detections ($p=.038$, $t=3.04$). There was a statistically significant difference between drug and averaged no treatment on the mean number of false alarms ($p=.009$, $t=4.77$).

2. There was no statistically significant difference between biofeedback and averaged no treatment on the mean

number of correct detections (p=.976, t=.03). There was a statistically significant difference between biofeedback and averaged no treatment on the mean number of false alarms (p=.005, t=5.71).

3. There was no statistically significant difference between drug and biofeedback treatments on the mean number of correct detections (p=.136, t=1.86) or the mean number of false alarms (p=.225, t=1.43).

The rate of change between adjacent phases for individual subjects was analyzed using a test of correlated proportions. The raw data for the individual subjects is available in Appendix G. The instances where statistically significant differences occurred between experimental phases can be seen in Table 2.

TABLE 2

Continuous Performance Task I: Significant Differences of Performance Rate for Individual Subjects Between Drug (B), Biofeedback (C) and No Treatment (A) Phases

Subjects	Treatment Phases			
	A[1]-B	B-A[2]	A[2]-C	C-A[3]
	Correct Detections			
1			$p<.05$ $z=2.0$	$p<.01$ $z=2.7$
2	$p<.05$ $z=2.0$	$p<.05$ $z=2.23$	$p<.05$ $z=2.0$	$p<.05$ $z=2.23$
3				
4				
5		$p<.05$ $z=2.0$	$p<.05$ $z=2.0$	
	False Alarms			
1			$p<.01$ $z=2.7$	$p<.05$ $z=2.0$
2	$p<.05$ $z=2.0$		$p<.05$ $z=2.0$	$p<.01$ $z=2.83$
3				
4				
5				

The significant differences for correct detections noted in Table 2 reflect an increase in subjects 1, 2, and 5 performance decrement over time. The false alarm differences for subjects 1 and 2 are due to reductions in the number of errors over time.

Additional Analysis. The false alarms of the subjects were reanalyzed to identify possible treatment affects. The data was divided into three categories: expected; false alarms which followed A or X in isolation, impulsive; those occurring in an AX sequence after the A; random, those occurring without apparent reference to the letters A or X. The type of false alarms in the drug and biofeedback conditions were compared to the averaged no treatment false alarms. The data in Table 3 is presented as percentages for ease of comparison.

TABLE 3

Percent Change From Averaged No Treatment False Alarms by Type and Treatment Condition

Type	Drug	Biofeedback
Expected	-18.3	-21.3
Impulsive	-39.6	-74
Random	-57.6	-78.8

Table 3 shows that both treatments reduced the number of false alarms made in the three categories. Random errors showed the greatest reduction followed by impulsive and expected false alarms.

<u>Continuous Performance Task II</u>. This task requires subjects to identify a target word embedded in the context of a story. The variables of interest are correct detections and false alarms.

TABLE 4

Continuous Performance Task II: Correlated t-test Results of Drug (B), Biofeedback (C) and Averaged No Treatment (A) Comparisons (N=5)

Condition	Mean	Difference S.D.	t-value	2-tail probablility
		Correct Detections		
A[1]	42.0			
A[2]	40.0			
A[3]	27.0			
ΣA's/3	36.3			
B	40.2	14.43	.61	.575
C	28.8	20.14	-.83	.454
B-C		20.70	1.23	.286
		False Alarms		
A[1]	28.0			
A[2]	37.0			
A[3]	19.2			
ΣA's/3	27.8			
B	25.8	28.47	-.16	.883
C	12.8	11.56	-2.90	.044
B-C		19.81	1.47	.216

The no treatment phases were somewhat variable for both correct detections and false alarms. While the difference did not reach the critical fifty percent level, as outlined in Chapter 3, some aspects require an explanation. For both variables the final no treatment phase performance was well below preceding no treatment levels; for correct detections there was a 32.5 percent decrease and for false alarms a 47.5 percent decrease. This situation was anticipated. Since biofeedback induced self-control is a learned behavior it is reasonable to expect that performance would not return to pre-treatment levels. Another large difference was noted in the second no treatment phase for the false alarm variable. The false alarms that occurred in this phase were 32.6 percent higher than the first no treatment condition. A visual inspection of the data (Appendix G) identified that the source of this difference was subject 4. The false alarm rate for this subject was radically higher, excepting drug treatment, than the remaining subjects. Excluding subject 4's behavior results in a more consistent performance level.

A post hoc analysis of the Table 4 data for both variables identified one significant difference. The increase in false alarms from biofeedback to the last no treatment phase was significant ($p=.007$, $t=-5.12$).

The following hypothetical results are obtained from the correlated t-test analysis. Additional data is available in Appendix G.

1. There was no statistically significant difference between drug and averaged no treatment on the mean number of correct detections ($p=.675$, $t=.61$) or the mean number of false alarms ($p=.883$, $t=-.16$).

2. There was no statistically significant difference between biofeedback and averaged no treatment or the mean number of correct detections ($p=.454$, $t=-.83$) or the mean number of false alarms ($p=.044$, $t=-2.90$).

3. There was no statistically significant difference between drug and biofeedback treatments on the mean number of correct detections ($p=.286$, $t=.16$) or the mean number of false alarms ($p+.216$, $t=1.47$).

The rate of change between adjacent phases for individual subjects was analyzed using a test of correlated proportions. The raw data for individual subjects is available in Appendix G. The instances when a statistically significant difference occurred between experimental phases is presented in Table 5.

TABLE 5

Continuous Performanc Task II: Significant Differences of Performance Rate for Individual Subjects Between Drug (B), Biofeedback (C) and No Treatment (A) Phases

Subjects	Treatment Phases			
	A[1]-B	B-A[2]	A[2]-C	C-A[3]
	Correct Detections			
1		$p<.05$ $z=2.7$	$p<.05$ $z=2.24$	$p<.05$ $z=2.0$
2		$p<.05$ $z=2.23$		
3	$p<.05$ $z=2.0$			$p<.05$ $z=2.23$
4			$p<.05$ $z=2.0$	
5		$p<.05$ $z=2.23$		
	False Alarms			
1	$p<.05$ $z=2.0$	$p<.05$ $z=2.45$	$p<.01$ $z=2.83$	$p<.05$ $z=2.0$
2				
3	$p<.05$ $z=2.0$			
4				$p<.05$ $z=2.0$
5				

Table 5 illustrates that only subject 1 demonstrated the critical profile of adjacent significant changes necessary to claim treatment effects. Biofeedback treatment increased the subject's performance decrement and reduced his false alarm rate. Drug treatment resulted in an increase in subject 1's false alarm rate.

Dichotic Task I. This task requires subjects to state a target number heard in a specified ear. The variables of interest are: correct detections, false alarms and intrusions.

As illustrated in Table 6, the performance during the no treatment phases for each of the three variables was relatively stable. The percent difference between the no treatment conditions was under 30 percent with one exception. The difference between conditions A[1] and A[2] for false alarms was 37%. An inspection of the data (Appendix G) indicates that subject 4 showed the greatest increase in false alarms.

A post hoc analysis of succeeding treatment conditions found no significant differences at the .01 level for correct detections, false alarms or intrusions. At a less rigorous alpha level differences were noted for both false alarms and intrusions. For the false alarm variable the differences were between B-A[2] (p.=.045), A[2]-C (p.=.015) and C-A[3] (p.=.02). The noted differences between phases for intrusions were A[1]-B (p.=.037), B-A[2] (p.=.045) and

A[2]-C 9 (p.=.03).

TABLE 6

Dichotic Listening Task I: Correlated t-test Results of Drug (B), Biofeedback (C) and Averaged No Treatment (A) Comparisons (N=5)

Condition	Mean	Difference S.D.	t-value	2-tail probability
		Correct Detections		
A[1]	46.8			
A[2]	39.6			
A[3]	39.2			
ΣA's/3	42.1			
B	46.8	42.66	3.98	.016
C	44.8	4.84	1.26	.275
B-C		3.00	1.49	.210
		False Alarms		
A[1]	5.4			
A[2]	7.4			
A[3]	5.2			
ΣA's/3	6.0			
B	3.2	1.80	-3.47	.026
C	2.0	1.43	-6.24	.003
B-C		.45	6.00	.004
		Intrusions		
A[1]	14.2			
A[2]	18.2			
A[3]	12.6			
ΣA's/3	14.2			
B	6.2	5.07	-3.53	.024
C	7.6	2.98	-4.96	.008
B-C		4.10	- .76	.488

A behavior of interest for this task is the nature of the intrusion errors; intrusions being the subjects reporting digits or words from the unattended ear. A reveiw of the data shows that 94.7 percent of the intrusions were digits. The majority of the errors were isolated rather than occurring in clusters; and there was an even distribution of errors between the first and second half of the task. All the subjects made at least one word intrusion error during the experiment. Two word intrusions, "you" and "dog," were repeated during phases A[2] and A[3] by subject 2.

The following hypothetical results are obtained from the results of the correlated t-test analysis.

1. There was no statistically significant difference between stimulant drug and averaged no treatments on the mean number of correct detections (p=.016, t=3.98), false alarms (p=.026, t=-3.47) or intrusions (p=.024, t=-3.53).

2. There was no statistically significant difference between biofeedback and averaged no treatments on the mean number of correct detections (p=.275, t=1.26). There was a statistically significant difference between biofeedback and averaged no treatments on the mean number of false alarms (p=.003, t=-6.24) and intrusions (p=.008, t=4.96).

3. There was no statistically significant difference between biofeedback and drug treatment on the mean number of correct detections (p=.210, t=1.49) or intrusions (p=.488, t=-.76). There was a statistically significant difference between drug and biofeedback treatment on the mean number of false alarms (p=.004, t=6.00).

The rate of change between adjacent phases for individual subjects was analyzed using a test of correlated proportions. The raw data for individuals is available in Appendix G. Table 7 illustrates the instances when a statistically significant difference occurred between experimental phases.

TABLE 7

Dichotic Listening Task I: Significant Differences of Performance Rate for Individual Subjects Between Drug (B), Biofeedback (C) and No Treatment (A) Phases

Subjects	Treatment Phases			
	A[1]-B	B-A[2]	A[2]-C	C-A[3]
Correct Detections				
1				
2	$p<.05$ $z=2.24$			
3				
4				
5		$p<.05$ $z=2.0$	$p<.05$ $z=2.0$	
False Alarms				
1				
2				
3				
4	$p<.05$ $z=2.44$	$p<.05$ $z=2.0$	$p<.05$ $z=2.0$	$p<.05$ $z=2.24$
5				
Intrusions				
1				
2			$p<.05$ $z=2.24$	
3	$p<.05$ $z=2.0$			$p<.05$ $z=2.0$
4			$p<.05$ $z=2.0$	
5				

As shown in Table 7, two individuals experienced adjacent significant changes. Subject 5 had a significantly lower correct detection rate during the middle no treatment phase. Subject 4 experienced reductions in the false alarm rate during both drug and biofeedback treatment phases.

Dichotic Task II. This task requires the subjects to state a target number heard in an ear specified by a randomly distributed tone. The variables of interest are correct detections, false alarms and intrusions. The mean performance of the subjects across the ten time intervals is offered in Table 8. Further data is presented in Appendix G.

TABLE 8

Dichotic Listening Task II: Correlated t-test Results of Drug (B), Biofeedback (C) and Averaged No Treatment (A) Comparisons (N=5)

Condition	Mean	Difference S.D.	t-value	2-tail probability
Correct Detections				
A[1]	46.0			
A[2]	40.6			
A[3]	40.4			
ΣA's/3	42.3			
B	42.8	3.15	.33	.757
C	44.2	7.45	.56	.605
B-C		5.94	-.53	.626
False Alarms				
A[1]	10.4			
A[2]	4.4			
A[3]	2.4			
ΣA's/3	5.7			
B	2.6	2.46	-2.85	.046
C	2.4	2.68	-2.78	.050
B-C		3.27	.14	.898
Intrusions				
A[1]	14.8			
A[2]	19.8			
A[3]	11.8			
ΣA's/3	15.5			
B	16.2	3.17	.52	.632
C	8.6	2.30	-6.70	.003
B-C		4.16	4.09	.015

The no treatment phases for all three variables were relatively stable with one exception. There was a 57.7 percent decrease in false alarms from phase A[1] to A[2]. Subjects 1, 2 and 4 were primarily responsible for the dramatic change. The most plausible explanation for the difference is the relative novelty of the task. The gradual decrease in false alarms indicates that the subjects were becoming acclimated to this task expectation.

A post hoc comparison of adjacent treatment conditions found no significant differences at the p.<.01 level for the three variables. Two comparisons approached the experimental alpha level; false alarm phases A[1]-B (p.=.033) and intrusion phases A[2]-C (p=.024).

The following hypothetical results were obtained from the correlated t-test.

1. There was no statistically significant difference between stimulant drug and averaged no treatments on the mean number of correct detections (p=.757, t=.33), false alarms (p=.046, t=2.85) or intrusions (p=.632, t=.52).

2. There was no statistically significant difference between biofeedback and averaged no treatments on the mean number of correct detections (p=.605, t=.56) or false alarms (p=.05, t=-2.78). There was a statistically significant difference between biofeedback and averaged no treatments on the mean number of intrusions (p=.003, t=-.670).

3. There was no statistically significant difference between stimulant drug and biofeedback treatments on the mean number of correct detections (p=.626, t=.56), false alarms (p.898, t=.14) or intrusions(p=.015, t=4.09).

The rate of change between adjacent phases for individual subjects was analyzed using a test of correlated proportions. The raw data for individual subjects is available in Appendix G. The instances when a statistically significant difference occurred between experimental phases are presented in Table 9.

TABLE 9

Dichotic Listening Task II: Significant Differences of Performance Rate for Individual Subjects Between Drug (B), Biofeedback (C) and No Treatment (A) Phases

Subjects	Treatment Phases			
	A[1]-B	B-A[2]	A[2]-C	C-A[3]
	Correct Detections			
1	$p<.01$ $z=2.64$			
2			$p<.01$ $z=2.64$	$p<.05$ $z=2.45$
3			$p<.05$ $z=2.0$	
4				
5		$p<.05$ $z=2.0$		
	False Alarms			
1				
2				
3				
4			$p<.05$ $z=2.0$	
5				
	Intrusions			
1				
2	$p<.05$ $z=2.0$			
3				
4		$p<.05$ $z=2.0$		
5			$p<.05$ $z=2.23$	

It is evident from Table 9 that only subject 2 demonstrated the desired pattern of adjacent significant changes. In his case biofeedback increased his performance decrement over time.

Additional Analysis. A specific item of interest in this experimental task was the subjects' ability to shift attention between ears at the sound of a tone. This behavior was measured by the number of correctly identified digits, maximum of two, which immediately followed the ten switching signals. Table 10 presents the results.

TABLE 10

Percent of Targets Correctly Identified after Switching Signal by Treatment Condition

	Treatment Condition				
Subject	A[1]	B	A[2]	C	A[3]
1	90	95	85	95	95
2	80	60	60	60	35
3	75	80	50	75	75
4	75	95	85	100	85
5	65	45	40	40	30
Average	77	75	66	74	64

As can be seen in Table 10 most subjects were relatively efficient in the performance of this task. Only subject 3 showed any sizable percentage change between adjacent phases, which was due to a singularly low A[2] phase. The level of performance on this task may be related to measured intelligence, since the highest level was achieved by subject 1 (WISC-R, F.S.=116) and the lowest by subject 5 (WISC-R, F.S.=80). It is evident in Table 10 that the average performance of the subjects indicated a tendency for superior performance under treatment conditions, however the difference is so small that further statements concerning performance are not warranted.

An analysis of the transitions between ears indicated that right to left changes were the most difficult, accounting for 37.5 percent of the transitional errors. The subjects also had difficulty in their evaluation of the switching tones. Approximately one third of the errors were due to the subjects changing their ear of report when no change was indicated. For example, a subject would be attending to the right ear, hear a tone which indicated he should continue listening to that ear, and then begin reporting from the left ear. However, subjects were able to recognize this error and return to the correct ear.

The intrusion errors for this task were primarily digits (93.6%) and generally followed the pattern of the first dichotic task. The errors tended to occur in isolation with a slight increase during the second half of the task. There were two repeated word errors, "dog" and "eat," during the B and C phases. Subject 2 was responsible for the repeated "dog" error in both this and the previous dichotic task.

Recognition Memory Task. This task requires subjects to recognize and state a target word presented with three foils. The variables of interest are correct recognition, subject, category and rhyme errors. The mean performance of the subjects for each of the variables is presented in Table 11.

The no treatment performance as shown in Table 11 was fairly stable for the rhyme, category and correct detection variables. The percent of change in the subjects' responses between the three no treatment conditions was generally under twenty percent. The percent of change for the student foil was 25.2 percent, yet this is substantially less than the established fifty percent level.

A post hoc analysis of correct detections and memory foils exposed no significant differences between adjacent treatment phases. The post hoc analysis also revealed there were no statistically significant differences for location of answers between treatments. That is the subjects were required to identify the target word from three other sequentially presented words. With the exception of a clear recency effect, (40% of the answers were in the final position) the answers were evenly distributed between the first, second and third locations, and there was no difference between phases.

TABLE 11

Recognition Memory: Correlated t-test Results of Drug (B), Biofeedback (C) and Averaged No Treatment (A) Comparisons (N=5)

Condition	Mean	Difference S.D.	t-value	2-tail probability
		Correct Detections		
A[1]	17.2			
A[2]	18.4			
A[3]	17.8			
ΣA's/3	17.8			
B	18.4	3.79	.35	.742
C	17.8	2.41	-.19	.862
B-C		3.90	.46	.670
		Subject Errors		
A[1]	9.2			
A[2]	8.8			
A[3]	11.4			
ΣA's/3	9.8			
B	11.0	3.58	.75	.495
C	10.2	2.10	.43	.692
B-C		3.42	.52	.629
		Category Errors		
A[1]	6.0			
A[2]	6.8			
A[3]	5.6			
ΣA's/3	6.1			
B	4.8	2.79	-1.07	.345
C	6.8	2.50	.59	.584
B-C		2.45	-1.83	.142
		Rhyme Errors		
A[1]	7.6			
A[2]	6.0			
A[3]	5.2			
ΣA's/3	6.3			
B	5.8	1.57	-.66	.544
C	5.2	1.66	-1.44	.223
B-C		1.14	1.18	.305

The following hypothetical results were obtained from the correlated t-test analysis.

1. There was no statistically significant difference between stimulant drug and averaged no treatments on the mean number of correct detections ($p=.741$, $t=.35$), subjects errors ($p=.495$, $t=.75$), category errors ($p=.345$, $t=-1.07$), and rhyme errors ($p=.544$, $t=-.66$).

2. There was no statistically significant difference between biofeedback and averaged no treatments on the mean number of correct detections ($p=.862$, $t=-.19$), subject errors ($p=.692$, $t=.43$), category errors ($p=.584$, $t=-1.83$), and rhyme errors ($p=.223$, $t=-1.44$).

3. There was no statistically significant difference between stimulant drug and biofeedback treatment on the mean number of correct detections ($p=.690$, $t=.46$), subject errors ($p=.629$, $t=.52$), category errors ($p=.142$, $t=-1.83$), and rhyme errors ($p=.305$, $t=1.18$).

The rate of change between adjacent phases for individual subjects was analyzed using a test of correlated proportions. The raw data for individual subjects is available in Appendix G. The cases when a statistically significant difference occurred between experimental phases is presented in Table 12.

It is evident from Table 12's data that two subjects experienced adjacent significant changes. Subject 1 showed a significant decrease in correct detections during biofeedback treatment. Subject 3 increased his subject and rhyme error rates during the same treatment.

Additional Analysis. In order to better analyze the relationship between recognition memory variables the data was converted into percent of the total response. The converted data is presented in Table 13.

TABLE 12
Recognition Memory Task: Significant Differences of Performance Rate for Individual Subjects Between Drug (B), Biofeedback (C) and No Treatment (A) Phases

Subjects	Treatment Phases A[1]-B	B-A[2]	A[2]-C	C-A[3]
Subject Errors				
1				
2				
3		$p<.05$ $z=2.0$	$p<.05$ $z=2.0$	
4				
5			$p<.05$ $z=2.0$	
Rhyme Errors				
1				
2	$p<.05$ $z=2.0$			
3		$p<.05$ $z=2.24$	$p<.05$ $z=2.0$	$p<.05$ $z=2.0$
4				
5		$p<.05$ $z=2.0$		
Category Errors				
1				
2			$p<.05$ $z=2.0$	
3	$p<.05$ $z=2.0$			
4				
5		$p<.05$ $z=2.0$		
Correct Detections				
1			$p<.05$ $z=2.0$	$p<.05$ $z=2.24$
2		$p<.05$ $z=2.0$		
3				
4	$p<.05$ $z=2.0$			
5				

TABLE 13

Percent of Memory Response Type by Treatment Phase

	Treatment Phase				
Response Type	A[1]	B	A[2]	C	A[3]
Subject Errors	23	27.5	22	25.5	28.5
Rhyme Errors	19	14.5	15	13	13
Category Errors	15	12	17	17	14
Correct Detect.	43	46	46	44.5	44.5

A weak, but interesting trend evident in Table 13 is that the percentage of subject errors tends to increase under treatment conditions. The expectations were that treatments would have no effect on error rate or would reduce the rate. A review of individual responses shows that four subjects generally followed this trend with two exceptions. Subject 2 decreased in subject associate errors by one in phase C and subject 5 showed no change in this error type from phase A[1] to B.

Locus of Control Task. This task requires the subjects to give a "yes" or "no" response to forty questions (Nowicki and Strickland, 1973). The variable of interest is the number of external responses. The group mean of external responses is presented in Table 14. Additional data is available in Appendix G.

TABLE 14

Locus of Control Task: Correlated t-test Results of Drug (B), Biofeedback (C) and No Treatment (A) Comparisons of Mean External Responses (N=5)

Condition	Mean	Difference S.D.	t-value	2-tail probability
A[2]	17.0			
B	20.2	2.78	2.58	.061
C	11.8	5.36	2.17	.096
B-C		5.42	3.47	.026

A visual inspection of the data (Appendix G) shows that all subjects reduced their external responses from the drug treatment to the biofeedback phases. The bulk of the change (34.1%) occurred between the no treatment and biofeedback phases. Individual subject performance in terms of percentage change between conditions is presented in Table 15.

TABLE 15

Percent Change Between Phases in External Responses on the Nowicki-Strickland Scale by Subject

Subject	Drug-Biofeedback	Drug-No Treatment	No Treatment-Biofeedback
1	- 72.7	- 9.1	- 70.0
2	- 52.2	- 26.1	- 35.3
3	- 29.4	- 23.5	- 7.7
4	- 17.6	+ 5.9	- 22.2
5	- 50.0	- 22.9	- 35.3

It is clear in Table 15 that three subjects, 1, 2 and 5, were responsible for most of the difference between drug and biofeedback conditions. Subjects 1 and 4 demonstrated the most dramatic change from no treatment to biofeedback, when compared to their other treatment phases. Subject 3 showed the greatest change between drug and no treatment with only a slight change from no treatment to the biofeedback condition. For subjects 2 and 5 the percent of change between adjacent phases was relatively equal.

Fifty-two percent of the change between drug and biofeedback treatments was accounted for by the factors identified by Wolf et al. (1982). A change in answers attributed to a personal control/helplessness factor accounted for thirty-three percent of the decrease in external responses. The factors of luck and achievement/friendship contributed 9.5 percent apiece to the total change (Appendix G). Within the identified factors there was no clear performance pattern. However, two subjects, 1 and 5, displayed large changes on the personal control/helplessness factor. In the biofeedback condition subject 1 decreased these external responses by eighty percent and in the no treatment phase subject 5 decreased external responses by seventy-one percent.

The following hypothetical results are obtained from the correlated t-test.

1. There was no statistically significant change in measured locus of control between stimulant drug and no treatment ($p=.061$, $t=.258$).

2. There was no statistically significant change in

measured locus of control between biofeedback and no treatment (p=.096, t=2.17).

3. There was no statistically significant change in measured locus of control between stimulant drug and biofeedback treatment (p=.026, t=3.47).

Conclusion. This experiment generated several significant group results which confirm and clarify the effects of stimulant drug and biofeedback treatments on attention. In the case of sustained attention both treatments affected the number of false alarms made on a conventional continuous performance task. On a second continuous performance task which used highly meaningful material neither treatment had a significant effect. The performance difference between the two tasks requires careful consideration, since the second task approximates classroom expectations while the first may have little relevance to a school setting. Effects on selective attention, as measured by the dichotic listening tasks, were confined to the biofeedback treatment. This treatment significiantly altered the number of intrusion errors made on both dichotic tasks. It also significantly changed the number of false alarms made during the first task. The change in false alarms was also the only instance where a significant difference was noted between the two treatments. This result has implications for the issue of treatment selection and needs a detailed discussion.

The recognition memory performance of the subjects was not significantly changed by either treatment. There was a tendency for subject errors to increase in the drug and biofeedback conditions. This increase was an unexpected finding that merits discussion since it may indicate some treatment effects on memory retrieval.

The experiment also failed to note any significant treatment effects on measured locus of control. However, the performance of one subject suggests that biofeedback treatment may have altered his measured control orientation. This result deserves some disucssion due to the implications a change in control attribution has for general behavioral performance.

Few significant treatment effects were identified for subjects in the individual case. Some subjects demonstrated effects within a given experimental task and two subjects showed some consistent changes across experimental tasks. This trend in the single case requires careful analysis for two reasons. First, the noted effects may offer insights into treatment selection for individuals. Secondly, due to the available data and the nature of the median regression line important differences may not have been identified by the statistical test. Instances when false negatives may have occurred must be presented in order to offer a valid picture of treatment affects in the single case.

CHAPTER V

DISCUSSION OF RESULTS

Introduction. The purpose of this experiment was to test whether stimulant drug and biofeedback treatments affected specific behaviors of children diagnosed as attention disordered with hyperactivity. The behaviors of experimental concern were auditory, attention, and recognition memory, and measured locus of control. The answers to these questions must be viewed conservatively because of the design limits of the experiment, and the paucity of reliable and valid statistical tests for the single case.

The results of any experiment should also generate secondary questions. In this experiment these issues revolve around the manner in which the treatments affected the subjects' performance. The answers to these questions are of necessity hypothetical, and could become the subject of future experimentation. The discussion in this chapter will be guided by the statistically significant individual and group results, and by data trends which merit presentation.

This chapter is divided into three parts. The initial discussion focuses on the relationship between the major experimental areas and the subjects' performance. The next section presents the treatment and theoretical implications of the results for children diagnosed as Attention Deficit Disordered with Hyperactivity. The conclusion will offer a final summary of the experiment.

Attention. The results of this experiment show that both drug and biofeedback treatments had significant effects on the attention of the experimental subjects. The results also demonstrate that of the two treatments, biofeedback was the more potent in the production of change. The treatments also produced significant change in the individual case.

The experimental tasks were designed to measure treatment effects on several aspects of attention as applied to attention-disordered and hyperactive children. These children are described as being deficient in their ability to sustain their attention (Peters and Douglas, 1979), unable to ignore irrelevant stimuli (Ross and Ross, 1976) and inefficient in switching attention (Dykman, 1976). The continuous performance tasks were designed to measure whether treatments affected the subjects' sustained attention (correct detections) and response to irrelevant stimuli (false alarms).

These tasks involved two conditions. Continuous Performance Task I (CPT I) was intended to be uninteresting and fatiguing, thereby creating a situation where the subjects could be easily distracted by extraneous stimuli. The second Continuous Performance Task (CPT II) embedded the target in a story offering the subjects an interesting but immaterial distraction.

The dichotic listening tasks (DLT I, DLT II) were constructed to measure whether treatments influenced the subjects' ability to focus their attention on a single information channel (correct detections), and inhibit responding to irrelevant messages from the same source (false alarms) and from a different channel (intrusions). The second dichotic task (DLT II) required that the subjects shift the focus of their attention to the instruction of a randomly distributed tone. This latter task was assumed to approximate a natural selective listening situation.

The results of this experiment confirm that neither treatment significantly affected the subjects' ability to focus their attention as measured by correct detections. This finding is consistent with previous research which noted that drug treatment did not increase correct detections (Conners and Delamater, 1980; Dykman, Ackerman and McCray, 1980; Werry, et al., 1980). However, there was a trend on this variable for drug treatment to result in improved performance on CPT I (p=.036). The post hoc analysis for CPT I and DLT I yielded no significant differences between drug treatment and adjacent no treatment phases for this variable. The expectation would be for some significant differences to occur between adjacent phases if the increase in correct detections was a strong trend.

On the single subject level significant differences in the correct detection rate were noted. However, the results were the opposite of what would be expected. Over time on continuous performance tasks it was expected that the rate of accurate target identification would decrease and false alarms increase. No change in performance rate on dichotic tasks would be expected because of to the brief duration of the activity. Peters and Douglas (1979) also suggest that the main effect of drug treatment is to improve significantly the decrement rate. Yet, on neither task did treatments significantly improve this rate. During CPT I drug treatment significantly increasd the decrement rate for subject 2 as did biofeedback for subjects 1, 2 and 5. On CPT II biofeedback significantly increased the decrement rate for subject 1.

There are several possible explanations for this phenomenon. The most plausible lie in the construction of the tasks. The traditional performance decrement is described by a rapid decrease in correct detections followed by a steady state level. The performance of the experimental subject did not show this expected plateau (see Appendix G) perhaps because of the tasks' duration. Therefore, a meaningful analysis of the subjects' performance is not possible. A second likelihood is that the decrement reported in the literature is a group phenomenon and individual performance is simply unpredictable (Jerrison, 1970). A third possibility is that treatments, particularly biofeedback, somehow interfere with the subjects' ability to focus their attention. However, this contingency is unlikely given the false alarm and intrusion data which we have considered.

The data on false alarms and intrusions suggests that biofeedback has a more powerful effect on the inhibition of responses to distracting stimuli than does drug treatment. In terms of false alarms drug treatment produced a significant change during CPT I (p=.009). Biofeedback significantly altered false alarms during CPT I (p=.005), DLT I (p=.003) and was significantly different from drug treatment during DLT I (p=.004). The post hoc analysis of adjacent phases identified two significant changes; A[2] - C (p.<.01) during CPT I and C - A[3] (p.<.01) during CPT II. In both cases the biofeedback level was lower than no treatment. The difference noted during CPT II gives some credence to a possible (p=.044) biofeedback effect on false alarms. Of the two treatments only biofeedback had a significant effect on intrusions: DLT I (p=.008) and DLT II (p=.003).

In terms of the single subject data only subjects 1, 2 and 4 demonstrated the critical pattern of adjacent significant changes. The significant single subject effects were confined to the false alarm variable. Subject 1 had an increase in the false alarm rate during CPT I and a decrease during CPT II, both associated with biofeedback treatment. Biofeedback also decreased the false alarm rate for subject 2 during CPT I, and for subject 4 during DLT I. Drug treatment reduced this rate for subject 4 during DLT I and increased it for subject 1 during CPT II.

The absence of any clear treatment effect for CPT II was noted. This task was designed to simulate a classroom-type activity: the performance of an uninteresting task while ignoring highly interesting material. A possible explanation for the lack of treatment effect is that the activity was not a valid test: more specifically, that no treatment would exert any influence on the detection of an indefinite article in the context of a listening selection. It is impossible to rule out the possibility, but there are trends that argue for some treatment effect. The first is that four of the five subjects experienced large reductions in the false alarm level during the biofeedback phase and for one subject it was a significant reduction. Another factor is that there was a signficant difference between the biofeedback and the last no treatment conditions. These trends would most likely not be present if the activity was too rigorous a test of the subjects' attention. The more likely possiblity is that for this extremely demanding task the treatment influence is weak.

The data clearly demonstrates that the treatments affected attention, but the secondary question remains: how was the change achieved and why was biofeedback so effective. The last question is especially puzzling since the action of both treatments is to increase activation of the autonomic nervous system (Danish and Yaffe, 1979; Snyder, 1980; Stoyva, 1979). Fewer treatment differences would be expected for equivalent treatments.

The statistical data from the two continuous performance tasks indicates that the two treatments had similar results. Each treatment resulted in the subjects being better able to focus their attention. This is shown by the false alarm results and treatment effects on the relationship between correct detections and false alarms. In the latter case it is plausible to assume that inattention would be reflected by the number of false alarms and correct detections approaching each other. Directed attention in turn would be implied by the two variables being further apart. For these two tasks the latter situation was obtained. During CPT I the averaged percent difference between correct detections and false alarms for no treatments was 65.6 while for drug treatment it was 80.1 and for biofeedback, 87.1. On CPT II, the percent differences were averaged no treatments = 13.6, drug treatment = 21.8 and biofeedback treatment = 38.8. A slight but interesting trend is the larger difference noted for biofeedback treatment.

A review of the treatment differences shows a tendency for the drug treatment performance to be characterized by a high response rate (see Tables 1 and 4). This response style results in a large number of hits and also of false alarms. The biofeedback performance produced fewer hits, but also fewer false alarms. A strategy difference is also suggested by the data in Table 3. The large differences in impulsive and random errors imply that in the biofeedback condition the subjects may have employed a more conservative decision making criterion. The no treatment false alarm and correct detection pattern noted above was also evident during the first dichotic task. The no treatment phases were less stable and the tendency was towards a less discriminating response style.

It is not clear why this trend should occur. Neither task had a response cost design which would encourage one style over another. Outside of the time difference the two testing situations were reasonably equivalent, and the case notes reveal no information implying a change in subject motivation. While it is possible that time or history produced the difference it is unlikely. The performance of the subjects during the no treatment conditions was relatively stable, the major exception being the CPT II A[3] phase. In this instance, the subjects seemed to employ a free response style where hits and false alarms were almost equivalent. Rather than showing greater discrimination over time, the subjects became less discriminating.

The reasons why the treatments should result in different response patterns is not evident from the data. However, speculation could take the following lines: the biofeedback pattern indicates a tendency towards reduced risk taking. If one of the consequences of biofeedback is an increase in a sense of personal control, this might be reflected by a conservative response style. Very limited support for this possibility comes from the locus of control data. Subject 1 who demonstrated the largest reduction in external responses, indicating an increase in personal causal attribution, consistently demonstrated the identified pattern: a liberal response style during drug treatment and a conservative style during biofeedback.

A second speculative possibility is that biofeedback somehow slows the subjects' reaction time more than drug treatment, thus allowing the subjects more time to discriminate between stimuli. This is perhaps a more plausible hypothesis, since effective biofeedback treatment induces a state of physiological relaxation. In a relaxed state the subjects would be inclined toward less impulsive responses. Unfortunately, the measures used in this experiment are too crude to detect variations in reaction times, so this possibility remains unsupported.

The subjects' performance on DLT II points to a dramatic difference between the two treatments. Namely, that biofeedback seems to produce a more flexible attentional state than drug treatment. The initial assumption was that difficulties with shifting attention would be noted by target omissions after the switching tone. However, throughout this experiment, changes in correct detections have not been a reliable measure of attentional changes. It is shown in Table 10 that treatments had little effect on this factor. A more sensitive measure of attention switching would appear to be the level of intrusion errors. Simply put, if attention is not effectively reallocated to a new channel, one would expect a high level of intrusions. If the switching requirement does place an extra burden on the allocation of attention, differences should also be noted between the two dichotic tasks.

An analysis of performance between the two dichotic tasks shows that during drug treatment, there was a decrease in correct detections and surprisingly in false alarms. However, there was a sizable increase in intrusions. A one-tailed, correlated t-test found the difference in intrustions to be significant ($p.<.025$, $t=3.52$). While not reaching the experimental alpha level, the significance level creates a strong supposition that attention switching increased the number of intrusions. Yet, this was the only remarkable difference of the five comparisons. The average no treatment levels were fairly consistent, as was the biofeedback phase, but with a slight worsening of performance in DLT II, a situation which would be expected with an increased attentional load. The inference as to why B phase intrusions increased between tasks is that in some way drug treatment does not facilitate the efficient switching of attention. This phenomenon has also been noted in other research (Hiscock et al., 1979; Lubar and Shouse, 1979a, 1979b).

The reasons why this situation should occur are a puzzle. If the answer is that it simply took more time to shift attention during drug treatment, a difference in the location of errors would be expected. However, the intrusion errors were generally evenly distributed, with a simple majority occurring in the final half of the task. There was also no evidence from the false alarm variable that there was a delay in switching time. Finally, the correct detection of digits after the tone argues against a time lag in the shift of attention. The earlier suggestion that biofeedback slows reaction time also fails to explain the difference, for the same reasons.

The possibility that the drug treatment performance was an experimental anomoly cannot be eliminated. However, the fact that it occurred in another dichotic listening experiment casts doubt on this as a plausible explanation (Hiscock, et al., 1979).

We are basically left with the phenomenon that for some reason drug treatment does not facilitate the efficient reallocation of attention while biofeedback does. Both treatments apparently have the same physiological effect, and on static attention both tasks produce similar results. Somehow biofeedback seems to produce a fluid state where attention can be easily reallocated according to task demands. Drug treatment seems to produce a focused attention that does not easily reorient itself to changes in demand.

Recognition Memory. The results of the recognition memory task demonstrate that neither treatment had a significant group effect. Significant single subject patterns were confined to biofeedback treatment. Subject 1 decreased the correct detection rate. Subject 3 increased the subject and rhyme error rates.

The intent behind this task was purely exploratory since nothing is known about treatment effects on recognition memory. The design of the task, study-test and forced choice simulated actual classroom expectations. The performance expectation was that the target and foil relationship would be constant, the target and subject error levels being higher than category and rhyme errors.

The lack of significant differences indicates that treatments simply do not have powerful consequences for the memory performance of the subjects. The absence of treatment improvement could have been obtained if the subjects' memory performance was at its optimum level. However, this is impossible to determine given the current data.

The data did reveal an interesting trend during the treatment conditions. The percent of subject errors tended to increase during treatment. While admitedly a marginal effect, particularly given the A[3] level (see Table 13), it offers some insight into possible treatment action.

The initial analysis of the subject associates failed to note any obvious patterns that could account for this trend.

The subjects' associates were analyzed along the syntagmatic-paradigmatic dimension (Entwistle, 1966). Paradigmatic means subject associates are from the same class of speech as the target, syntagmatic means from a different class. While the subjects made more subject errors when the word was from the same class of speech as the target, the ratio of paradigmatic and syntagmatic associates errors was roughly equivalent across phases. An ancillary finding was that the experimental subjects produced approximately the same ratio between syntagmatic and paradigmatic associates to targets for their grade level as that found by Entwistle (1966) in her subjects.

Subject errors were also grouped by type of category membership: subordinate, basic and superordinate (Mervis, 1980). However, the errors between type maintained a roughly equivalent ratio across treatment conditions and revealed no trends.

A possible explanation for the increase in subject errors is implied by Collins' and Loftus' (1975) theory of semantic memory. The authors hypothesize that semantic memory is organized along the lines of a network. Concepts (nodes) are linked together by various pathways. Activation of one node causes adjacent nodes to be stimulated. The strength of the activation is diminished by time and space. Linking this theory with the action of the treatments that is, an increase in arousal (Snyder, 1980; Stoyva, 1979) the following scenario may be offered: subject associate nodes exist in close proximity to target nodes. Any time a target is activated the associate receives some degree of stimulation. Consequently, a likelihood exists that associates could be confused with targets on a recognition test. The effect of the treatment is to increase the activation of the system. The strength of the linked nodes is increased so when a target is activated the probability is increased that it will be confused with a strong associate. There is no further supporting evidence for this position so it must remain speculative.

Locus of Control. The results of this task indicate that neither treatment has an effect on measured locus of control. However the design of this task makes the experimental results particularly susceptible to the effects of measurement, history and maturation.

There are two performance patterns which increase the probability that the experimental results are due to treatment rather than to extraneous factors. The first is when the A[2] phase shows a large (at least 50%) difference from phases B and C. The second is a functional equivalency between no treatment and one treatment phase, while the other treatemnt phase shows a large difference.

Among the subjects, only subject 1 demonstrated a large change between biofeedback and the other two measurement phases. This subject's external responses decreased by 70 percent during the biofeedback phase (see Table 15). A test of correlated proportions found the difference to be significant (p=.002; z=2.82).

It would be difficult to ascribe this change to maturation since only four weeks separated the adjacent phases. The effects of history are harder to dismiss. However, measured by the Coddington scale, the subject had few life change events during the experiment. A review of the case notes indicated no observed or reported events which would influence this variable. Measurement effects are equally difficult to dismiss. However, the magnitude of the change argues against measurement being totally responsible. The stability of the first two phases would not be expected if the subject was simply reacting to the measurement. Also, regression to the mean for this subject doesn't seem to be operating, given his performance pattern.

If it is plausible to ascribe the change to biofeedback treatment, the question becomes how this occurred. The Nowicki-Strickland scale (1973) is designed to measure childrens' beliefs concerning control over life events. A high external answer rate implies a belief that outside forces control one's life while a high internal score implies personal control. Of the known factors, subject 1 showed large decreases in external responses on the personal control (80%) and achievement/friendship (100%) factors (see Appendix G). These changes suggest the effect of biofeedback treatment was to increase the subject's belief that he was in control of life events. Since the effect of biofeedback training is to teach an individual to control his own physiological responses the effect on locus of control is not surprising. The possible biofeedback consequences on measured locus of control for subject 1 is also consistent with other research (Omizo, 1980; Omizo and Williams, 1981).

Single Subjects. The absence of consistently significant treatment effects on individual subjects is of some concern. If the findings from this experiment are accurate it would imply that neither treatment has a general effect within individuals. Rather, the noted effects are confined to the group case. The other possibility is that the analysis technique was not sensitive to all treatment induced changes.

This latter possibility deserves some consideration. For treatment effects to be claimed the experimental requirement was for adjacent significant changes. This requirement was necessary in order to establish confidence in treatment results. However, in some cases this was too restrictive, most notably when adjacent median regression lines had an O slope. In this situation the data analysis was not sensitive to a change in level alone. For example, if a subject had no false alarms on one phase and the next made twelve during each of the ten time intervals no significant difference would be noted. The essential requirement of change over time was not present even though the difference is clearly significant. This situation may have posed a particular problem during the dichotic tasks due to their brief duration. The time may have been too short to establish a reliable progress rate. Taking the above into account the individual analysis will be supplemented by an additional procedure. In this case treatments will be considered to have an important effect if the level of difference between adjacent zero slopes exceeds fifty percent (see Appendix G).

Given the above modification the effects of the treatments on individual subjects were mixed. However there were some possible patterns which should be considered. Subject 3's profile indicates that drug treatment tended to facilitate his attentional behavior. Drug treatment improved his performance on three of the false alarm variables. Biofeedback treatment improved performance on one false alarm variable and interfered on another. On the memory task biofeedback increased his student and rhyme errors. Subject 5 behaved in a similar fashion. Drug treatment seemed to generally facilitate her performance. The major exception was DLT I where biofeedback had a superior effect on false alarms. Subjects 3 and 5 also share a common factor. Over the experimental period they both experienced the largest number of life changes. On the Coddington Scale (1971) they had respectively 98 and 95 life change units. The average for the rest of the group was 21. The implication is that for subjects experienceing a high level of recent change drug treatment facilitates their ability to focus attention.

This effect is not surprising if it is assumed that change induces stress, and that stress seems to result in the narrowing of attentional focus (Easterbrook, 1959). The medication would tend to increase the focus of attention even further. If this is the case we would expect to see an increase for these subjects on DLT II intrusions. In fact Subject 3 increased both level and rate and subject 5 increased in level during the drug treatment phase. They were the only subjects to show an increase on this variable for drug treatment. Both in turn experienced reductions of intrusions during biofeedback treatment. This trend should not be taken as evidence that stimulant therapy is indicated for children under stress. Acute stress is actually a contraindication for stimulant drug treatment (P.D.R., 1983). An argument could be validly made that biofeedback treatment would be prefered. Overfocused attention is maladaptive and interferes with normal functioning. Biofeedback treatment seems to produce a fluid but adequately focused attention state, the result being more adaptive attention.

A second visible pattern was the apparent biofeedback induced interference on sustained attention. As was discussed earlier the correct detection change may be a task artifact or indicative of a difference in response strategy. In the cases of subjects 1, 2 and 5, the reduction in correct detections was accompanied by a large, but not significant, decrease in the false alarm levels, a pattern which reflects the suggested strategy change.

Neither subjects 3 or 4 consistently demonstrated a conservative response style during the biofeedback condition, and a liberal style during drug treatment. Their individual profiles tended to be mixed. There were no identified individual characteristics which offer any insights into the noted performance difference. If biofeedback induces a change in response style its effects are not found within all individuals. The experimental data does indicate that this was a consequence for three subjects so it cannot be easily dismissed as an artifact.

With the exception of one subject none of the individuals showed an experimentally significant effect on intrusions for DLT II. This was a surprising finding given the noted group results. One possible explanation for the lack of significance is the already mentioned measurement limitation. Simply, the task duration and number of data points did not produce a sufficiently stable line for confident comparisons. The other possibility is that such a trend exists but in the individual case it is not dramatic.

An inspection of the data (Table 8, Appendix G) shows that there was a large reduction in intrusion errors for biofeedback (54.1%) and much less for drug treatment (18.4%), with each individual showing a biofeedback superiority.

When the two dichotic tasks are compared there is only a slight difference for biofeedback performance on intrusions. However, the difference on the variable during drug treatment from DLT I to DLT II is 33.4 percent. Once again each individual experienced a substantial increase in intrusions from DLT I to DLT II during drug treatment. An interesting, but inexplicable finding, was that the two subjects (4 and 5) who produced the greatest increase in drug treatment intrusions were both treated with EMG biofeedback. The EMG treatment was selected since their physiological reaction to events was expressed more strongly through muscular rather than thermal action.

A second associated pattern is the subjects' false alarm performance on the two dichotic tasks. With the exception of subject 5, both treatments reduced the false alarms of each subject during DLT I. Subject 1 experienced large reductions in level but not a significant reduction in rate. During DLT II, drug treatment produced the more potent reduction in false alarms, with the exception of subject 1. The reduction was significantly different for three subjects, and with subject 4 showing a large (88.3%) reduction in level but not slope. Again with the exception of subject 1, biofeedback produced little change in either level or slope for false alarms.

The trend is vague yet it does show that during drug treatment four individuals increased their focused attention, but at the cost of more intrusion errors.

Biofeedback reduced the intrusion level for all subjects but also at a cost. Subjects 1, 2, and 4 experienced reductions in correct detections and for subjects 2, 3 and 5 there was no change in false alarms from the preceding no treatment phase. The two DLT II patterns imply a possible difference in attentional strategy. The addition of a switching tone increased the attentional demands on the subjects. During drug treatment the subjects focused their attention on the identification aspect of the task, tending to ignore the second but equally important task of inhibiting responses to intrusions. During biofeedback the subjects seemed to distribute their attention across all task aspects. This possible strategy difference may imply why there were few significant individual differences in intrusions for biofeedback treatment. Attention is theorized to be a limited capacity system where the amount of attention is constant but its distribution may vary (Kahnemann, 1973); the broad distribution of attention resulted in a reliable but not individually dramatic reduction in intrusions. Once again, the reason why biofeedback should alter attentional strategy is obscure. The response homogeneity present during drug treatment is not present for biofeedback, leaving the rather weak conclusion that biofeedback effects on selective attention are individually specific, tending to produce a broad distribution of attentional resources.

While the trends in the data are interesting, their reliability is limited. A more conservative interpretation of the single subject results indicates a rough equivalency between treatments.

The recognition memory performance of individuals shows that biofeedback was the only treatment which produced significant differences (see Table 12, Appendix G). For subject 3, it stimulated subject and rhyme errors; for subject 5 it decreased the category and rhyme error levels. Effects for subject 1 were mixed showing an increase in correct detections and category errors. There are no consistent patterns between individuals or within the individual subjects which would shed light on this difference. The semantic network theory, presented earlier, doesn't offer a useful explanation. It would only suggest that biofeedback treatment alters the activation level between targets and types of associate. Individual subject characteristics are equally unenlightening. The conclusion that can be derived from these results is that biofeedback affects the recognition memory of subjects in an idiosyncratic fashion.

Implications. The results of this study have implications both for treatment and for future research. The implications for treatment must be considered with caution given the design limits. On the other hand, possible future research is guided by the same limits.

The basic question to be addressed about any treatment is whether it does any harm, and if so, do the benefits outweigh the undersirable results. On the group level there was no evidence that either treatment significantly worsened the subjects' attention, memory or locus of control. However, there were three trends which cause concern and require further research. The first is the significant decrement in performance noted during the continuous performance tasks. Further research is required to confirm whether this was a design artifact or treatment induced. The nature of this research should be relevant to a classroom situation, perhaps involving the tracking of a significant story line or character. The second item of concern was the drug treatment effect on intrusions. The medication seemed to act in a manner that did not facilitate the switching of attention. If DLT II is considered a valid measure of selective attention, this raises the question of how useful drug treatment is for performance on selective attention tasks. In the light of classroom academic expectatons, this becomes a serious issue since success in school depends on effective selective attention. Further research on this drug effect could also answer a major question surrounding drug treatment. Why is there no evidence of substantive academic improvement attendant on successful drug treatment? Researchers should focus on the reading process and the movement of attention between visual and auditory modes. The final point of concern is the effect of treatments on subject errors on the recognitions memory task. This is of interest because of possible instructional implications. If subjects under treatment tend to store and retrieve material from memory according to personal association, then instruction should be individualized. For example the use of a language experience reading approach. However, research is needed to establish whether treatments do in fact produce this effect. Memory research should also expand into recall and story comprehension effects in order further to explore treatment effects on memory.

The individual analysis also revealed no consistently undesirable treatment effects. The treatments interfered with performance on at least one variable for each subject. However, there was no consistent pattern between or within individuals.

Since the treatments had no noted untoward effects, did they result in a benefit to the subjects? The group data indicates that the improvements generated by both treatments were confined to the attention variables. Both treatments facilitated the subjects' performance on a sustained attention task while only biofeedback improved attention on selective attention tasks. The conservative experimental alpha level helps to establish that the noted differences are real. However, the evidence is not strong enough to warrant the conclusion that biofeedback is a generally superior treatment for attentional disordered and hyperactive children. This caution is merited not only by the issues surrounding the internal validity of the experiment but also by the single subject behavior. In fact, in the latter case drug treatment offers the illusion of greater benefit for children in the throes of many life changes. The findings of this experiment require extensive validation before comparisons may be made with confidence. In particular, the selective attention results require substantiation by research across settings, experimenters and measures of the variable. A particular focus of future research should be the use of ecologically valid settings and measures. The absence of strong treatment effects on CPT II is a cause for some worry. Intuitively, I feel that this task was the most consistent with the expectations placed on children in school. The implication of this result is that neither treatment may facilitate classroom sustained attention. The future research on this variable must be extensive and well controlled, since an improvement in classroom sustained attention is a major treatment expectation.

The results of this experiment also raise some interesting theoretical issues. Biofeedback treatment seems to work by improving the subjects' ability to inhibit response under conditions of sustained and selective attention. However, is this due to improved decision making criteria or through attenuation of distracting material? Future research could test this question by studying peripheral attention mechanisms, in particular, eye movement patterns. The issue would be whether under biofeedback treatment, attention is directed towards distracting material without response or whether it is ignored. The data from this experiment implies the former condition may be the case.

Finally, the effects of biofeedback on measured locus of control also deserve further investigation. Previous research (Omizo, 1980; Omizo and Michael, 1982) has noted both a generalized and a limited effect. The results of this research suggest that the effect may be a function of measured intelligence. Thus biofeedback induced attribution changes may be confined only to a subgroup of the attentional disordered and hyperactive population. This variable should also be studied using a variety of technique, perhaps including structured classroom activities.

Summary

Within the limits imposed by this experiment, it is possible to conclude that biofeedback treatment has a significant effect on the auditory sustained and selective attention of the experimental population. The effects of drug treatment are confined to auditory sustained attention. Treatment effects on sustained attention were confined to a laboratory type task and did not extend to a task simulating classroom performance. Performance on the selective attention tasks showed that biofeedback facilitated the subjects' ability to focus and switch attention on dichotic listening tasks. The single subject results did not clearly confirm the relative superiority of biofeedback treatment. Consequently, the importance of the group results is primarily for the guidance of future research.

The single subject results indicate that both treatments helped the subjects control their attention. There was an indication that drug treatment exerts a more powerful focusing of attention in subjects experiencing significant life changes. However, this effect may contraindicate drug treatment since rigid attention is not adaptive. For the confident guidance of treatment selection these trends require further confirmation.

There were no significant group effects on auditory recognition memory or measured locus of control. Significant individual effects were too few to admit the drawing of any conclusions.

In summary the value of this experiment was that it confirmed that biofeedback did affect the auditory attention of the experimental subjects. The generality of the finding needs to be established by further research. However, it does establish an effect where before none was known.

SELECTED BIBLIOGRAPHY

Aarskog, D., et al. The effect of the stimulant drugs, dextroamphetamine and methylphenidate on secretion of growth hormone in hyperactive children. Journal of Pedicatrics, 1977, 90, 136-139.

Alexander, A., French, C.A. & Goodman, N.J. A comparison of auditory and visual feedback in biofeedback assisted relaxation training. Psychophysiology, 1975, 12, 119-123.

Aman, M.G., & Werry, J.S. Methylphenidate in children: effects upon cardiorespiratory function on exertion. International Journal of Mental Health, 1975, 4, 119-131.

Arnold, L., et al. Levoamphetamine and dextroamphetamine: comparative efficacy in the hyperactive syndrome. Archives of General Psychiatry, 1972, 27, 816-822.

Baddeley, A.D. The psychology of memory. New York: Basic Books, 1976.

Barkley, R.A. Hyperactive Children. New York: The Guilford Press, 1981.

Barkley, R.A. The effects of methylphenidate on various types of activity level and attention in hyperkinetic children. Journal of Abnormal Child Psychology 1977, 5, 351-369.

Barkley, R.A., & Cunningham, C. Stimulant drugs and activity level in hyperactive children. American Journal of Orthopsychiatry, 1979, 49, 491-499.

Barkley, R.A., & Jackson, T.L., Jr. Hyperkinesis, autonomic nervous system activity and stimulant drug effects. Journal of Child Psychology and Psychiatry, 1977, 18, 347-357.

Barling, J. Maternal antecedents of children's multidimensional locus of control beliefs. Journal of Genetic Psychology, 1982, 140, 155-156.

Basmajian, J.V. Facts vs. myth in emg biofeedback. Biofeedback and self regulation, 1976, 1, 369-371.

Bassuk, E., & Schoonover, S.C. The practioners guide to psychoactive drugs. New York: Plenum Medical Book, 1978.

Beatty, J., & O'Hanlon, J.F. Operant control of posterior theta rhythms and vigilance performance: repeated treatments and transfer of training. In N. Birbaumer & H.D. Kimmel (eds.), Biofeedback and self regulation, Hillsdale, N.J.: Laurence Erlbaum Assoc., 1979.

Bernstein, J.E., Page, J.G. & Janicki, R. Some characteristics of children with minimal brain dysfunction. In C.K. Conners (Ed.), Clinical use of stimulant drugs in children. Amsterdam: Excerpta Medica, 1974.

Blume, J. Iggie's House. New York: Dell Publishing Co., 1970.

Boring, E.G. Attention: research and beliefs concerning the conception in scientific psychology before 1930. In D.E. Mostofsky (Ed.), Attention: contemporary theory and analysis. New York: Appleton-Century-Crofts, 1970.

Bhatara, V., et al. Muscle relaxation therapy in hyperkinesis: is it effective. Journal of Learning Disabilities, 1979, 12, 182-186.

Braud, L.W. The effects of frontal emg biofeedback and progressive relaxation upon hyperactivity and its behavioral concomitants. Biofeedback and self regulation, 1978, 3, 69-89.

Braud, L.W., Lupin, M.N., & Braud, W. The use of electromyographic biofeedback in the control of hyperactivity. Journal of Learning Disabilities, 1975, 8, 420-425.

Broadbent, D.E. Perception and communication. New York: Pergamon Press, 1958.

Broadbent, D.E. A mechanical model for human attention and immediate memory. Psychological Review, 1957, 9, 205-215.

Brown, R.T. A developmental analysis of visual and auditory sustained attention and reflection-impulsivity in hyperactive and normal children. Journal of Learning Disabilities, 15, 1982, 614-618.

Buchsbaum, M., & Wender, P. Averaged evoked responses in normal and minimally brain dysfunctioned children treated with amphetamine. Archives of General Psychiatry, 1973, 29, 764-770.

Bugental, D., et al. Causal attribution of hyperactive children and motivational assumptions of two behavior change approaches: evidence for an interactionist position. Child Development, 1977, 48, 874-884.

Cantwell, D.P., & Carlson, G.A. Stimulants. In J. Werry (Ed.) Pediatric psychopharmacology. New York: Brunner Mazel, 1978.

Carlson, J.G. Locus of control and frontal muscle action potential. In N. Birbaumer & H.D. Kimmel (Eds.), Biofeedback and self regulation. Hillsdale, N.J.: Laurence Erlbaum Assoc., 1979.

Carroll, J.B., Davies, P., & Richman, B. (Eds.). Word frequency book. New York: American Heritage, 1971.

Carter, J.L., & Russell, H. Biofeedback and academic attainment of id children. Academic Therapy, 1980, 15, 483-486.

Cherry, R.C. Development of selective auditory attention skills in children. Perceptual and Motor Skills, 1981, 52, 379-385.

Childress, R.N. The effectiveness of emg biofeedback training compared to ritalin (methylphenidate) in the management of hyperkinesis. (Doctoral dissertation, Texas Tech University, 1979). Dissertation Abstracts International, 1979, 40, 906B.

Coddington, R. The significance of life events as etiologic factors in the diseases of children. Journal of Psychosomatic Research, 1971, 16, 205-213.

Cohen, M.J., & Johnson, H.J. Relation between heart rate and muscular activity in a classical conditioning paradign. Journal of Experimental Psychology, 1971, 90, 222-226.

Collins, A.M. & Loftus, E.F. A spreading-activation theory of semantic processing. Psychological Review, 1975, 82, 407-428.

Collins, B., Whalen, C.K., & Henker, B. Ecological and pharmacological influences on behaviors in the classroom: the hyperkinetic behavioral syndrome. In S. Salzinger, J. Antrobus & J. Glick. The ecosystem of the "sick" child. New York: Academic Press, 1980.

Conners, C.K. Application of biofeedback to treatment of children. Journal of the American Academy of Child Psychiatry, 1979, 18, 143-153.

Conners, C.K. Psychotropic drug treatment of children. In J.G. Bernstein (Ed.). Clinical psychopharmacology. Littleton, Ma.: PSG Publishing, 1978.

Conners, C.K. (ed.). Clinical use of stimulant drugs in children. Amsterdam: Excerpta Medica, 1974.

Conners, C.K. Rating scales for use in drug studies with children, Psychopharmacology Bulletin (Special Issue: Pharmacotherapy of Children), 1973, 24-83.

Conners, C.K. Recent drug studies with hyperkinetic children. Journal of Learning Disabilities, 1971, 4, 12-19.

Conners, C.K. A teacher rating scale for use in drug studies with children. American Journal of Psychiatry, 1969, 126, 152-156.

Conners, C.K., & Delamater, A. Visual motor tracking by hyperkinetic children. Perceptual and Motor Skills, 1980, 51, 487-497.

Conners, C.K., & Rothschild, G. The effects of dextroamphatamine on habituation of peripheral vascular response in children. Journal of Abnormal Psychology, 1973, 1, 16-25.

Conrad, W.G., Dworkin, E.S., Shai, A., & Tobiessen, J.E. Effects of amphatamine therapy and prescriptive tutoring on the behavior and achievement of lower class hyperactive children. Journal of Learning Disabilities, 1971, 4, 509-517.

Cott, A. The role of sensorimotor rhythm feedback in the biofeedback treatment of epilepsy: a preliminary report. In N. Birbaumer & H.D. Kimmel (Eds.), Biofeedback and self regulation. Hillsdale, N.J.: Laurence Erlbaum Assoc., 1979.

Cramer, P. Idiodynamic sets as determinants of children's false recognition errors. Developmental Psychology, 1974, 10, 86-92.

Cramer, P. A developmental study of errors in memory.

Developmental Psychology, 1972, 7, 204-209.

Dalby, J.T. Hyperactive children's underuse of learning time: correction by stimulant treatment. Child Development, 1977, 48, 1448-1453.

Danish, M., & Yaffe, S.J. Psychopharmacology in childhood and adolesence. In E. Denhoff & L. Stern (Eds.). Minimal brain dysfunction: a developmental approach. New York: Masson, 1979.

Denckla, M.B., et al. Tics following methylphenidate administration. Journal of the American Medical Association, 1976, 235, 1349-1351.

Diagnostic and statistical manual of mental disorders (3rd ed.). Washington, D.C.: American Psychiatric Association, 1980.

Douglas, V.I. Differences between normal and hyperkinetic children. In C.K. Conners (Ed.). Clinical use of stimulant drugs in children. Amsterdam: Excerpta Medica, 1974.

Douglas, V.I. & Peters, K.G. Toward a clearer definition of the attentional deficit of hyperactive children. In G. A. Hale & M. Lewis (Eds.). Attention and cognitive development. New York: Plenum Press, 1979.

Doyle, A. Listening to distraction: a developmental study of selective attention. Journal of Experimental Child Psychology, 1973, 15, 100-115.

Doyle, R., Anderson, R. & Halcomb, P. Attention deficits and the effects of visual distraction. Journal of Learning Disabilities, 1976, 9, 48-54.

Duke, M.P. & Nowicki, S. Locus of control and achievement -- the confirmation of a theoretical expectation. Journal of Psychology, 1974, 87, 263-267.

Dunn, O.J. & Clark, V.A. Applied Statistics: Analysis of Variance and Regression. New York: J. Wiley & Sons, 1974.

Dykman, R. & Ackerman, P.T. The mbd problem: attention, intention and information processing. In R. Anderson & C. Halcomb (Eds.). Learning disability/minimal brain dysfunction syndrome. Springfield, Ill.: Charles C. Thomas, 1976.

Dykman, R. et al. Two blinded studies of the effects of stimulant drugs on children: pemoline, methylphenidate and placebo. In R. Anderson & C. Halcomb (Eds.). Learning disability/minimal brain dysfunction syndrome. Springfield, Ill.: Charles C. Thomas, 1976.

Dykman, R., Ackerman, P. & McCray, D.S. Effects of methylphenidate on selective and sustained attention in hyperactive, reading disabled, and presumably attention-disordered boys. Journal of Nervous and Mental Disease, 1980, 168, 745-752.

Dykman, R., McGrew, J. & Ackerman, P. A double-blind clinical study of pemoline in mbd children: comments on the usefulness of psychological tests. In C.K. Conners (Ed.). Clinical use of stimulant drugs in children. Amsterdam: Excerpta Medica, 1974.

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

Eaton, M. et al. Psychoactive medication and learning disabilities. Journal of Learning Disabilities, 1977, 10, 403-410.

Eliot, R. Differences in the motivational significance of heart rate and palmar conductance: two tests of a hypothesis. Journal of Personality and Social Psychology, 1970, 14, 211-228.

Entwistle, D.E. Word associations of young children. Baltimore: Johns Hopkins Press, 1966.

Ferguson, G.A. Statistical analysis in psychology and education (2nd ed.). New York: McGraw Hill, 1981.

Feldman, S., Denhoff, E. & Denhoff, J.I. The attention disorders and related syndromes: outcomes in adolescence and young adult life. In E. Denhoff & L. Stern (Eds.). Minimal brain dysfunction: a developmental approach. New York: Masson, 1979.

Finch, A.J., Pezzuti, K.A. & Nelson, W.M. Locus of control and academic achievement in emotionally disturbed children. Journal of Consulting and Clinical Psychology, 1975, 43, 103.

Firestone, P. & Douglas, V. The effects of reward and punishment on reaction times and autonomic activity in hyperactive and normal children. Journal of Abnormal

Child Psychology, 1975, 3, 201-216.

Firestone, P. Factors associated with children's adherence to stimulant medication. Toronto: Ontario Ministry of Health, 1980.

Fisher, M.A. Dextroamphatamine and placebo practice effects on selective attention in hyperactive children. Journal of Abnormal Child Psychology, 1978, 6, 25-32.

Flanagan, J. Galvanic skin response: emotion or attention. Proceedings of the American Psychological Association, 1967, 2, 7-8.

Flesh, R.F. A new readability yardstick. Journal of Applied Psychology, 1948, 32, 221-223.

Gaarder, K.R. & Montgomery, P.S. Clinical biofeedback: a procedural manual. Baltimore: Williams & Wilkins, 1977.

Gadow, K. Prevalence of drug treatment for hyperactivity and other childhood behavior disorders. In K. Gadow & J. Loney (Eds.). Psychosocial aspects of drug treatment for hyperactivity. Boulder, Col.: Westview Press, 1981.

Gadow, K.D. Effects of stimulant drugs on academic performance in hyperactive and learning disabled children. Jounral of Learning Disabilities, 1983, 16, 290-299.

Gale, A. & Lynn, R. A developmental study of attention. The British Journal of Educational Psychology, 1972, 42, 260-265.

Galejs, I. & Dsilva, C. Locus of control and achievement of Nigerian school-age children. Journal of Psychology, 1981, 109, 199-204.

Gargiulo, R.M., & Kuna, D.J. Arousal level and hyperkinesis: implications for biofeedback. Journal of Learning Disabilities, 1979, 12, 137-138.

Gittelman-Klein, R. Overview of clinical psychopharmacology in childhood disorders. In J.G. Bernstein (Ed.). Clinical psychopharmacology, Littleton, Ma.: PSG Publishing, 1978.

Gittleman-Klein, R. & Klein, D. Are behavioral and psychometric changes related in methylphenidate treated, hyperactive children. International Journal _of Mental Health_, 1975, _4_, 182-198.

Gopher, D. & Kahneman, D. Individual differences in attention and the prediction of flight criteria. _Perceptual and Motor Skills_, 1971, _33_, 1335-1342.

Gould, S.S. The effects of biofeedback training on the attention span of hyperactive, learning disabled children (Doctoral dissertation, University of New Mexico, 1978).
American Doctoral Dissertations, 1978, VXI (97), 529.

Goyer, P.F. Abuse of prescribed stimulant medication by a 13-year old hyperactive boy. _Journal of the American Academy of Child Psychiatry_, 1979, _18_, 170-175.

Grinspoon, L. & Singer, S. Amphetamines in the treatment of hyperkinetic children. _Harvard Education Review_, 1973, _43_, 515-555.

Haight, M.J., Irvine, A.B. & Jampolsky, G.G. _The response of hyperkinesis to emg biofeedback_. Paper presented at the annual meeting of the Biofeedback Research Society, Colorado Springs, Col., March, 1976.

Halpern, W.I. The medication clinic in the spectrum of children's services. _Diseases of the Nervous System_, 1977, _38_, 687-690.

Hampstead, W.J. The effects of emg-assisted relaxation training with hyperkinetic children: a behavioral alternative. _Biofeedback and Self Regulation_, 1979, _4_, 113-125.

Hastings, J.E. & Barkley, R. A review of psychophysiological research with hyperkinetic children. _Journal of Abnormal Child Psychology_, 1978, _6_, 413-447.

Haynes, S.N., Moseley, D. & McGowan, W.T. Relaxation training and biofeedback in the reduction of frontalis muscle tension. _Psychophysiology_, 1975, _12_, 547-552.

Heisel, J.S. Life changes as etiological factors in juvenile rheumatoid arthritis. _Journal of Psychosomatic Research_, 1972, _16_, 411.

Heisel, J.S., Ream, R.R., Rappaport, M. & Coddington, R.D. The significance of life events as contributing factors in the disease of children. _Behavioral Pediatrics_, 1973, _83_, 119-123.

Henker, B. & Whalen, C.K. the many messages of medication: hyperactive children's perceptions and attributions. In S. Salzinger, J. Antrobus & J. Glick (Eds.). The ecosystem of the "sick" child. New York: Academic Press, 1980.

Henker, B., Whalen, C.K. & Collins, B. Double-blind and triple-blind assessments of medication and placebo responses in hyperactive children. Journal of Abnormal Child Psychology, 1979, 7, 1-13.

Hersen, M. & Barlow, D.H. Single case experimental designs: stratagies for studying behavior change. New York: Pergamon Press, 1976.

Hiscock, B., Kinsbourne, M., Caplan, B. & Swanson, J. Auditory attention in hyperactive children: effects of stimulant medication on dichotic listening performance. Journal of Abnormal Psychology, 1979, 88, 27-32.

Hoy, E., Weiss, G., Mind, L. & Cohen, R. The hyperactive child at adolescence: cognitive, emotional and social functioning. Journal of Abnormal Child Psychology, 1978, 6, 311-324.

Huessy, H.R., Marshall, D.C. & Gendron, R.A. Five hundred children followed from grade 2 through grade 5 for the prevalence of behavior disorder. In C.K. Conners (Ed.). Clinical use of stimulant drugs in children. Amsterdam: Excerpta Medica, 1974.

Humphries, T. et al. Stimulant effects on persistance of motor performance of hyperactive children. Journal of Pediatric Psychology., 1979, 4, 55-66.

James, W. The Principles of Psychology, vol. 2. New York: Holt, 1890.

Jerison, H.J. Vigilance, discrimination, and attention. In D.I. Mostofsky (Ed.). Attention: contemporary theory and analysis. New York: Appleton-Century-Crofts, 1970.

Kahneman, D. Attention and effort, Englewood Cliffs, N.J.: Prentice-Hall, 1973.

Kahneman, D., Ben-Ishai, R. & Lotan, M. Relation of a test of attention to road accidents. Journal of Applied Psychology, 1973, 58, 113-115.

Kavale, K. The efficacy of stimulant drug treatment for hyperactivity: a meta-analysis. Journal of Learning Disabilities, May, 1982, 15, 280-289.

Kazdin, A.E. Statistical analysis for single-case experimental designs. In M. Hersen & D. Barlow. Single-case experimental designs: stratagies for studying behavior change. New York: Pergamon Press, 1976.

Kerlinger, F. Foundations of behavioral research (2nd ed.). New York: Holt, Rinehart and Winston, 1973.

Kiesler, D. Experimental designs in psychotherapy research. In A. Bergin and S. Garfield (Eds.). Handbook of psychotherapy and behavior change. New York: Wiley, 1971.

Kinsbourne, M. & Kaplan, P.J. Children's learning and attention problems. Boston: Little Brown, 1979.

Kinsbourne, M., Swanson, J. & Herman, D. Laboratory measurement of hyperactive children's response to stimulant medication. In E. Denhoff & L. Stern (Eds.). Minimal brain dysfunction: a developmental approach. New York: Masson Publishing USA, 1979.

Krause, T. Psychophysiological changes in hyperactive and normal children as a function of medication and biofeedback training (Doctoral dissertation, University of California, Irving, 1977). Dissertation Abstracts International, 1977, 38, 6219B.

Krippner, S. et al. Stimulant drugs and hyperkinesis: a question of diagnosis. Reading World, 1974, 13, 193-222.

Krishna, K.P. Anxiety and locus of control. Indian Journal of Clinical Psychology, 1981, 8, 55-56.

Kunst-Wilson, W.R. & Zajonc, R.B. Affective discrimination of stimuli that cannot be recognized. Science, 1980, 207, 557-559.

Lambert, N.M., Sandoval, J. & Sassone, D.M. Prevalence of hyperactivity and related treatments among elementary school children. In K. Gadow & J. Loney (Eds.). Psychosocial aspects of drug treatment for hyperactivity. Boulder, Col.: Westview Press, 1981.

Lambert, N.M., Sandoval, J. & Sassone, D. Prevalence of treatment regimens for children considered to be hyperactive. American Journal of Orthopsychiatry, 1979, 49, 482-490.

LaPouse, R. & Monk, M. An epidemiologic study of behavioral characteristics in children. American Journal of Public Health, 1953, 48, 1134-1144.

Laufer, M. & Denhoff, E. Hyperactive behavior symptoms in children. Journal of Pediatrics, 1957, 50, 463.

Leary, P.M. et al. Clinical experiences with methylphenidate. South African Medical Journal, 1979, 374-376.

Lerer, R.J. et al. Handwriting deficits in children with minimal brain dysfunction: effects of methylphenidate (ritalin) and placebo. Journal of Learning Disabilities, 1979, 12, 26-31.

Lewis, C.S. The Lion, the Witch and the Wardrobe. New York: Macmillan, 1950.

Liberman, R.P., Davis, M.W., Moon, W. & Moore, J. Research design for analyzing drug-environment-behavior interactions. Journal of Nervous and Mental Disease, 1973, 156, 432-439.

Lindauer, B.K. & Paris, S. Problems with a false memory paradign for developmental memory. Journal of Experimental Child Psychology, 1976, 22, 319-330.

Loney, J. et al. Hyperkinetic/agressive boys in treatment: predictors of clinical response to methylphenidate. American Journal of Psychiatry, 1978, 135, 12.

Lubar, J.F. & Shouse, M. EEG and behavioral changes in a hyperkinetic child concurrent with training of the sensorimotor rhythm (smr): a preliminary report. Paper presented at the 5th annual meeting of the Biofeedback Society of America, Danvers, Ma., October, 1979[a].

Lubar, J.F. & Shouse, M. Use of biofeedback in the treatment of hyperactivity. In B. Lahey (Ed.). Behavior therapy with hyperactive and learning disabled children. New York: Oxford University, 1979.

Lucas, B. & Sells, C.J. Nutrient intake and stimulant drugs in hyperactive children. Journal of the American Dietetic Association, 1977, 70, 373-377.

Luthe, W. Autogenic training: method, research and application in medicine. In T. Barber et al. (Eds.). Biofeedback and self-control. Chicago: Aidine, Atherton, 1971.

Lynch, W.C. Instrumental control of peripheral vasomotor responses in children. Psychophysiology, 1976, 13, 219-221.

Lynn, R. Attention, arousal and the orientation reaction. New York: Pergamon Press, 1966.

Martin, L.L. & Hershey, M. An exploratory investigation of the effects on a biofeedback technique with hyperactive, learning disabled children. Paper presented at the 54th annual international convention of the Council for Exceptional Children, Chicago, Ill., April 4-9, 1976.

Meldman, M.J. Diseases of attention and perception. New York: Pergamon Press, 1970.

Mehlman, B. The reliability of psychiatric diagnosis. Journal of Abnormal and Social Psychology, 1952, 47, 577-578.

Mendelson, W., Johnson, N. & Stewart, M. Hyperactive children as teenagers. Journal of Nervous and Mental Disease, 1971, 153, 273-279.

Mervis, C.B. Category structure and the development of categorization. In R.J. Spiro, B.C. Bruce & W.F. Brewer (Eds.). Theoretical issues in reading comprehension: perspectives from cognitive psychology, linguistics, artificial intelligence and education. Hillsdale, N.J.: Laurence Erlbaum, 1980.

Merwin, J.C. Review of the wrat. In O. Buros (Ed.). Mental measurement yearbook (7th ed.). Highland Park, N.J.: Gryphon Press, 1972.

Milich, R.S. & Loney, J. The factor composition of the wisc for hyperkinetic/mbd males. Journal of Learning Disabilites, 1979, 12, 491-495.

Milstein, V. & Small, J.G. Photic responses in "minimal brain dysfunction." Diseases of the Nervous System, 1974, 35, 355-357.

Monaghan, J.H., Robinson, J.O. & Dodge, J.A. The children's life events inventory. Journal of Psychosomatic Research, 1979, 23, 63-68.

Moore, C.L. Behavior modification and electromyographic biofeedback as alternatives to drugs for the treatment of hyperkinesis in children (Doctoral dissertation, East Texas State University, 1977). Dissertation Abstracts International, 1977, 38, 2872B.

Morais, J. Spatial constraints on attention to speech. In J. Requin (Ed.). Attention and performance vii. Hillsdale, N.J.: Laurence Erlbaum, 1978.

Moray, N. Attention: selective processes in vision and hearing. London: Hutchinson Education, 1969.

Murray, J.N. Understanding and use of chemotherapy by learning disabilities and behavior disorders teachers. Journal of Learning Disabilities, 1980, 13, 356-361.

Norman, D.A. Memory and attention (2nd ed.). New York: John Wiley & Sons, 1976.

Nowicki, S. Jr. & Strickland, B.P. A locus of control scale for children. Journal of Consulting and Clinical Psychology, 1973, 40, 148-154.

Nowicki, S. Reported stressful events during developmental periods and their relation to locus of control orientation in college students. Journal of Consulting and Clinical Psychology, 1978, 46, 1552-1553.

Office of child development and the office of the assistant secretary for health and scientific affairs report of the conference on the use of stimulant drugs in the treatment of behaviorally disturbed young children. Washington, D.C.: Dept. of Health, Education and Welfare, 1971.

O'Leary, K.D. Pills or skills. Journal of Applied Behavioral Analysis, 1980, 13, 191-204.

Ollendick, D.G. Locus of control and anxiety as mediating variables of locus of conflict in disadvantaged youth. Journal of Psychology, 1979, 101, 23-25.

Omizo, M. The effects of biofeedback induced relaxation training in hyperactive adolescent boys. Journal of Psychology, 1980, 105, 131-138.

Omizo, M.M. & Michael, W.B. Biofeedback induced relazation training and impulsivity, attention to task, and locus of control among hyperactive boys. Journal of Learning Disabilities, 1982, 15, 414.

Omizo, M. & Williams, R.E. Biofeedback training can calm the hyperactive child. Academic Therapy, 1981, 17, 43-46.

Padilla, E.R., Rohsenow, J. & Bergman, A.B. Predicting accident frequency in children. Pediatrics, 1976, 58, 223.

Page, J.G. et al. A multi-clinic trial of pemoline in childhood hyperkinesis. In C.K. Conners (Ed.). Clinical use of stimulant drugs in children. Amsterdam: Excerpta Medica, 1974.

Peper, E. The possible uses of biofeedback in education. In E. Peper, S. Ancoli & M. Quinn (Eds.) Mind/body integration. New York: Plenum Press, 1979.

Peper, E. & Grossman, E. Thermal biofeedback training in children with headache. In E. Peper, S. Ancoli & M. Quinn (Eds.) Mind/body integration. New York: Plenum Press, 1979.

Peper, E. & Grossman, E.F. Preliminary observations of thermal biofeedback in children with migraine. Proceedings of the Biofeedback Research Society. Colorado Springs, Col.: 1974.

Physicians' desk reference (37th ed.) Oradell, N.J.: Medical Economics, 1983.

Prawat, R.S., Jones, H. & Hampton, J. Longitudinal study of attitude development in pre-, early, and later adolescent samples. Journal of Educational Psychology, 1979, 71, 363-369.

Rapoport, J.L. et al. Destroamphetamine: cognitive and behavioral effects in normal prepubertal boys. Science, 1978, 199, 560-563.

Raskin, D.C. Attention and arousal. In W.F. Prokasy & D.C. Raskin (Eds.). Electrodermal activity in psychological research. New York: Academic Press, 1973.

Riddle, K.D. & Rapoport, J.L. A 2-year follow-up of 72 hyperactive boys. Journal of Nervous and Mental Diseases, 1976, 162, 126-134.

Rie, H., Rie, E., Stewart, S. & Amburl, G. Effects of trialin on underachieving children. American Journal of Orthopsychiatry, 1976, 46, 313-322. [a].

Rie, H., Rie, E., Stewart, S. & Amburl, B. Effects of methylphenidate on underachieving children. Journal of Consulting and Clinical Psychology, 1976, 44, 250-260. [b].

Rivera, E. & Omizo, M. The effects of relaxation and biofeedback on attention to task and impulsivity among hyperactive children. Exceptional Child, 1980, 27, 41-51.

Roche, A.F. et al. The effects of stimulant medication on the growth of hyperkinetic children. Pediatrics, 1979, 63, 847-850.

Rosenthal, R. Experimenter effects in behavioral research. New York: Appleton-Century-Crofts, 1966.

Rosenthal, R. & Allen, T.W. Intratask distractability in hyperactive and nonhyperactive children. Journal of Abnormal Child Psychology, 1980, 8, 175-187.

Ross, D.M. & Ross, S. Hyperactivity: research, theory, and action. New York: John Wiley & Sons, 1976.

Rosvold, H.E., Mirsky, A.F., Sarason, I., Bransom, E. Jr., & Beck, L. A continuous performance test of brain damage. Journal of Consulting Psychology, 1956, 20, 343-350.

Rotter, J.B. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 1966, 80, 1-28.

Safer, D.J. & Allen, R.P. Hyperactive children: diagnosis and management. Baltimore: University Park, 1976.

Safer, D., Allen, R., & Barr, E. Deparession of growth in hyperactive children on stimulant drugs. New England Journal of Medicine, 1972, 287, 217-220.

Sandoval, J. The measurement of the hyperactive syndrome in children. Review of Educational Research, 1977, 47, 293-318.

Satterfield, J.H. et al. Response to stimulant drug treatment in hyperactive childrens prediction from eeg and neurological findings. Journal of Autism and Childhood Schizophrenia, 1973, 3, 36-48.

Satterfield, J.H. et al. Patho-physiology of the hyperactive syndrome. Archives of General Psychiatry, 1974, 31, 839-844.

Schulman, J.L. et al. Modification of activity level through biofeedback and operant conditioning. Journal of Applied Behavior Analysis, 1978, 11, 145-152.

Schultz, E. Prevalence of behavioral symptoms in rural elementary schoolchildren. Journal of Abnormal Child Psychology, 1974, 2, 17-24.

Shepard, W.O., Cohen, D., Gold, L. & Orbino, P. Personal and peer word associations in relation to children's false recognition errors. Developmental Psychology, 1976, 12, 477-478.

Shetty, T. Alpha rhythms in the hyperkinetic child. Nature, 1971, 234, 476. [a].

Shetty, T. Photic response in hyperkinesis of childhood. Science, 1971, 174, 1356-1357. [b].

Shouse, M.N. The role of cns arousal levels in the management of hyperkinesis: methyphenidate and eeg biofeedback training (Doctoral dissertation, University of Tennessee, 1976). Dissertation Abstracts International, 1976, 37, 4206B.

Simpson, D.D., & Nelson, A.E. Attention training through breathing control to modify hyperactivity. Journal of Learning Disabilities, 1974, 7, 15-24.

Simpson, D.D., & Nelson, A.E. Breathing control and attention training: a preliminary study of a psychophysiological approach to self-control of hyperactive behavior in children. Washington, D.C.: National Center for Educational Research and Development, 1972. [a].

Simpson, D.D., & Nelson, A.E. Breathing control and attention training. Fort Worth, Texas: Institute of Behavioral Research, 1972. [b].

Simpson, R.L. et al. Stimulant medications and the classroom attention-to-task and diviant social behaviors of twelve hyperactive males. Learning Disability Quarterly, 1980, 3, 19-27.

Snyder, S.H. Biological aspects of mental disorder. New York: Oxford University, 1980.

Sophian, C. & Stigler, J.W. Does recognition memory improve with age. Journal of Experimental Child Psychology, 1981, 32, 343-353.

Spache, G. A new readability formula for primary grade reading materials. Elementary School Journal, 1953, 53, 410-413.

Sprague, R.L. & Sleator, E.K. Methylphenidate in hyperkinetic children: difference in dose effects on learning and social behavior. Science, 1977, 198, 1274-1276.

Sprague, R. & Sleator, E. Drugs and dosages: implications for learning disabilities. In R.M. Knight & D. Bakker (Eds.). The neuropsychology of learning disorders. Baltimore: University Park, 1976.

Sprague, R.L. & Sleator, E. What is the proper dose of stimulant drugs in children? International Journal of Mental Health, 1975, 4, 75-104.

Sprague, R., Barns, W. & Werry, J. Methylphenidate and thioridazine: learning, reaction time, activity and classroom behavior in disturbed children. American Journal of Orthopsychiatry, 1970, 40, 615-628.

Spring, L.A. et al. Reaction time and effect of ritalin on children with learning problems. Perceptual and Motor Skills, 1973, 36, 75-82.

Sroufe, L.A. & Stewart, M.A. Treating problem children with stimulant drugs. New England Journal of Medicine, 1973, 289, 407-413.

Stableford, W. et al. Sequential withdrawal of sitmulant drugs and use of behavior therapy with two hyperactive boys. American Journal of Orthopsychiatry, 1976, 46, 301-312.

Stein, K. Brainstorms. Omni, 1981, October, 53-57; 104-144.

Stoyva, J. Some unresolved issues in the generalization of muscle relaxation. In N. Birbaumer & H.D. Kimmel (Eds.). Biofeedback and self regulation. Hillsdale, N.J.: Laurence Eelbaum, 1979.

Sulzbacher, S.I. Psychotropic medication with children: an evaluation of procedural biases in results of reported studies. In B. Lahey (Ed.). Behavior therapy with hyperactive and learning disabled children. New York:

Oxford University, 1979.

Suter, S. & Loughry-Machado, L. Skin temperature biofeedback in children and adults. Journal of Experimental Child Psychology, 1981, 32, 77-87.

Swanson, J. & Kinsbourne, M. The cognitive effects of stimulant drugs on hyperactive children. In G. Hale & M. Lewis (Eds.). Attention and cognitive development New York: Plenum Press, 1979. [a].

Swanson, J. & Kinsbourne, M. State-dependent learning and retrieval: methodological cautions and theoretical considerations. In J. Kihlstrom & F. Evans (Eds.) Functional disorders of memory. Hillsdale, N.J.: Laurence Erlbaum, 1979. [b].

Swanson, J., Kinsbourne, M., Roberts, W. & Zucker, K. Time response analysis of the effect of stimulant medication on the learning ability of children referred for hyperactivity. Pediatrics, 1978, 61, 21-29.

Swanson, J. & Kinsbourne, M. Stimulant-related state-dependent learning in hyperactive children. Science, 1976, 192, 1354-1357.

Swanson, L. Locus of control and academic achievement in learning disabled children. Journal of Social Psychology, 1981, 113, 141-142.

Swanson, L. Comparison of normal and learning disabled children on short-term memory recall and selective attention. Journal of Genetic Psychology, 1979, 135, 155-156.

Sykes, D.H., Douglas, V.I., Weiss, G. & Mind, K.K. Attention in the hyperactive child and the effect of methylphenidate (ritalin). Journal of Child Psychology and Psychiatry, 1971, 12, 129-139.

Sykes, D.H., Douglas, V.I. & Morgenstern, G. sustained attention in hyperactive children. Journal of Child Psychology and Psychiatry, 1973, 14, 213-220.

Tarver, S.G. The development of visual selective attention and verbal rehearsal in learning disabled boys. Journal of Learning Disabilities, 1977, 10, 490-500.

Tarver, S.G. & Hallahan, D.P. Attention deficits in children with learning disabilites. Journal of Learning Disabilities, 1974, 7, 560-569.

Tarver, S.G. et al. Verbal rehearsal and selective attention in children with learning disabilities: a developmental lag. Journal of Experimental Child Psychology 1976, 22, 375-385.

Thorndike, R. Review of the wrat. In O. Buros (Ed.). Mental Measurement Yearbook. (7th ed.). Highland Park, N.J.: Gryphon Press, 1972.

Thurston, C. Effects of methylphenidate (ritalin) on selective attention in hyperactive children. Journal of Abnormal Child Psychology, 1979, 7, 471-481.

Treisman, M. Stratagies and models of selective attention. Psychological Review, 1969, 76, 282-299.

Vaitl, D., Kenkmann, H. & Kuhmann, W. Heart rate stabilization feedback and concomitant physiological changes. In N. Birbaumer & H.D. Kimmel (Eds.). Biofeedback and self regulation. Hillsdale, N.J.: Laurence Erlbaum, 1979.

VanKalmthout, M. Operant heart rate conditioning in freely moving rats. In N. Birbaumer & H.D. Kimmel (Eds.) Biofeedback and self regulation. Hillsdale, N.J.: Laurence Erlbaum, 1979.

Vincent, J.P., Williams, B.J., Harris, G. & Duval, G.C. Classroom observations of hyperactive children: a multiple validation study. In K. Gadow & J. Loney (Eds.). Psychosocial aspects of drug treatment of hyperactivity. Boulder, Col.: Westview Press, 1981.

Wallace, G., & Larson, S.C. Educational assessment of learning problems. Boston: Allyn & Bacon, 1971.

Ward, C.H. et al. The psychiatric nomenclature: reasons for disagreement. Archives of General Psychiatry, 1962, 7, 198-205.

Ware, J.R., Kowal, B., & Baker, R.A. Jr. The role of experimenter attitude and contingent reinforcement in a vigilance task. Fort Knox, Kentucky: United States Army Human Research Unit, 1963.

Watson, D.L., & Hall, D.L. Self-control of hyperactivity. Sacramento, Cal.: California State Dept. of Education, 1977.

Wechsler,D. Wechsler intelligence scale for children-revised. New York: Psychological Corporation, 1974.

Weiner, W.J., Navsieda, P.A., & Klawans, H.L. Methylphenidate-induced chorea: case report and pharmacologic implications. Neurology, 1978, 28, 1041-1014.

Weingarter, H. et al. Cognitive processes in normal and hyperactive children and their response to amphetamine treatment. Journal of Abnormal Psychology, 1980, 89, 25-37.

Weiss, B., & Laties, V.G. Enhancement of human performance by caffeine and the amphetamines. Pharmacological Reviews, 1962, 14, 1-36.

Weiss, G. et al. Studies on the hyperactive child: viii, five year follow-up. Archives of General Psychiatry, 1971, 24, 409-414.

Weithorn, C., & Ross, R. Stimulant drugs for hyperactivity. American Journal of Orthopsychiatry, 1976, 46, 168-173.

Werry, J., & Quay, H. the prevalence of behavior symptoms in younger elementary school children. American Journal of Orthopsychiatry, 1971, 41, 136-141.

Werry, J., Aman, M.G., & Diamond, E. Imipramine and methylphenidate in hyperactive children. Journal of Child Psychology and Psychiatry, 1980, 21, 27-35.

Whalen, C.K., & Henker, B. Psychostimulants and children: a review and analysis. Psychological Bulletin, 1976, 83, 1113-1130.

White, O.R. A manual for the calculation and use of the median slope -- a technique of progress estimation and prediction in the single case. Working Paper No. 16, Regional Resource Center for Handicapped Children, Eugene, Oregon: University of Oregon, 1973.

White, O.R. The prediction of human performances in the single case: an examination of four techniques. Working Paper No. 15, Regional Resource Center for Handicapped Children, Eugene, Oregon: University of Oregon, 1972.

White, S., & Pillemer, D.B. Childhood amnesia and the development of a socially accessible memory system. In J. Kihlstrom & F.J. Evans (Eds.). Functional disorders of memory., Hillsdale, N.J.: Laurence Erlbaum, 1979.

Witelson, S., & Rabinovitch, M.S. Children's recall strategies in dichotic listening. Journal of Experimental Child Psychology, 1971, 12, 106-113.

Wolf, T.M., Sklov, M.C., Hunter, S.M., & Berenson, G.S. Factor analytic study of the children's Nowicki-Strickland locus of control sacle. Educational and Psychological Measurement, 1982, 42, 333-337.

Wolraich, M.L. Stimulant drug therapy in hyperactive children: research and clinical implications. Pediatrics, 1977, 60, 512-518.

Wunsch-Hitzig, R., Gould, M., & Dohrenwend, B. Hypoheses about the prevalence of clinical maladjustment in children in the United States. In S. Salzinger, J. Antrobus & J. Glick (Eds.). The ecosystem of the "sick" child. New York: Academic Press, 1980.

Yussen, S.R., & Berman, L. Memory predictors for recall and recognition in first-, third-, and fifth-grade children. Developmental Psychology, 1981, 17, 224-229.

Zahn, T.P., Little, B., & Wender, P.H. Pupillary and heart rate reactivity in children with minimal brain dysfunction. Journal of Abnormal Child Psychology, 1978, 6, 135-147.

Zahn, T.P., Rapoport, J.L., & Thompson, C.L. Autonomic and behavioral effects of dextroamphetamine and placebo in normal and hyperactive prepubertal boys. Journal of Abnormal Child Psychology, 1980, 8, 145-160.

Zwick, R., & Marascuilo, . Selection of pairwise multiple comparison procedures for parametric and nonparametric analysis of variance models. Psychological Bulletin, 1984, 95, 148-155.

APPENDIX A

DIAGNOSTIC CRITERIA FOR ATTENTION DEFICIT DISORDER WITH HYPERACTIVITY

The child displays, for his or her mental and chronological age, signs of developmentally inappropriate inattention, impulsivity, and hyperactivity. The signs must be reported by adults in the child's environment, such as parents and teachers. Because the symptoms are typically variable, they may not be observed directly by the clinician. When the reports of teachers and parents conflict, primary consideration should be given to the teacher reports because of greater familiarity with age-appropriate norms. Symptoms typcially worsen in situations that require self-application, as in the classroom. Signs of the disorder may be absent when the child is in a new or a one-to-one situation.

The number of symptoms specified is for children between the ages of eight and ten, the peak age range for referral. In younger children, more severe forms of the symptoms and a greater number of symptoms are usually present. The opposite is true of older children.

A. Inattention. At least three of the following:
- (1) often fails to finish things he or she starts
- (2) often doesn't seem to listen
- (3) easily distracted
- (4) has difficulty concentrating on schoolwork or other tasks requiring sustained attention
- (5) has difficulty sticking to a play activity

B. Impulsivity. At least three of the following:
- (1) often acts before thinking
- (2) shifts excessively from one activity to another
- (3) has difficulty organizing work (this not being due to cognitive impairment)
- (4) needs a lot of supervision
- (5) frequently calls out in class
- (6) has difficulty awaiting turn in games or group situations

C. Hyperactivity. At least two of the following:
- (1) runs about or climbs on things excessively
- (2) has difficulty sitting still or fidgets excessively
- (3) has difficulty staying seated
- (4) moves about excessively during sleep

(5) is always "on the god" or acts as if "driven by a motor."

D. Onset before the age of seven.

E. Duration of at least six months.

F. Not due to Schizophrenia, Affective Disorder, or Severe or Profound Mental Retardation.

APPENDIX B

STIMULANT DRUGS

Generic & Brand Names	Starting Dose	Maximum Dose	Remarks
methylphenidate HCL Ritalin	2.5 mg. two times per day for age 6 and over	20 mg./day	The drug should be given before breakfast and lunch in divided doses. It may lower the convulsive threshold and cause anorexia, growth suppression, insomnia, irritability, depressive reactions, headache, stomach ache, skin rash, increased heart rate and blood pressure, tics and cohera.
dextroamphetamine sulfate Dexampex Dexadrine Ferndex Tablets Dexadrine Spansules Diphylets	2.5 mg. two to four times per day for ages	10 mg./day	The same conditions noted above hold for this drug but a more marked growth suppression, insomnia and irritability.
pemoline Cylert	18.75 mg. once per day	37.5 mg./day	The drug does not take for for 2-3 weeks. In addition to the same effects noted above, it may also cause tissue damage.

APPENDIX C

STANDARDIZED TESTS

Goldman-Fristoe-Woodcock Test of Auditory Discrimination:

This test is an individual norm-referenced standardized measure of the ability to discriminate between speech sounds. The G-F-W is appropriate for individuals aged 5-0 through adulthood. The test is administered via tape recorder and earphones. The split-halp reliability of the G-F-W is .79 for the Quiet Subtest with a validity estimate of .68 for the same subtest.

by Goldman, R., Fristoe, M., & Woodcock, R.W. Circle Pines, Mn: American Guidance Services, 1970.

Harris Test of Lateral Dominance:

The Harris Test is a clinical screening device for measuring lateral dominance.

by Harris, R. New York: Psychological Corporation.

Key Math Diagnostic Arithmetic Test:

The Key Math is an individual standardized and grade-referenced test of fourteen arithmetic skills. Test items are graded and range from below grade 1.0 to above grade 9.0. The internal consistency reliability for the Mental Computation Subtest is .64.

by Connolly, A.J., Nachtman, W., & Pritchett, E.M. Circle Pines, Mn: American Guidance Services, 1971.

Wechsler Intelligence Scale for Children-Revised:

The WISC-R is a norm-referenced and standardized test of general intellectual performance. The test is appropriate for individuals aged 6.5 through 16.5. The split-half reliability for the Full Scale IQ is .96 and a reported correlation with the Stanford-Binet (Form L-M, 1972 norms) of .73.

by Wechsler, D. New York: Psychological Corporation, 1974.

Spache Diagnostic Reading Scales-Revised:

The Spache is a norm-referenced and standardized individual reading test. The test consists of three word lists and sixteen reading passages as well as seven phonics tests. All of the subtests are graded ranging from primer to the eighth grade level. The test-retest reliability (ten weeks) is .88 for the Independent Level and .90 for Potential Reading Level.

by Spache, G.D. Monterey Park, Ca: CTB/McGraw Hill, 1972.

Coddington Social Readjustment Rating Questionnaire (Protocol #1):

Specific information concerning this questionnaire is located in _Order of Phases_ in this dissertation.

Protocol #1

Coddington Social Readjustment Rating Questionnaire
Elementary Age Group

1. Beginning another school year
2. Outstanding personal achievement
3. Beginning school
4. Move to a new school district
5. Increase in number of arguments with parents
6. Change in parents' financial status
7. Death of a grandparent
8. Decrease in the number of arguments between parents
9. Mother beginning to work
10. Becoming a full-fledged member of a church
11. Brother or sister leaving home
12. Serious illness requiring hospitalization of parent
13. Decrease in the number of arguments with parents

14. Change in father's occupation requiring increased absence from home

15. Change in child's acceptance by peers

16. Increase in number of arguments between parents

17. Death of a close friend

18. Birth of a brother or sister

19. Pregnancy in unwed teenage sister

20. Serious illness requiring hospitalization of brother or sister

21. Loss of job by parent

22. Failure of a grade in school

23. Divorce of parents

24. Suspension from school

25. Addition of third adult to family

26. Marital separation of parents

27. Serious illness requiring hospitalization of child

28. Marriage of parent to step-parent

29. Having a visible congenital deformity

30. Acquiring a visible deformity

31. Death of a brother of sister

32. Discovery of being an adopted child

33. Becoming involved with drugs or alcohol

34. Jail sentence of parent for 30 days or less

35. Jail sentence of parent for 1 year or more

APPENDIX D

Agreement

I agree to allow my child   to participate in Mr. Frank Dufresne's research for his doctoral dissertaion from period May to August, 1983. I understand that all identifying information will be confidential. I understand that the experiment may result in my child experiencing some anxiety. Should this occur Mr. Dufresne will take all professionally appropriate action and notify me as soon as possible. I also understand that I have the right to inspect my child's research records upon request and that I may withdraw my child from the experiment at any time. At the conclusion of the research Mr. Dufresne will provide me with an abstract of his research findings and I will have access to the completed dissertation.

Frank Dufresne	Signature
Date	Date

The Commonwealth of Massachusetts
University of Massachusetts
Amherst 01003

SCHOOL OF EDUCATION
HUMAN SERVICES AND APPLIED
BEHAVIORAL SCIENCES DIVISION
HILLS SOUTH

Dear Dr.

I am a doctoral candidate at the University of Massachusetts. I am currently engaged in research concerning the cognitive processes of children diagnosed Attention Deficit Disorder with Hyperactivity. In particular I am interested in the treatment effevts of stimulant medication and biofeedback training on attention and memory.

I am looking for volunteer male subjects between the ages of eight and twelve to participate in the experiment.

I would be interested in discussing my proposed research with you in more detail and whether you have any patients you feel might be potential participants. I have enclosed a brief description of the proposed experiment and a response card if you are interested in pursuing my request further.

Sincerely,

Frank Dufresne
Teaching Associate
Special Education
Concentration

SUMMARY

At this time the majority of children diagnosed Attention Deficit Disorder with Hyperactivity are treated with stimulant medication. Despite sucessful medication control of undesirable behavior many children demonstrate continued academic difficulties. There is also a group of children who do not respond favorably to medication or whose parents object to stimulant therapy. These children are frequently left without a viable treatment alternative. Given the above situation it is necessary that we know more about the cognitive processes of these children, how treatment affects their cognitive skills and whether there is a cost effective alternative to stimulant therapy when it is neither desirable or possible.

The proposed experiment would study the auditory sustained and selective attention, memory and locus of control orientation of hyperactive children. The experimental tasks are designed so they will pose no disruption of ongoing treatment. The children will be seen five times to measure their performance and will receive twelve biofeedback training sessions while on "drug holiday" over the summer. Each measurement session will last approximately one hour and the biofeedback training about one half hour per session.

The subjects involved in the study will be five males, ages 8-12 and diagnosed Attention Deficit Disorder with Hyperactivity. In addition the subjects must meet the following criteria: average intelligence; normal hearing; receiving stimulant medication for at least two months and have "drug free holidays" as part of their treatment plan. In conclusion all efforts will be made to insure the confidentiality of the subjects, parents and physicians involved in this experiment.

The Commonwealth of Massachusetts
University of Massachusetts
Amherst 01003

SCHOOL OF EDUCATION
HUMAN SERVICES AND APPLIED
BEHAVIORAL SCIENCES DIVISION
HILLS SOUTH

Dear Parent(s):

This letter is being forwarded to you by your pediatrician who I contacted concerning potential subjects for a research project. Your physician felt you might be interested in having your child participate in my project but to preserve confidentiality we agreed the initial request would be made by the doctor's office.

I am a doctoral candidate at the University of Massachusetts. I am currently engaged in research on the cognitive processes of children diagnosed as Attention Deficit Disorder with Hyperactivity. In particular I am interested in the treatment effects of stimulant medication and biofeedback training on attention and memory.

Children who are involved in the project would be seen a total of seventeen times over the spring and summer of this year. Five sessions would last about one hour and would involve tests of memory, attention and how the children feel about their behavior. The remaining twelve sessions would last about a half hour and would involve training in biofeedback relaxation. Biofeedback is a way of teaching children to relax by training them to control their muscle tension and temperature and it has been useful in treating a varity of childhood problems.

The results of this study will give new information on how different treatments effect the attention and memory of children.

If you are interested in learning more about this research please complete the enclosed card or call me at home (628-4429). I will be looking forward to hearing from you.

Sincerely,
Frank Dufresne

Frank Dufresne
Teaching Associate
Special Education
Concentration

Release of Information

I authorize the release of my son's ____________________ medical and school records to Mr. Frank Dufresne. This above permission will expire September, 1983.

____
Name:

____
Date:

APPENDIX E

Nowicki-Strickland Locus of Control Scale for Children

1. Do you believe that most problems will solve themselves if you just don't fool with them? yes no

2. Do you believe that you can stop yourself from catching a cold? yes no

3. Are some kids just born lucky? yes no

4. Most of the time do you feel that getting good grades means a great deal to you? yes no

5. Are you often blamed for things that just aren't your fault? yes no

6. Do you believe that if somebody studies hard enough he or she can pass any subject? yes no

7. Do you feel that most of the time it doesn't pay to try hard because things never turn out right anyway? yes no

8. Do you feel that if things start out well in the morning that it's going to be a good day no matter what you do? yes no

9. Do you feel that most of the time parents listen to what their children have to say? yes no

10. Do you believe that wishing can make good things happen? yes no

11. When you get punished does it usually seem it's for no good reason at all? yes no

12. Most of the time do you find it hard to change a friend's (mind) opinion? yes no

13 Do you think that cheering more than luck helps a team to win? yes no

14. Do you feel that it's nearly impossible to change your parent's mind about anything? yes no

15. Do you believe that your parents should allow you to make most of your own decisions? yes no

16. Do you feel that when you do something wrong there's very little you can do to make it right? yes no

17. Do you believe that most kids are just born good at sports? yes no
18. Are most of the other kids your age stronger than you are? yes no

19. Do you feel that one of the best ways to handle most problems is just not to think about them? yes no

20. Do you feel that you have a lot of choice in deciding who your friends are? yes no

21. If you find a four leaf clover do you believe that it might bring you good luck? yes no

22. Do you often feel that whether you do your homework has much to do with what kind of grades you get? yes no

23. Do you feel that when a kid your age decides to hit you, there's little you can do to stop him or her? yes no

24. Have you ever had a good luck charm? yes no

25. Do you believe that whether or not people like you depends on how you act? yes no

26. Will your parents usually help you if you ask them to? yes no

27. Have you felt that when people were mean to you it was usually for no reason at all? yes no

28. Most of the time do you feel that you can change what might happen tomorrow by what you do today? yes no

29. Do you believe that when bad things are going to happen they just are going to happen no matter what you try to do to stop them? yes no

30. Do you think that kids can get their own way if they just keep trying? yes no

31. Most of the time do you find it useless to try to get your own way at home? yes no

32. Do you feel that when good things happen they happen because of hard work? yes no

33. Do you feel that when somebody your age wants to be your enemy there's little you can do to change matters? yes no

34. Do you feel that it's easy to get friends to do what you want them to? yes no

35. Do you usually feel that you have little to say about what you get to eat at home? yes no

36. Do you feel that when someone doesn't like you there's little you can do about it? yes no

37. Do you usually feel that it's almost useless to try in school because most other children are just plain smarter than you are? yes no

38. Are you the kind of person who believes that palnning ahead makes things turn out better? yes no

39. Most of the time, do you feel that you have little to say about what your family decides to do? yes no

40. Do you think it's better to be smart than to be lucky? yes no

Memory Task

The following appendix is arranged so that responses correspond to specific subjects. For example, the first response belongs to subject 1 and the second to subject 2.

List 1

Target	Student Associate	Rhyme	Category
path	April	math	trail
	walk		
	way		
	woods		
	walk		
motor	cycle	rotor	engine
beard*	person	leered	hair
motor	car	rotor	engine
	car		
	cycle		
exit	out	slit	entrance
	out		
	door		
	through		
	out		
treat	sticker	feat	reward
worm	butterfly	germ	animal
	John		
	hole		
	insect		
scar	injure	star	blemish
	hurt		
	me		
	scratch		
	burns		
stove	appliance	rove	furnace
	burn		
	grease		
dawn	night	fawn	sunrise
stove	cooking	rove	furnace

* Target words may vary due to duplication and replacement.

cold	shivering outside hat sneeze freezing	fold	chill
claw	hurts cat finger bear cat	flaw	nail
tray	eat t.v. dish cup dishes	grey	container
lamb treat cartoon	sheep food comics Smurfs ink	ham feat maroon	calf reward sketch
test	study learn math listen math	nest	exam
tag	sale price grab run game	drag	slip
grinder	food sandwich squish eat food	finder	utensil
dance	practice fun jump music fun	lance	ball

ring	brother loud wedding diamond wedding	bring	band
wool captain wool	bear ship sheep sheep sheep	full napkin full	silk officer silk
sign	message stop letters language stop	mine	mark
child	person kid young parent young	mild	chick
metal	hard steel steel cow gun	kettle	brass
bee	fun bad buzz honey honey	knee	wasp
captain ape	ship Maple monkey monkey monkey	napkin drape	officer gorilla
field	grass yard ground meadow corn	shield	pasture

teeth	sharp	wreath	fangs
	mouth		
	buck		
dust	vacuum	must	grime
teeth	shark	wreath	fangs
ear	drum	tear	head
	hand		
	noisy		
	nose		
	hearing		
party	happy	smarty	affair
dawn	morning	fawn	sunrise
party	food	smarty	affair
	cake		
	birthday		
dust	sneeze	must	grime
noise	loud	boys	sound
	classroom		
	loud		
	classroom		
syrup	maple	stirup	sauce
road	closed	load	lane
syrup	sticky	stirup	sauce
	sap		
	pancakes		
road	autobahn	load	lane
swamp	pond	romp	bog
	muddy		
	ducks		
	flamingos		
fruit	fiber	moot	pear
mop	hop	flop	broom
	wet		
	floor		
	floor		
elf	Santa	shelve	fairy
	shoemaker		
	shoemaker		
	mom		
	shoemaker		

seed	plant	lead	grain
	weed		
	flower		
	plants		
	garden		
snail	shell	sail	turtle
	hail		
	round		
	fish		
	onions		
jelly	fish	belly	jam
	grape		
	bean		
	beans		
	toast		
hammer	sharp	slammer	tool
	sharp		
	handle		
	saw		
	hitting		
gum	chew	dumb	candy
dress	clothes	less	skirt
gum	drop	dumb	candy
	bubble		
	bubble		
crayon	color	bran	pencil
	drawing		
	box		
	market		
	blue		
bread	delicious	said	bun
net	fish	fret	lasso
	fish		
	catfish		
	butterfly		
gasoline	fuel	glass	steam
	car		
	expensive		
	goes		
	pumping		

word	search	slurred	term
	work		
	say		
fruit	apple	moot	pear
word	communicate	slurred	term
gang	fun	sang	band
	people		
	tired		
	game		
	rough		

List 2

comb	hair	dome	brush
	hair		
insect	bug	bisect	hornet
author	movie	father	writer
comb	hair	dome	brush
pit	falls	mitt	mine
	fall		
	falls		
	hole		
	rattlesnake		
germs	yegh	terms	bug
	sick		
	coughs		
bum	legs	rum	hobo
germs	infected	terms	bug
paw	bear	saw	hand
	claw		
	hard		
	dog		
	dog		
scout	cub	shout	spotter
	boy		
	hair		
	cub		
	Squanto		
towel	dry	howl	cloth
	wet		
	clean		
	bath		
	bath		

prize	win	size	reward
	win		
	toy		
	win		
	fun		
devil	mean	gravel	spirit
	bad		
	Jimmy		
	hole		
	costume		
saint	praise	faint	guru
	good		
	ma		
	Claus		
	religious		
Maine	state	brain	street
	Boston		state
captain	boss	napkin	officer
Maine	horse	brain	state
	street		
author	Judy	father	writer
salt	food	malt	spice
	pepper		
	pepper		
	blood		
plug	tub	drug	cork
	games		
	fuse		
	record		
	sink		
bum	hippy	rum	hobo
weed	yard	greed	plant
	dope		
insect	caterpiller	bisect	hornet
weed	garden	greed	plant
hive	bee	drive	house
	bee		
	bee		
	bees		
	bees		

cub	bear bears bear bear scouts	nub	fawn
coal	burn hole ditch wood furnace	bowl	fuel
sponge	cloth clean water wet mop	lunge	wiper
dawn	morning	lawn	sunrise
fight	win bad mad fist	might	battle
steak	food yum food pork food	flake	roast
rules	regulations break teacher playground obey	mules	codes
mess	dirty Brad dirty clean room	less	untidy
priest	church church God God preacher	east	rabbi

star	spangled	gar	planet
	far		
	light		
	moon		
	constellation		
balloon	air	saloon	kite
	blimp		
	pop		
	clown		
	air		
atom	small	bottom	molecule
	air		
road	block	load	lane
atom	small	bottom	molecule
	particles		
pine	cone	fine	maple
	tree		
	tree		
	cone		
	porky		
bush	bushel	push	blueberry
	tree		
	prick		
	tree		
	thorns		
principal	leader	staple	teacher
	Evens		
	Abby		
	Hallowell		
	James		
uncle	related	rumple	aunt
	friend		
	cousin		
	friend		
	relative		
mail	bad	pail	postcard
	letter		
	letter		
	letter		
	letter		

needle	eye	puddle	pin
	sharp		
camp	out	lamp	site
needle	thread	puddle	pin
	shots		
luck	Vegas	muck	fate
	good		
	bad		
	good		
	cards		
bicycle	Scorpion	treacle	vehicle
	BMX		
	dirtbike		
	ride		
	dirtbike		
stairs	walk	fairs	ladder
	fleet		
	elevator		
	ways		
	up		
boots	shoes	loots	hiking
truck	car	duck	van
boots	shoes	loots	hiking
	shoes		
	boot		
belt	hurts	felt	suspenders
	pants		
	buckle		
	pants		
	spanking		
grade	carrots	fade	mark
author	young	father	writer
grade	five	fade	mark
	fourth		
	fourth		
tape	presents	gape	seal
	paper		
	mouth		
	refrigerator		
	christian		

nails	pound	tails	spikes
	hammer		
	wood		
	hammer		
	pounding		
movie	picture	groovy	play
	building		
	scary		
	PacMan		
	G		

List 3

square	rectangle	flair	shape
	pegs		
	circle		
	circle		
	diagram		
slave	black	grave	servant
	death		
soap	dirty	pope	Ivory
slave	uncle	grave	servant
	worker		
garage	shelter	mirage	barn
	tools		
	house		
	truck		
	car		
vacation	lake	donation	holiday
	fun		
	school		
	school		
	summer		
doll	toy	maul	Barbie
ghost	help	most	spook
	scare		
	mountain		
	story		
hero	superman	zero	leader
	helper		
	me		
	meadow		
	brave		

shout	yell	bout	call
jacket	wet	basket	coat
	warm		
	shirt		
	warm		
button	up	mutton	zipper
	hunting		
trap	raccoon	snap	ambush
button	pants	mutton	zipper
	clothes		
dragon	fake	flagon	lizzard
	fly		
	fire		
	fire		
	scary		
rifle	gun	trifle	firearm
	gun		
	gun		
	gun		
	shot		
dam	edge	tam	levee
	beaver		
	fish		
	river		
	falls		
lock	outside	knock	bolt
	door		
	break		
	out		
	bicycle		
coin	quarter	join	dime
	video		
	money		
	penny		
	money		
stamp	mail	tramp	letter
doll	store	maul	Barbie
shout	yell	bout	call
	mad		
stamp	mail	tramp	letter

acid	battery	rabid	tart
	battery		
	rain		
	ash		
	battery		
tub	shower	rub	bowl
	water		
	water		
	bath		
	wash		
stable	animals	able	barn
	horse		
	pop		
	horse		
	animals		
cane	candy	sane	stick
	candy		
	pop		
	walk		
	walking		
smart	genius	part	bright
	Smurf		
	me		
	bad		
	intelligent		
ruby	money	abbey	jewel
	money		
	diamond		
	ring		
	precious		
wine	alcohol	fine	drink
	beer		
lap	six	tap	lick
	knee		
wine	glass	fine	drink
web	spider	deb	mesh
	spider		
	spider		
	spider		
	spider		

puzzle	confusing pieces pieces cat frustrated	muzzle	problem
rolls	Popper butter tire eat oven	tolls	biscuit
soda	Sunkist food pop cake sugar	Yoda	Pepsi
ticket	show fence booth movie movie	thicket	lable
witch	mean goblin doctor ghost Oz	ditch	wizard
lap	lip	nap	lick
artist	painting John mom author	highest	painter
sword	fight wizards Nova king guillotine	lord	weapon
volcano	erupt erupting erupt erupt erupt	Draino	geyser

lid	coffee coffee cover pot steel	mid	cover
ink	pen pen lead knife pen	sink	paint
clay	diagram play sculpture play sculpture	flay	soil
marble	round rock game game ball	garble	granite
sled	snow snow slide slide sliding	fled	toboggan
vacuum	cleaner cleaner cleaner cleaner clean	perfume	brush
tissue	paper paper paper paper blowing	issue	hanky
glue	stick water paint	few	staple
soap	mouth	pope	Ivory

nurse	mom doctor girl doctor care	curse	nanny
drum	beat noise set horn music	sum	snare

List 4

gallon	orange car milk milk milk	mellon	pint
cotton rug	soft soft fur couch wipe	glutton slug	cloth carpet
judge	Watner man Watner court court	nudge	juror
tent	cover house sleep yellow camp	lent	shelter
clown	funny funny joke Jimmy circus	gown	jester
seat	belt sit sit movie chair	neat	sofa

wagon	carriage	shogun	cart
	carry		
	wheel		
	pull		
	western		
rubber	sole	scrubber	elastic
	tires		
	duck		
	duck		
	ball		
mile	run	file	distance
	long		
	yard		
	run		
	run		
fence	wood	tense	hedge
	wide		
	post		
	horse		
	broken		
master	animal	faster	boss
	dog		
	game		
	dog		
	king		
lake	George	bake	pond
	Laurel		
bread	money	lead	bun
lake	hurt	bake	pond
	swimming		
bottle	cap	throttle	jug
	soda		
	rocket		
	baby		
	wine		
smoke	detector	poke	exhaust
	pipe		
	cigarettes		
	fire		
	chimney		

clock	radio	flock	watch
	time		
	wise		
	time		
	tick		
knife	sharp	life	scalpel
	sharp		
	stab		
	spoon		
	stab		
bell	system	tell	gong
	noise		
	ring		
	ring		
	ring		
truck	automobile	muck	van
lunch	eat	hunch	meal
	dinner		
	bag		
	food		
wheat	grain	fleet	rice
	food		
	meat		
	corn		
	cereal		
plate	table	grate	platter
tool	saw	mule	hammer
plate	dish	grate	
platter			
	dish		
	dish		
shop	stop	flop	store
	buy		
	car		
	raisins		
	groceries		
model	ship	waddle	plan
	plane		
	plane		
	airplane		
	cars		

magic	show trick wand wand perform	tragic	charm
block	busters breath circle tools bricks	knock	snag
cave	under mine cold bear bear	knave	hole
ant	nasty march insect spider Antonious	grant	termite
stick	hurt dogs whip hit hockey	flick	pole
cake	birthday good eat cats decorating	sake	dessert
candy dust candy	sweet things sugar cotton Easter	sandy must sandy	sucker grime sucker
dress club	uniform fishing house ball mean	mess grub	clothes union

paint	thinner	taint	color
stage	closing	page	platform
dress	girl	mess	clothes
paint	brush	taint	color
	house		
deck	ship	heck	floor
camp	Dakota	lamp	site
deck	beetle	heck	floor
	pool		
	pool		
cage	monkey	gauge	jail
	animal		
	room		
	lion		
	animal		
rocket	ship	socket	missile
	Columbia		
	ship		
	ship		
	ship		
butter	scotch	mutter	oleo
	knife		
	oil		
	bread		
	bread		
ranch	cowboy	french	grange
	cowboys		
stage	coach	page	platform
ranch	animals	french	grange
	horses		
bark	tree	lark	skin
doctor	medic	actor	surgeon
dust	mop	must	grime
camp	out	lamp	site
bark	tree	lark	ski
noon	hour	soon	midnight
	night		
	after		
	night		
	lunch		

chain	tie tie lock truck escape	gain	bond
shadow	dark walking dark dare sun	motto	shade

List 5

care	take helping help help hospital	flair	worry
fear	less scared scare mad dragon	gear	feeling
news	cast paper important weather ABC	loose	information
part	of of good eyes cooperation	dart	whole
talk	chatter about	hawk	speak
rope	tie	grope	string
talk	listen communicate	hawk	speak
work	hard today hard play earning	jerk	labor

speed	limit car Scott slow writing	need	hurry
crowd	uncomfortable subway room empty concert	loud	group
brain	damage smart me head intelligent	train	mind
rope parade	burn street carnival elephant music	grope fade	string march
child	kid game kid adult kid	mild	infant
dent	car wall car fix car	bent	nick
bank error	account dumb wrong paint baseball	sank terror	ledge mistake
habit	eat things same hobby swearing	rabbit	way

know	blue	grow	understand
	yes		
	smart		
	now		
	answer		
number	one	slumber	digit
	one		
	five		
	letter		
	line		
sugar	sweet	figure	honey
past	ago	last	history
	tense		
sugar	maple	figure	honey
past	died	last	history
peace	beautiful	niece	calm
	quiet		
	friends		
	God		
	war		
pile	rocks	file	heap
	rocks		
	sticks		
	water		
	potatoes		
pupil	person	Topil	student
	person		
	person		
	people		
	people		
riot	funny	diet	uproar
	fight		
	funny		
	laugh		
	laughing		
pill	medicine	mill	drug
	mine		
sugar	bad	figure	honey
bones	bear	loans	ankle
pill	medicine	mill	drug

sound	effects	bound	static
	noise		
	effect		
meat	cake	seat	port
sound	hearing	bound	static
bones	fossils	loans	ankle
start	go	mart	begin
	finish		
	go		
	race		
meat	cutter	seat	port
taste	good	baste	bitter
	bud		
	eat		
	candy		
time	limit	lime	morning
	bandits		
	everything		
	clock		
	one		
weight	waste	freight	pound
	heavy		
	heavy		
dead	die	fed	gone
weight	long	freight	pound
inch	worm	winch	foot
	worm		
meat	bones	seat	pork
inch	long	winch	foot
	measure		
edge	cliff	wedge	side
	cliff		
	dead		
blood	rush	flood	gore
edge	cliff	wedge	side
farm	cow	alarm	garden
	chicken		
	house		
	horse		
	cows		

mountain	trees Manadnock	fountain	hill
blood mountain	pain valley White	flood fountain	gore hill
machine	motor computer gun car backhoe	saline	instrument
water	beverage play stand rocks swimming	barter	liquid
baby	carriage toys boy grand born	maybe	kitten
grass	dirt grows hopper meadow green	lass	reed
island plane	rangers manoeuver mean van F 17	grand grain	cape jet
milk	cheese farm bottle cow fat	bilk	coffee
blood flowers	vessels plant bowl	flood showers	gore daisy
south flowers	north rose	mouth showers	direction daisy

oil	expensive	foil	grease
	ground		
south	north	mouth	direction
oil	truck	foil	grease
	full		
forest	animals	lowest	woods
south	east	mouth	direction
forest	fire	lowest	woods
	tiger		
	big		

Continuous Performance Task II

The following are the formulas that were used to determine the readability of the selected passages.

Intermediate Grades (4-6). The Flesch formula was used to determine the readability of intermediate grade passages. The steps for computing the Reading Ease level are:

1. Take five samples of one hundred words each.

2. Compute the average number of syllables for the samples.

3. Compute the average number of words per sentence in the samples.

4. Subtract numbers 2 and 3 from 206.835 to find Reading Ease.

5. A Reading Ease score between 80 and 100 is considered the easy reading level for children in the intermediate grades.

Primary Grades (1-3). The Spache formula was used to determine the readability of primary grade passages. The steps for computing the grade level are:

1. Take two samples of one hundred words each.

2. Compute the average sentence length in the samples.

3. Determine the percentage of words not included in the Dale "Easy Word List."

4. Multiply the average sentence length by .141.

5. Multiply the percentage from the Dale List by .086.

6. Add .839 to the sum of numbers 4 and 5.

7. The resulting sum rounded to one decimal point is the grade level of the passage.

STORY I
LUCY LOOKS INTO A WARDROBE

Once there were four children whose names were Peter, Susan, Edmund and Lucy. This story is about something that happened to them when they were sent away from London during the war because of the air-raids. They were sent to the house of the old Professor who lived in the heart of the country, ten miles from the nearest railway station and two miles from the nearest post office. He lived in a very large house with the housekeeper called Mrs. Macready and three servants. He was a very old man with shaggy white hair, which grew over most of his face as well as on the head, and they liked him almost at once, but on the first evening when he came out to meet them at the front door he was so odd-looking that Lucy the youngest was a little afraid of him, and Edmund the next youngest wanted to laugh and had to keep on pretending he was blowing his nose to hide it.

As soon as they had said good night to the Professor and gone upstairs on the first night, the boys came into the girls' room and they all talked it over.

"We've fallen on our feet and no mistake," said Peter. "This is going to be perfectly splendid. The old chap will let us do anything we like."

"I think he's an old dear," said Susan.

"Oh, come off it!" said Edmund.

"Like what?" said Susan; "and anyway, it's time you were in bed."

"Trying to talk like Mother," said Edmund. And who are you to say when I'm to go to bed? Go to bed yourself."

"Hadn't we all better go to bed?" said Lucy. There's sure to be a row if we're heard talking here."

"No there won't," said Peter. "I tell you this is the sort of house where no one's going to mind what we do. Anyway, they won't hear us. It's about ten minutes' walk from here down to the dining room, and any amount of stairs and passages in between."

"What's that noise?" said Lucy suddenly. It was a far larger house than she had ever been in before and the thought of all those long passages and rows of doors leading into empty rooms was beginning to make her feel a little creepy.

"It's only the bird, silly," said Edmund.

"It's an owl," said Peter. "This is going to be the wonderful place for birds. I shall go to bed now. I say, let's go and explore to-morrow. You might find anything in a place like this. Did you see the mountains as we came along? And the woods? There might be eagles. There might be stags. There'll be hawks."

"Badgers!" said Lucy.

"Snakes!" said Edmund.

"Foxes!" said Susan.

But when next morning came, there was a steady rain falling, so thick that when you looked out of the window you could see neither the mountains nor the woods nor even the stream in the garden.

"Of course it would be raining!" said Edmund. They had just finished breakfast with the Professor and were upstairs in the room he had set apart for them---a long, low room with two windows looking out in one direction and two in another.

"Do stop grumbling, Ed," said Susan. "Ten to one it'll clear up in an hour or so. And in the meantime we're pretty well off. There's the wireless and the books.

"Not for me," said Peter, "I'm going to explore in the house."

Everyone agreed to this and that was how the adventures began. It was the sort of house that you never seem to come to the end of, and it was full of unexpected places. The first few doors they tried led only into spare bedrooms, as everyone had expected that they would; but soon they came to a very long room full of pictures and there they found the suit of armour; and after that was a room all hung with green, with a harp in one corner; and then came three steps down and five steps up, and then a kind of little upstairs hall and a door that led out onto a balcony, and then a whole series of rooms that led into each other and were lined with books---most of them very old books and some bigger than the Bible in a church. And shortly after that they looked into the room that was quite empty except for one big wardrobe; the sort that has a looking-glass in the door. There was nothing else in the room at all except a dead blue-bottle on the window-sill.

"Nothing there," said Peter, and they all trooped out again--all except Lucy. She stayed behind because she thought it would be worth while trying the door of the wardrobe, even though she felt almost sure that it would be locked. To her surprise it opened quite easily, and two moth-balls dropped out.

Looking into the inside, she saw several coats hanging up---mostly long fur coats. There was nothing Lucy liked so much as the smell and feel of fur. She immediately stepped into the wardrobe and got in among the coats and rubbed her face against them, leaving the door open, of course, because she knew that it is very foolish to shut oneself into the wardrobe. Soon she went further in and found that there was a second row of coats hanging up behind the first one. It was almost quite dark in there and she kept her arms stretched out in front of her so as not to bump her face into the back of the wardrobe. She took a step further in---then two or three steps---always expecting to feel woodwork against the tips of her fingers. But she could not feel it.

"This must be a simply enormous wardrobe!" thought Lucy, going still further in and pushing the soft folds of the coats aside to make room for her. Then she noticed that there was something crunching under her feet. "I wonder is that more moth-balls?" she thought, stooping down to feel it with her hands. But instead of feeling the hard, smooth wood of the floor of the wardrobe, she felt something soft and powdery and extremely cold. "This is very queer," she said, and went on a step or two further.

Next moment she found that what was rubbing against the face and hands was no longer soft fur but something hard and rough and even prickly. "Why, it is just the branches of trees!" exclaimed Lucy. And then she saw that there was the light ahead of her; not a few inches away where the back of the wardrobe ought to have been, but a long way off. Something cold and soft was falling on her. A moment later she found that she was standing in the middle of the wood at night-time with snow under her feet and snowflakes falling through the air.

Lucy felt a little frightened, but she felt very inquisitive and excited as well. She looked back over her shoulder and there, between the dark tree-trunks, she could still see the open doorway of the wardrobe and even catch the glimpse of the empty room from which she had set out. She had, of course, left the door open, for she knew that is is a very silly thing to shut oneself into the wardrobe. It seemed to be still daylight there. "I can always get back if anything goes wrong," thought Lucy. She began to walk forward, crunch-crunch, over the snow and through the wood towards the other light.

In about ten minutes she reached it and found that it was a lamp-post. As she stood looking at it, wondering why there was a lamp-post in the middle of the wood and wondering what to do next, she heard a pitter patter of feet coming towards her. And soon after that a very strange person stepped out from among the trees into the light of the lamp-post.

He was only a little taller than Lucy herself and he carried over his head the unbrella, white with snow. From the waist upwards he was like the man, but his legs were shaped like the goat's (the hair on them was glossy black) and instead of feet he had goat's hoofs. He also had the tail, but Lucy did not notice this at first because it was neatly caught up over the arm that held the umbrella so as to keep it from trailing in the snow. He had the red woollen muffler round his neck and his skin was rather reddish too. He had the strange but pleasant little face with <u>the</u> short pointed beard and curly hair, and out of <u>the</u> hair there stuck two horns, one on each side of <u>the</u> forehead. One of <u>the</u> hands, as I have said, held <u>the</u> unbrella; in <u>the</u> other arm he carried several brown paper parcels. What with <u>the</u> parcels and <u>the</u> snow it looked just as if he had been doing his Christmas shopping. He was <u>the</u> Faun. And when he saw Lucy he gave such a start of surprise that he dropped all his parcels.

"Goodness gracious me!" exclaimed <u>the</u> Faun.

WHAT LUCY FOUND THERE

"Good evening," said Lucy.

"Good evening, good evening," said <u>the</u> Faun. Excuse me---I don't want to be inquisitive---but should I be right in thinking that you are the Daughter of Eve?"

"My name's Lucy,"

"But you are---forgive me---you are what they call <u>the</u> girl?" asked <u>the</u> Faun.

"Of course I'm a girl,"

"You are in fact Human?"

"Of course I'm human."

"To be sure, to be sure," said <u>the</u> Faun. "How stupid of me! But I've never seen <u>the</u> Son of Adam or <u>the</u> Daughter of Eve before. I am delighted. That is to say---" and then he stopped as if he had been going to say something he had not intended but had remembered in time. "Allow me to introduce myself. My name is Tumnus."

"I'm very pleased to meet you, Mr. Tumnus," said Lucy.

"And may I ask, O Lucy, Daughter of Eve," said Mr. Tumnus, "how you have come into Narnia?"

"Narnia? What's that?" said Lucy.

"This is <u>the</u> land of Narnia," said <u>the</u> Faun, "where we are now; all that lies between <u>the</u> lamp-post and <u>the</u> great castle of Cair Paravel on <u>the</u> eastern sea. And you---you have come from <u>the</u> wild woods of <u>the</u> west?"

"I---I got in through <u>the</u> wardrobe in <u>the</u> spare room,"

"Ah!" "If only I had worked harder at geography when I was a little Faun, I should no doubt know all about <u>the</u> strange countries. It is too late now."

"But they aren't countries at all," said Lucy, almost laughing. "It's only just back there---at least---I'm not sure. It is summer there."

"Meanwhile," said Mr. Tumnus, "it is winter in Narnia, and has been for ever so long, and we shall both catch cold if we stand here talking in <u>the</u> snow. Daughter of Eve from <u>the</u> far land of Spare Oom where <u>the</u> summer reigns around <u>the</u> bright city of War Drobe, how would it be if you came and had tea with me?"

"Thank you very much, Mr. Tumnus," said Lucy. "But I was wondering whether I ought to be getting back."

"It's only just round <u>the</u> corner," said <u>the</u> Faun, "and there'll be a roaring fire---and toast---and sardines---and cake."

"Well, it's very kind of you," said Lucy. "But I shan't be able to stay long."

"If you will take my arm, Daughter of Eve," said Mr. Tumnus, "I shall be able to hold <u>the</u> umbrella over both of us. That's <u>the</u> way."

And so Lucy found herself walking through <u>the</u> wood arm in arm with this strange creature as if they had known one another all their lives.

They had not gone far before they came to a place where <u>the</u> ground became rough and there were rocks all about and little hills up and little hills down. At <u>the</u> bottom of one small valley Mr. Tumnus turned suddenly aside as if he were going to walk straight into an unusually large rock, but at <u>the</u> last moment Lucy found he was leading her into <u>the</u> entrance of a cave. As soon as they were inside she found herself blinking in <u>the</u> light of a wood fire. Then Mr. Tumnus stooped and took a flaming piece of wood out of <u>the</u> fire with a neat little pair of tongs and lit a lamp. "Now we shan't be long," he said, and immediately put a kettle on.

4.

Lucy thought she had never been in a nicer place. It was a little, dry, clean cave of reddish stone with a carpet on the floor and two little chairs ("one for me and one for a friend," said Mr. Tumnus) and a table and a dresser and a mantelpiece over the fire and above that a picture of an old Faun with a grey beard. In one corner there was a door which Lucy thought must lead to Mr. Tumnus' bedroom, and on one wall was a shelf full of books. Lucy looked at these while he was setting out the tea things.

"Now, Daughter of Eve," said the Faun.

And really it was a wonderful tea. There was a nice brown egg, lightly boiled for each of them, and then sardines on toast, and then buttered toast, and then toast with honey, and then a sugar-topped cake. And when Lucy was tired of eating the Faun began to talk. He told about the midnight dances and how the Nymphs who lived in the wells and the Dryads who lived in the trees came out to dance with the Fauns; about long hunting parties after the milk-white Stag who could give you wishes if you caught him; about feasting and treasure-seeking with the wild Red Dwarfs in deep mines and caverns far beneath the forest floor, and then about summer when the woods were green and old Silenus on his fat donkey would come to visit them, and sometimes Bacchus himself, and then the streams would run with wine instead of water and the whole forest would give itself up to jollification for weeks on end. "Not that it isn't always winter now," he added gloomily.. Then to cheer himself up he took out from its case on the dresser a strange little flute that looked as if it were made of straw and began to play.

"Oh Mr. Tumnus---I'm so sorry to stop you, and I do love that tune---but really, I must go home."

"It's no good now, you know," said the Faun, laying down his flute and shaking his head at her very sorrowfully.

"No good?" said Lucy, jumping up and feeling rather frightened. "What do you mean? I've got to go home at once. The others will be wondering what has happened to me." But a moment later she asked,"Mr. Tumnus! Whatever is the matter?" for the Faun's brown eyes had filled with tears and then the tears began trickling down his cheeks, and soon they were running off the end of his nose.

"Mr. Tumnus! Mr. Tumnus!" said Lucy in great distress. "Don't! Don't! What is the matter? Aren't you well? Dear Mr. Tumnus, do tell me what is wrong," But the Faun continued sobbing as if his heart would break. And even when Lucy went over and put her arms round him and lent him her handkerchief, he did not stop. He merely took the handkerchief and kept on using it, wringing it out with both hands whenever it got too wet to be any more use, so that presently Lucy was standing in a damp patch.

"Mr. Tumnus!" bawled Lucy in his ear, shaking him. "Do stop. Stop it at once! You ought to be ashamed of yourself, a great big Faun like you. What on earth are you crying about?"

"Oh---oh---oh!" sobbed Mr. Tumnus, "I'm crying because I'm such a bad Faun."

"I don't think you're a bad Faun at all."

"Oh---oh---you wouldn't say that if you knew. No, I'm the bad Faun.

"But what have you done?" asked Lucy.

"My old father, now," said Mr. Tumnus, "that's his picture over the mantelpiece. He would never have done the thing like this."

"A thing like what?" said Lucy.

"Like what I've done," said the Faun. "Taken service under the White Witch. That's what I am. I'm in the pay of the White Witch.

"The White Witch? Who is she?"

"Why, it is she that has got all Narnia under her thumb. It's she that makes it always winter. Always winter and never Christmas; think of that!"

"How awful!" said Lucy. "But what does she pay you for?"

"That's the worst of it," Would you believe that I'm the sort of Faun to meet a poor innocent child in the wood, one that had never done me any harm, and pretend to be friendly with it, and invite it home to my cave, all for the sake of lulling it asleep and then handing it over to the White Witch?"

"No," said Lucy. "I'm sure you wouldn't do anything of the sort."

"But I have,"

"Well, that was pretty bad. But you're so sorry for it that I'm sure you will never do it again."

"Daughter of Eve, don't you understand?" said the Faun. "It isn't something I have done. I'm doing it now, this very moment."

"What do you mean?" cried Lucy, turning very white.

"You are the child. I had orders from the White Witch that if ever I saw the Son of Adam or the Daughter of Eve in the wood, I was to catch them and hand them over to her. And you are the first I ever met. And I've pretended to be your friend and asked you to tea, and all the time I ve been meaning to wait till you were asleep and then go and tell her."

"Oh, but you won't, Mr. Tumnus," said Lucy. "You won't, will you?"

"And if I don't," said he, beginning to cry again, "she's sure to find out. And she'll have my tail cut off, and my horns sawn off, and my beard plucked out, and she'll wave her wand over my beautiful cloven hoofs and turn them into horrid solid hoofs like a wretched horse's."

"I'm very sorry, Mr. Tumnus," said Lucy. "But please let me go home."

"Of course I will," said the Faun. "Of course I've got to. I see that now. I hadn't known what Humans were like before I met you. Of course I can't give you up to the Witch; not now that I know you. But we must be off at once. I'll see you back to the lamp-post. I suppose you can find your own way from there back to Spare Oom and War Drobe?"

"I'm sure I can."

"We must go as quietly as we can. The whole wood is full of the spies. Even some of the trees are on her side."

They both got up and left the tea things on the table, and Mr. Tumnus once more put up the umbrella and gave Lucy his arm, and they went out into the snow. The journey back was not at all like the journey to the Faun's cave; they stole along as quickly as they could, without speaking a word, and Mr. Tumnus kept to the darkest places. Lucy was relieved when they reached the lamp-post again.

"Do you know your way from here, Daughter of Eve?"

Lucy looked very hard between the trees. "Yes. I can see the wardrobe door."

"Then be off home as quick as you can and---c-can you ever forgive me for what I meant to do?"

"Why, of course I can. And I do hope you won't get into dreadful trouble on my account."

"Farewell, Daughter of Eve," said he. "Perhaps I may keep the handkerchief?"

"Rather!" said Lucy, and then ran towards the far-off patch of daylight as quickly as her legs would carry her. And presently instead of rough branches brushing past her she felt coats, and instead of crunching snow under her feet she felt wooden boards, and all at once she found herself jumping out of the wardrobe into the same empty room from which the whole adventure had started.

"I'm here," she shouted. "I'm here. I've come back, I'm all right."

STORY II
EDMUND AND THE WARDROBE

Lucy ran out of the empty room into the passage and found the other three.

"It's all right," she repeated, "I've come back."

"What the earth are you talking about, Lucy?" asked Susan.

"Why?" eaid Lucy in amazement, "haven't you all been wondering where I was?"

"So you've been hiding, have you?" said Peter. "Poor old Lu, hiding and nobody noticed! You'll have to hide longer than that if you want people to etart looking for you."

"But I've been away for hours and hours," said Lucy.

The others all stared at the other.

"Batty!" said Edmund tapping his head. "Quite batty."

"What do you mean, Lu?" asked Peter.

"What I said," answered Lucy. "It was just after breakfast when I went into the wardrobe, and I've been away for hours and hours, and had tea, and all sorts of things have happenod."

"Don't be eilly, Lucy," said Susan. "We've only just come out of the room a moment ago, and you were there then."

"She's not being silly at all," said Peter, "she's just making up the story for fun, aren't you, Lu? And why shouldn't she?"

"No, Peter, I'm not," she said. "It'e---it's the magic wardrobe. There's a wood inside it, and the enow, and there's the Faun and the witch and it's called Narnia; come and see."

The others did not know what to think, but Lucy was so excited that they all went back with her into the room. She rushed ahead of them, flung open the door of the wardrobe and cried, "Now! go in and see for yourselvee."

"Why you goose," said Susan, putting her head inside and pulling the fur coats apart, "it's juet an ordinary wardrobe, look! there's the back of it."

Then everyone looked in and pulled the coats apart; and they all saw---Lucy herself saw---the perfectly ordinary wardrobe. There was no wood and no snow, only the back of the wardrobe, with hooks on it. Peter went in and rapped his knuckles on it to make sure that it was solid.

"A jolly good hoax, Lu," he said as he came out again, "you have really taken us in, I must admit. We half believed you."

"But it wasn't a hoax at all," said Lucy, "really and truly. It was all different a moment ago. Honestly it was. I promisê."

"Come Lu," said Peter, "that's going a bit far. You've had your joke. Hadn't you better drop it now?"

Lucy grew very red in the face and tried to say something, though she hardly knew what ehe was trying to say, and burst into tears.

For the next few days she was very miserable. She could have made it up with the others quite easily at any moment if she could have brought herself to say that the whole thing was only a etory made up for fun. But Lucy was a very truthful girl and she knew that she was really in the right; and she could not bring herself to say this. The others who thought she was telling the lie, and a silly lie too, made her very unhappy. The two elder ones did this without meaning to do it, but Edmund could be epiteful, and on this occasion he was epiteful. He eneered and jeered at Lucy and kept on asking her if she'd found any other new countries in the cupboards all over the house. What made it worse was that these days ought to have been delightful. The weather was fine and they were out of doors from morning to night, bathing, fishing, climbing trees, birde' nesting, and lying in the heather. But Lucy could not properly enjoy any of it. And so things went until the next wet day.

That day, when it came to the afternoon and there was still no sign of a break in the weather, they decided to play hide-and-eeek. Susan was "It" and as eoon as the others ecattered to hide, Lucy went to the room where the wardrobe was. She did not mean to hide in the wardrobe, because she knew that would only eet the others talking again about the whole wretched bueiness. But she did want to have one more look inside it; for by thie time she was beginning to wonder herself whether Narnia and the Faun had not been the dream. The house was so large and complicated and full of hiding places that she thought she would have time to have one look in the wardrobe and then hide somewhere else. But as soon as she reached it she heard steps in the passage outside, and then there was nothing for it but to jump into the wardrobe and hold the door closed behind her. She did not shut it properly because she knew that it is very silly to shut oneself into a wardrobe, even if it is not the magic one.

Now the steps she had heard were those of Edmund; and he came into the room just in time to see Lucy vanishing into the wardrobe. He at once decided to get into it himself---not because he thought it a particularly good place to hide but because he wanted to go on teasing her about the imaginary country. He opened the door. There were the coats hanging up as usual, and a smell of moth-balls, and darkness and silence, and no sign of Lucy. "She thinks I'm Susan come to catch her," said Edmund to himself, "and so she's keeping very quiet in at the back." He jumped in and shut the door, forgetting what a very foolish thing this is to do. Then he began feeling about for Lucy in the dark. He had expected to find her in the few seconds and was very surprised when he did not. He decided to open the door again and let in the light. But he could not find the door either. He didn't like this at all and began groping wildly in every direction; he even shouted out, "Lucy! Lu! Where are you? I know you're here."

There was no answer and Edmund noticed that his own voice had a curious sound---not the sound you expect in a cupboard but a kind of open-air sound. He also noticed that he was unexpectedly cold;: and then he saw a light.

"Thank goodness," said Edmund, "the door must have swung open of its own accord." He forgot all about Lucy and went towards the light which he thought was the open door of the wardrobe. But instead of finding himself stepping out into the spare room he found himself stepping out from the shadow of some dark fir trees into the open place in the middle of a wood.

There was crisp, dry snow under his feet and more snow lying on the branches of the trees. Overhead there was a pale blue sky, the sort of sky one sees on a fine winter day in the morning. Straight ahead of him he saw between the tree trunks the sun, just rising, very red and clear. Everything was perfectly still, as if he were the only living creature in the country. There was not even a robin or a squirrel among the trees, and the wood stretched as far as he could see in every direction. He shivered.

He now remembered that he had been looking for Lucy, and also how unpleasant he had been to her about her "imaginary country" which now turned out not to have been imaginary at all. He thought that she must be somewhere quite close and so he shouted, "Lucy! Lucy! I'm here too--Edmund."

There was no answer.

"She's angry about all the things I've been saying lately," thought Edmund. And though he did not like to admit that he had been wrong, he also did not much like being alone in the strange, cold, quiet place; so he shouted again.

"I say, Lu! I'm sorry I didn't believe you. I see now you were right all along. Do come out. Make it Pax."

Still there was no answer.

"Just like the girl," said Edmund to himself, "sulking somewhere, and won't accept an apology." He looked round him again and decided he did not much like this place, ana had almost made up his mind to go home, when he heard, very far off in the wood, a sound of bells. He listened and the sound came nearer and nearer and at last there swept into sight a sledge drawn by two reindeer.

The reindeer were about the size of Shetland ponies and their hair was so white that even the snow hardly looked white compared with them; their branching horns were gilded and shone like something on fire when the sunrise caught them. Their harness was of scarlet leather and covered with bells. On the sledge, driving the reindeer, sat a fat dwarf who would have been about three feet high if he had been standing. He was dressed in polar bear's fur and on his head he wore a red hood with a long gold tassel hanging down from its point, his huge

3.

beard covered his knees and served him instead of a rug. But behind him, on a much higher seat in the middle of the sledge sat a very different person---a great lady, taller than any woman that Edmund had ever seen. She also was covered in white fur up to her throat and held a long straight golden wand in her right hand and wore a golden crown on her head. Her face was white---not merely pale, but white like snow or paper or icing sugar, except for her very red mouth. It was a beautiful face in other respects, but proud and cold and stern.

The sledge was a fine sight as it came sweeping towards Edmund with the bells jingling and the Dwarf cracking his whip and the snow flying up on each side of it.

"Stop!" said the lady, and the Dwarf pulled the reindeer up so sharp that they almost sat down. Then they recovered themselves and stood champing their bits and blowing. In the frosty air the breath coming out of their nostrils looked like smoke.

And what, pray, are you?" said the Lady, looking hard at Edmund.

"I'm---I'm---my name's Edmund," said Edmund rather awkwardly. He did not like the way she looked at him.

The Lady frowned. "Is that how you address a Queen?" she asked, looking sterner than ever.

"I beg your pardon, your Majesty, I didn't know," said Edmund.

"Not know the Queen of Narnia?" cried she. "Ha! You shall know us better hereafter. But I repeat---what are you?"

"Please, your Majesty," said Edmund, "I don't know what you mean. I'm at school---at least I was---it's the holidays now."

TURKISH DELIGHT

"But what are you?" said the Queen again. "Are you a great overgrown dwarf that has cut off its beard.

"No, your Majesty," said Edmund, "I never had a beard, I'm a boy."

"A boy!" said she. "Do you mean you are a Son of Adam?"

Edmund stood still, saying nothing. He as too confused by this time to understand what the question meant.

"I see you are an idiot, whatever else you may be," said the Queen. Answer me, once and for all, or I shall lose my patience. Are you human?"

"Yes, your Majesty," said Edmund.

"And how, pray, did you come to enter my dominions?

"Please, your Majesty, I came in through a wardrobe."

"A wardrobe? What do you mean?"

"I---I opened a door and just found myself here, your Majesty," said Edmund.

"Ha!" said the Queen, speaking more to herself than to him. "A door. A door from the world of men! I have heard of such things. This may wreck all. But he is only one, and he is easily dealt with." As she spoke these words she rose from her seat and looked Edmund full in the face, her eyes flaming, at the same moment she raised her wand. Edmund felt sure that she was going to do something dreadful but he seemed unable to move. Then, just as he gave himself up for lost, she appeared to change her mind.

"My poor child," she said in quite a different voice, "how cold you look! Come and sit with me here on the sledge and I will put my mantle around you and we will talk."

Edmund did not like this arrangement at all but he dared not disobey; he stepped on to the sledge and sat at her feet, and she put a fold of her fur mantle around him and tucked it well in.

"Perhaps something hot to drink?" said the Queen. "Should you like that?"

"Yes, please, your Majesty," said Edmund, whose teeth were chattering.

The Queen took from somewhere among her wrappings a very small bottle which looked as if it were made of copper. Then, holding out her arm, she let one drop fall from it on to the snow beside the sledge. Edmund saw the drop for a second in mid-air, shining like a diamond. But the moment it touched the snow

4.

there was a hissing sound and there stood the jewelled cup full of something that steamed. The Dwarf immediately took this and handed it to Edmund with a bow and a smile; not a very nice smile. Edmund felt much better as he began to sip the hot drink. It was something he had never tasted before, very sweet and foamy and creamy, and it warmed him right down to his toes.

"It is dull, Son of Adam, to drink without eating," said the Queen presently. "What would you like best to eat?"

"Turkish Delight, please, your Majesty," said Edmund.

The Queen let another drop fall from her bottle on to the snow, and instantly there appeared the round box, tied with green silk ribbon, which, when opened, turned out to contain several pounds of the best Turkish Delight. Each piece was sweet and light to the very centre and Edmund had never tasted anything more delicious. He was quite warm now, and very comfortable.

While he was eating the Queen kept asking him questions. At first Edmund tried to remember that it is rude to speak with one's mouth full, but soon he forgot about this and thought only of trying to shovel down as much Turkish Delight as he could, and the more he ate, the more he wanted to eat, and he never asked himself why the Queen should be so inquisitive. She got him to tell her that he had one brother and two sisters, and that one of the sisters had already been in Narnia and had met the Faun there, and that no one except himself and the brother and the sisters knew anything about Narnia. She seemed especially interested in the fact that there were four of them, and kept on coming back to it. "You are sure there are just four of you?" she asked. "The Sons of Adam and the Daughters of Eve, neither more nor less?" and Edmund, with his mouth full of Turkish Delight, kept on saying, "Yes, I told you that before," and forgetting to call her "Your Majesty? but she didn't seem to mind now.

At last the Turkish Delight was all finished and Edmund was looking very hard at the empty box and wishing that she would ask him whether he would like some more. Probably the Queen knew quite well what he was thinking; for she knew, though Edmund did not, that this was enchanted Turkish Delight and that anyone who had once tasted it would want more and more of it, and would even, if they were allowed, go on eating it till they killed themselves. But she did not offer him any more. Instead, she said to him,

"Son of Adam, I should so much like to see the brother and the two sisters. Will you bring them to me?"

"I'll try," said Edmund, still looking at the empty box.

"Because, if you did come again--bringing them with you of course---I'd be able to give you the Turkish Delight. I can't do it now, the magic will only work the once. In my own house it would be another matter."

"Why can't we go to the house now?" said Edmund. When he had first got on to the sledge he had been afraid that she might drive away with him to the unknown place from which he would not be able to get back, but he had forgotten about the fear now.

"It is a lovely place, my house," said the Queen. "I am sure you would like it. There are whole rooms full of Turkish Delight, and what's more, I have no children of my own. I want a nice boy whom I could bring up as a Prince and who would be King Of Narnia when I am gone. While he was Prince he would wear the gold crown and eat Turkish Delight all day long; and you are much the cleverest and handsomest young man I've ever met. I think I would like to make you the Prince---some day, when you bring the others to visit me."

"Why not now?" said Edmund. His face had become very red and his mouth and fingers were sticky. He did not look either clever or handsome whatever the Queen might say.

"Oh, but if I took you there now," said she, "I shouldn't see your brother and your sisters. I very much want to know your charming relations. You are to be the Prince and---later on---the King; that is understood. But you must have courtiers and nobles. I will make your brother the Duke and your sisters Duchesses."

"There's nothing special about them," said Edmund, "and, anyway, I could always bring them some other time."

"Ah, but once you were in my house," said the Queen, "you might forget all about them. You would be enjoying yourself so much that you wouldn't want the bother of going to fetch them. No. You must go back to your own country now and come to me another day, with them, you understand. It is no good coming without them."

"But I don't even know the way back to my own country," pleaded Edmund.

"That's easy," answered the Queen. "Do you see the lamp?" She pointed with her wand and Edmund turned and saw the same lamppost under which Lucy had met the Faun. "Straight on, beyond that, is the way to the World of Men. And now look the other way"---here she pointed in the opposite direction---"and tell me if you can see the little hills rising above the trees."

"I think I can," said Edmund.

"Well, my house is between the two hills. So next time you come you have only to find the lamp-post and look for those two hills and walk through the wood till you reach my house. You had better keep the river on the right when you get to it. But remember---you must bring the others with you. I might have to be very angry with you if you came alone."

"I'll do my best," said Edmund.

"And, by the way," said the Queen, "you needn't tell them about me. It would be fun to keep it a secret between us two, wouldn't it? Make it a surprise for them. Just bring them along to the two hills---a clever boy like you will easily think of the excuse for doing that---and when you come to the house you could just say 'Let's see who lives here' or something like that. I am sure that would be best. If your sister has met one of the Fauns, she may have heard strange stories about me---nasty stories that might make her afraid to come to me. Fauns will say anything, you know, and now---"

"Please, please," said Edmund suddenly, "please couldn't I have just one piece of Turkish Delight to eat on the way home?"

"No, no," said the Queen with a laugh, "you must wait till next time." While she spoke, she signalled to the Dwarf to drive on, but as the sledge swept away out of sight, the Queen waved to Edmund calling out, "Next time! Next time! Don't forget. Come soon."

Edmund was still staring after the sledge when he heard someone calling his name, and looking round he saw Lucy coming towards him from another part of the wood.

"Oh, Edmund!" she cried. "So you've got in too! Isn't it wonderful, and the---"

"All right," said Edmund, "I see you were right and it is the magic wardrobe after all. I'll say I'm sorry if you like. But where on earth have you been all this time? I've been looking for you everywhere."

STORY III
BACK ON THIS SIDE OF THE DOOR

Because the game of hide-and-seek was still going on, it took Edmund and Lucy some time to find the others. But when at last they were all together (which happened in the long room, where the suit of armour was) Lucy burst out, "Peter! Susan! It's all true. Edmund has seen it too. There is the country you can get to through the wardrobe. Edmund and I both got in. We met one another in there, in the wood. Go on, Edmund; tell them all about it.

"What's all this about, Ed?" said Peter.

And now we come to one of the nastiest things in the story. Up to the moment Edmund had been feeling sick, and sulky, and annoyed with Lucy for being right, but he hadn't made up his mind what to do. When Peter suddenly asked him the question he decided all at once to do the meanest and most spiteful thing he could think of. He decided to let Lucy down.

"Tell us, Ed," said Susan.

And Edmund gave the very superior look as if he were far older than Lucy (There was really only the year's difference) and then the little snigger and said "Oh, yes, Lucy and I have been playing---pretending that all the story about a country in the wardrobe is true. Just for fun, of course, There's nothing there really."

Poor Lucy gave Edmund one look and rushed out of the room.

Edmund, who was becoming a nastier person every minute, thought that he had scored a great success, and went on at once to say, "There she goes again. What's the matter with her? That's the worst of young kids, they always---"

"Look here," said Peter turning on him savagely, "shut up! You've been perfectly beastly to Lu ever since she started this nonsense about the wardrobe and now you go playing games with her about it and setting her off again. I believe you did it simply out of spite."

"But it's all nonsense," said Edmund, very taken aback.

"Of course it's all nonsense," said Peter, "that's just the point. Lu was perfectly all right when we left home, but since we've been down here she seems to be either going queer in the head or else turning into the most frightful liar. But whichever it is, what good do you think you'll do by jeering and nagging the one day and encouraging her the next?"

"I thought---I thought," said Edmund; but he couldn't think of anything to say.

"You didn't think anything at all," said Peter, "It's just spite. You've always liked being beastly to anyone smaller than yourself; we've seen that at the school before now."

"Do stop it," said Susan; "it won't make things any better having the row between you two. Let's go and find Lucy."

It was not surprising that when they found Lucy, the good deal later, everyone could see that she had been crying. Nothing they could say to her made any difference. She stuck to the story and said:

"I don't care what you think, and I don't care what you say. You can tell the Professor or you can write to Mother or you can do anything you like. I know I've met the Faun in there and ---I wish I'd stayed there and you are the beasts, beasts."

It was an unpleasant evening. Lucy was miserable and Edmund was beginning to feel that the plan wasn't working as well as he had expected. The two older ones were really beginning to think that Lucy was out of her mind. They stood in the passage talking about it in whispers long after she had gone to bed.

The result was that next morning they decided that they really would go and tell the whole thing to the Professor. "He'll write to Father if he thinks there is really something wrong with Lu," said Peter; "it's getting beyond us." So they went and knocked at the study door, and the Professor said "Come in," and got up and found chairs for them and said he was quite at their disposal. Then he sat listening to them with the tips of his fingers pressed together and never interrupting, till they had finished the whole story. After that he eaid nothing for quite the long time. Then he cleared hie throat and eaid the last thing either of them expected.

"How do you know?" he asked, "that your sister's story is not true?"

"Oh, but---" Anyone could eee from the old man's face that he was perfectly eerious. Then Susan pulled herself together and said, "But Edmund said they had only been pretending."

"That ie a point," eaid the Professor, "which certainly deserves consideration; very careful consideration. For instance---if you will excuse me for asking the question---does your experience lead you to regard your brother or your sister as the more reliable? I mean, which is the more truthful?"

"That's just the funny thing about it, Sir," said Peter, Up till now, I'd have said Lucy every time."

"And what do you think, my dear?" said the Professor, turning to Susan.

"Well," said Susan, "in general, I'd say the same as Peter, but thie couldn't be true---all this about the wood and the Faun."

"That is more than I know," said the Professor, "and the charge of lying against someone whom you have always found truthful is the very serious thing; a very serious thing indeed."

"We were afraid it mightn't even be lying," said Susan. "We thought there might be something wrong with Lucy."

"Madness, you mean?" said the Profeeeor quite coolly. "Oh, you can make your minds easy about that. One has only to look at her and talk to her to see that she ie not mad."

"But then," said Susan and stopped. She had never dreamed that a grown-up would talk like the Professor and didn't know what to think.

"Logic!" said the Professor half to himself. "Why don't they teach logic at the echoole? There are the three possibilitiee. Either your sister is telling lies, or she is mad, or she is telling the truth. You know she doesn't tell lies and it ie obvious that ehe is not mad. For the moment then and unless any further evidence turns up, we must assume that she ie telling the truth."

Susan looked at him very hard and was quite eure from the expreesion on his face that he was not making fun of them.

"But how could it be true, Sir?" said Peter.

"Why do you say that?" asked the Profeeeor.

"Well, for one thing," said Peter, "if it was real why doesn't everyone find the country every time they go to the wardrobe? I mean, there was nothing there when we looked; even Lucy didn't pretend there was."

"What has that to do with it?" said the Professor.

"Well, Sir, if things are real, they're there all the time."

"Are they?" said the Profeesor; and Peter did not know quite what to say.

"But there was no time," said Susan, "Lucy had had no time to have gone anywhere, even if there was such a place. She came running after us the very moment we were out of the room. It was lees than the minute, and she pretended to have been away for hours."

"That ie the very thing that makes her story so likely to be true," said the Professor. "If there really ie the door in this house that leads to the other world (and I should warn you that this ie a very strange house, and even I know very little about it)---if, I say, she had got into another world, I should not be surprieed to find that the other world had a separate time of its own; so that however long you stayed there it would never take up any of our time. On the other hand, I don't think many girls of her age would invent the idea for themselves. If she had been pretending, ehe would have hidden for a reasonable time before coming out and telling the etory."

"But do you really mean, Sir," said Peter, "that there could be other worlds---

3.

all over the place, just round the corner---like that?"

"Nothing is more probable," said the Professor, taking off his spectacles and beginning to polish them, while he muttered to himself, "I wonder what they do teach them at these schools."

"But what are we to do?" said Susan. She felt that the conversation was beginning to get off the point.

"My dear young lady," said the Professor suddenly looking up with a very sharp expression at both of them, "there is one plan which no one has yet suggested and which is well worth trying."

"What's that?" said Susan.

"We might all try minding our own business," said he. And that was the end of that conversation.

After this things were a good deal better for Lucy. Peter saw to it that Edmund stopped jeering at her, and neither she nor anyone else felt inclined to talk about the wardrobe at all. It had become a rather alarming subject. And for a time it looked as if all the adventures were coming to an end; but that was not to be.

This house of the Professor's---which even he knew so little about---was so old and famous that people from all over England used to come and ask permission to see over it. It was the sort of house that is mentioned in guide books and even in histories; and well it might be for all manner of stories were told about it, some of them even stranger than the one I am telling you now. And when parties of sight-seers arrived and asked to see the house, the Professor always gave them permission, and Mrs. Macready, the housekeeper, showed them around, telling them about the pictures, and the armour, and the rare books in the library. Mrs. Macready was not fond of children, and did not like to be interrupted when she was telling visitors all the things she knew. She had said to Susan and Peter almost on the first morning (along with a good many other instructions) "And please remember you're to keep out of the way whenever I'm taking a party over the house."

"Just as if any of us would want to waste half the morning trailing round with a crowd of strange grown-ups!" said Edmund, and the other three thought the same. That was how the adventures began for the second time.

A few mornings later Peter and Edmund were looking at the suit of armour and wondering if they could take it to bits when the two girls rushed into the room and said, "Look out! Here comes Mrs. Macready and a whole gang with her."

"Sharp's the word," said Peter, and all four made off through the door at the far end of the long room. But when they had got out into a Green Room and beyond it, into a library, they suddenly heard voices ahead of them, and realized that Mrs. Macready must be bringing her party of sight-seers up the back stairs---instead of up the front stairs as they had expected. And after that---whether it was that they lost their heads, or that Mrs. Macready was trying to catch them, or that some magic in the house had come to life and was chasing them into Narnia---they seemed to find themselves being followed everywhere, until at last Susan said, "Oh bother those trippers! Here---let's get into the Wardrobe Room till they've passed. No one will follow us in there." But the moment they were inside they heard voices in the passage---and then someone fumbling at a door---and then they saw a handle turning.

"Quick!" said Peter, "there's nowhere else," and flung open the wardrobe. All four of them ran and bundled inside it and sat there, panting, in the dark. Peter held the door closed but did not dare shut it; for, of course, he remembered, as every sensible person does, that you should never shut yourself up in a wardrobe.

INTO THE FOREST

"I wish the Macready would hurry up and take all these people away," said Susan presently, "I'm getting horribly cramped."

4.

"And what a filthy smell of camphor! said Edmund.

"I expect the pockets of these coats are full of it, Said Susan, "to keep away moths."

"There's something sticking into my back," said Peter.

"And isn't it cold?" Said Susan.

"Now that you mention it, it is cold," said Peter, "and hang it all, it's wet too. What's the matter with the place? I'm sitting on something wet. It's getting wetter every minute." He struggled to his feet.

"Let's get out,' said Edmund, "they've gone."

"O-o-oh!" said Susan suddenly. And everyone asked her what was the matter.

"I'm sitting against the tree," said Susan, "and look! It's getting ligher---over there."

"By jove, you're right," said Peter, "and look there---and there, the trees all round. And the wet stuff is snow. Why, I do believe we've got into the wood after all."

And now there was no mistaking it and all the children stood blinking in the daylight of the winter day. Behind them were coats hanging on pegs,. in front of them were snow-covered trees.

Peter turned the once to Lucy.

"I apologise for not believing you," he said, "I'm sorry. Will you shake hands?"

"Of course," said Lucy, and did.

"And now," said Susan, "What do we do next?'

"Do?" said Peter, "why, go and explore the wood, of course."

"Ugh!" said Susan, stamping her feet, "It's pretty cold. What about putting on some of the coats?"

"They're not ours," said Peter doubtfully.

"I am sure nobody would mind," said Susan. "It isn't as if we wanted to take them out of the house; we shan't take them even out of the wardrobe."

"I never thought of that, Su, said Peter. "Of course, now you put it that way, I see. No one could say you had bagged the coat as long as you leave it in the wardrobe where you found it. And I suppose the whole country is in the wardrobe."

They immediately carried out Susan's very sensible plan. The coats were rather too big for them so that they came down to the heels and looked more like royal robes than coats when they had put them on. But they all felt a good deal warmer and each thought the others looked better in their new get-up and more suitable to the landscape.

"We can pretend we are Arctic explorers," said Lucy.

"This is going to be exciting enough without any pretending," said Peter, as he began leading the way forward into the forest. There were heavy darkish clouds overhead and it looked as if there might be more snow before night.

"I say," began Edmund presently, "oughtn't we to be bearing a bit more to the left, that is, if we are aiming for the lamp-post." He had forgotten for the moment that he must pretend never to have been in the wood before. The moment the words were out of his mouth he realised that he had given himself away. Everyone stopped; everyone stared at him. Peter whistled.

"So you really were here," he said, "the time Lu said she'd met you in here---and you made out she was telling lies."

There was a dead silence. "Well, of all the poisonous little beasts---" said Peter and shrugged his shoulders and said no more. There seemed, indeed, no more to say and presently the four resumed their journey; but Edmund was saying to himself, "I'll pay you all out for this, you pack of stuck-up, self-satisfied prigs."

"Where are we going anyway?" said Susan, chiefly for the sake of changing the subject.

"I think Lu ought to be the leader," said Peter, "goodness knows she deserves it. Where will you take us, Lu?"

"What about going to see Mr. Tumnus?" said Lucy. "He's the nice Faun I told about."

Everyone agreed to this and off they went, walking briskly and stamping their feet. Lucy proved a good leader. At first she wondered whether she would be able to find the way, but she recognized an odd-looking tree in one place and a stump in another and brought them on to where the ground became uneven and into the little valley and at last to the very door of Mr. Tumnus' cave. But there a terrible surprise awaited them.

The door had been wrenched off its hinges and broken to bits. Inside, the cave was dark and cold and had the damp feel and smell of a place that had not been lived in for several days. Snow had drifted in from the doorway and was heaped on the floor, mixed with something black, which turned out to be the charred sticks and ashes from the fire. Someone had apparently flung it about the room and then stamped it out. The crockery lay smashed on the floor and the picture of the Faun's father had been slashed into shreds with a knife.

"This is a pretty good wash-out," said Edmund, "not much good coming here."

"What's this?" said Peter, stooping down. He had just noticed a piece of paper which had been nailed through the carpet to the floor.

"Is there anything written on it?" asked Susan.

"Yes, I think there is," answered Peter, "but I can't read it in this light. Let's get out into the open air."

They all went out in the daylight and crowded round Peter as he read out the following words:---

> "The former occupant of these premises, Faun Tumnus, is under arrest and awaiting his trial on a charge of High Treason against her Imperial Majesty Jadis, Queen of Narnia, Chatelaine of Cair Paravel, Empress of Lone Islands, etc., also of comforting her said Majesty's enemies, harbouring spies and fraternising with Humans.
>
> Signed Fenris Ulf,
> Captain of the Secret Police,
>
> LONG LIVE THE QUEEN!"

The children stared at each other.

"I don't know that I'm going to like this place after all," said Susan.

"Who is this Queen, Lu,?" said Peter. "Do you know anything about her?"

"She isn't a real queen at all," answered Lucy, "she's a horrible witch, the White Witch. Everyone---all the wood people---hate her. She has made an enchantment over the whole country so that it is always winter here and never Christmas."

"I---I wonder if there's any point in going on," said Susan. "I mean, it doesn't seem particularly safe here and it looks as if it won't be much fun either. And it's getting colder every minute, and we've brought nothing to eat. What about just going home?"

"Oh, but we can't, we can't," said Lucy suddenly. "Don't you see? We can't just go home, not after this. It is all on my account that the poor Faun has got into the trouble. He hid me from the Witch and showed me the way back. That's what it means by comforting the Queen's enemies and fraternising the Humans. We simply must try to rescue him."

"A lot we could do!" said Edmund, "when we haven't even got anything to eat!"

"Shut up---you!" said Peter, who was still very angry with Edmund. "What do you think, Susan?"

"I've a horrid feeling that Lu is right," said Susan. "I don't want to go a step further and I wish we'd never come. But I think we must try to do something for the Whatever-his-name is---I mean the Faun."

"That's what I feel too," said Peter. "I'm worried about having the food us. I'd vote for going back and getting something from the larder, only there doesn't seem to be any certainty of getting into the country again when once you've got out of it. I think we'll have to go on."

6.

"So do I," said both <u>the</u> girls.

"If only we knew where <u>the</u> poor chap was imprisoned!" said Peter.

They were all still, wondering what to do next, when Lucy said, "Look! There's <u>the</u> robin, with <u>the</u> red breast. It's <u>the</u> first bird I've seen here. I say!---I wonder can <u>the</u> birds talk in Narnia? It almost looks as if it wanted to say something to us." Then she turned to <u>the</u> Robin and said, "Please, can you tell us where Tumnus <u>the</u> Faun has been taken to?" As she said this she took a step towards <u>the</u> bird. It at once hopped away but only as far as to <u>the</u> next tree. There it perched and looked at them.

STORY FOUR
WHAT HAPPENED AFTER DINNER

"And now," said Lucy, "do please tell us what's happened to the Tumnus."

"Ah, that's bad," said the Beaver shaking his head. "That's a very, very bad business. There's no doubt he was taken off by the police. I got that from the bird who saw it done."

"But where's he been taken to?' asked Lucy.

"Well, they were heading northwards when they were last seen and we all know what that means."

"No, we don't," said Susan. But the Beaver shook his head in the very gloomy fashion.

"I'm afraid it means they were takimg him to the house," said the Beaver.

"But what'll they do to him, Mr. Beaver?" gasped Lucy.

"Well," said the Beaver, "you can't exactly say for sure. But there's not many taken in there that ever comes out again. Statues. All full of statues they say it is---in the courtyard and up the stairs and in the hall. People she's turned---"(he paused and shuddered) "turned into stone."

"But, Mr. Beaver," said Lucy, "Can't we---I mean we must do something to save him. It's too dreadful and it's all on my account."

"I don't doubt you'd save him if you could, dearie," said the Beaver, "but you've no chance of getting into the House against the will and ever coming out alive."

"Couldn't we have some stratagem?" said Peter. "I mean couldn't we dress up as something, or pretend to be---the pedlars or anything---or watch till she was gone out---or---oh, hang it all, there must be some way. The Faun saved my sister at his own risk, Mr. Beaver. We can't just leave him to be---to be---to have that done to him."

"It's no good, Son of Adam," said the Beaver, "no good your trying, of all people. But now that Aslan is on the move---"

"Oh, yes! Tell us about Aslan!" said several voices at once; for once again that strange feeling---like the first signs of spring, like good news, had come over them.

"Who is Aslan?" asked Susan.

"Aslan?" said the Beaver, "Why don't you know? He's the King. He's the Lord of the whole wood, but not often here, you understand. Never in my time or my father's time. But the word has reached us that he has come back. He is in Narnia at the moment. He'll settle the White Queen all right. It is he, not you, that will save The Tumnus."

"She won't turn him into stone, too?" said Edmund.

"Lord love you, Son of Adam, what a simple thing to say!" answered the Beaver with a great laugh. "Turn him into stone? If she can stand on her two feet and look him in the face it'll be the most she can do and more than I expect of her. No, no. He'll put all to rights as it says in an old rhyme in these parts:--

Wrong will be right, when Aslan comes in sight,
At the sound of his roar, sorrows will be no more,
When he bares his teeth, winter meets its death
And when he shakes his mane, we shall have spring again.

You'll understand when you see him."

"But shall we see him?" asked Susan.

"Why, Daughter of Eve, that's what I brought you here for. I'm to lead you where you shall meet him," said the Beaver.

"Is---is he a man?" asked Lucy.

"Aslan a man!" said the Beaver sternly. "Certainly not. I tell you he is the King of the wood and the son of the great Emperor-Beyond-the-Sea. Don't you know who is the King of Beasts? Aslan is a lion---the Lion, the great Lion."

2.

"Ooh!" said Susan, "I'd thought he was a man. Is he---quite safe? I shall feel rather nervous about meeting the lion."

"That you will, dearie, and no mistake," said the Beaver, "if there's anyone who can appear before Aslan without their knees knocking, they're either braver than most or else just silly."

"Then he isn't safe?" said Lucy.

"Safe?" said the Beaver. "Don't you hear what Mrs. Beaver tells you? Who said anything about safe? 'Course he isn't safe. But he's good. He's the King, I tell you."

"I'm longing to see him," said Peter, "Even if I do feel frightened when it comes to the point."

"That's right, Son of Adam," said the Beaver bringing his paw down on the table with a crash that made all the cups and saucers rattle. "And so you shall. Word has been sent that you are to meet him, tomorrow if you can, at the Stone Table."

"Where's that?" said Lucy.

"I'll show you," said the Beaver. "It's down the river, a good step from here. I'll take you to it!"

"But meanwhile what about poor Mr. Tumnus?" said Lucy.

"The quickest way you can help him is by going to meet Aslan," said the Beaver, "once he's with us, then we can begin doing things. Not that we don't need you too. For that's another of the old rhymes:---

When Adam's flesh and Adam's bone
Sits at Cair Paravel in throne,
The evil time will be over and done.

"So things must be drawing near their end now he's come and you've come. We've heard of Aslan coming into these parts before---long ago, nobody can say when. But there's never been any of your race here before."

"That's what I don't understand, Mr. Beaver," said Peter, "I mean isn't the Witch herself human?"

"She'd like us to believe it," said the Beaver, "and it's on that that she bases her claim to be Queen. But she's no Daughter of Eve. She comes of your father Adam's---"(here Mr. Beaver bowed)"your father Adam's first wife, her they called Lilith. And she was one of the Jinn. That's what she comes from on one side. And on the other she comes of the giants. No, no, there isn't a drop of real Human blood in the Witch."

"That's why she's bad all through, Mr. Beaver," said Mrs. Beaver.

"True enough, Mrs. Beaver," replied he, "there may be the views about Humans (meaning no offence to the present company). But there's no two views about things that look like Humans and aren't."

"I've known good dwarfs," said Mrs. Beaver.

"So've I, now you come to speak of it," said her husband, "but precious few, and they were the ones least like men. But in general, take my advice, when you meet anything that's going to be Human and isn't yet, or used to be Human once and isn't now or ought to be Human and isn't, you keep your eyes on it and feel for your hatchet. And that's why the Witch is always on the lookout for the Humans in Narnia. She's been watching for you this many a year, and if she knew there were four of you she'd be more dangerous still."

"What's that to do with it?" asked Peter.

"Because of another prophecy," said the Beaver. "Down at Cair Paravel---that's the castle on the sea coast down at the mouth of the river which ought to be the capital of the whole country if all was as it should be---down at Cair Paravel there are four thrones and it's a saying in Narnia time out of mind that when the Sons of Adam and the Daughters of Eve sit in those four thrones, then it will be the end not only of the White Witch's reign but of her life, and that is why we had to be so cautious as we came along, for if she knew about you four,

3.

your lives wouldn't be worth a shake of my whiskers!"

All the children had been attending so hard to what Mr. Beaver was telling them that they had noticed nothing else for a long time. Then during the moment of silence that followed his last remark, Lucy suddenly said:

"I say---where's Edmund?"

There was a dreadful pause, and then everyone began asking "Who saw him last? How long has he been missing? Is he outside?" And then all rushed to the door and looked out. The snow was falling thickly and steadily, the green ice of the pool had vanished under a thick white blanket, and from where the little house stood in the centre of the dam you could hardly see either bank. Out they went, plunging well over the ankles into the soft new snow, and went round the house in every direction. "Edmund! Edmund!" they called till they were hoarse. But the silently falling snow seemed to muffle the voices and there was not even an echo in answer.

"How perfectly dreadful!" said Susan as they at last came back in despair. "Oh, how I wish we'd never come."

"What on earth are we to do, Mr. Beaver?" said Peter.

"Do?" said the Beaver who was already putting on his snow boots, "Do? We must be off at once. We haven't the moment to spare!"

"We'd better divide into four search parties," said Peter, "and all go in different directions. Whoever finds him must come back here the once---"

"Search parties, Son of Adam?" said the Beaver, "what for?"

"Why, to look for Edmund of course!"

"There's no point in looking for him," said the Beaver.

"What do you mean?" said Susan, "he can't be far away yet. And we've got to find him. What do you mean when you say there's no use looking for him?"

"The reason there's no use looking," said the Beaver, "is that we know already where he's gone!" Everyone stared in amazement. "Don't you understand?" said the Beaver. "He's gone to her, to the White Witch. He has betrayed us all."

"Oh, surely---oh really!" said Susan, he can't have done that."

"Can't he?" said the Beaver looking very hard at the three children, and everything they wanted to say died on their lips for each felt suddenly quite certain inside that this was exactly what Edmund had done.

"But will he know the way?" said Peter.

"Has he been in this country before?" asked the Beaver, "has he ever been here alone?"

"Yes," said Lucy almost in a whisper, "I'm afraid he has."

"And did he tell you what he'd done or who he'd met?"

"Well, no, he didn't," said Peter.

"Then mark my words," said the Beaver, "he has already met the White Witch and joined her side, and been told where she lives. I did't like to mention it before (he being your brother and all) but the moment I set eyes on the brother of yours I said to myself 'Treacherous.' He had the look of one who has been with the Witch and eaten the food. You can always tell them if you've lived long in Narnia, something about the eyes."

"All the same," said Peter in a rather choking sort of voice, "we'll still have to go and look for him. He is our brother after all, even if he is rather the little beast, and he's only the kid."

"Go to the Witch's house?" said Mrs. Beaver. "Don't you see that the only chance of saving either him or yourselves is to keep away from her?"

"How do you mean?" said Lucy.

"Why all she wants is to get all four of you (she's thinking all the time of those four thrones at Cair Paravel). Once you were all four inside the house the job would be done---and there'd be four new statues in her collection before you'd had time to speak. But she'll keep him alive as long as he's the only one she's got, because she'll want to use him as the decoy; as bait to catch the rest of you with."

"Oh, can no one help us?" wailed Lucy.

"Only Aslan.," said the Beaver, "we must go and meet him. That's our only chance now."

"It seems to me, my dears," said the Beaver, "that it is very important to know just when he slipped away. How much he can tell her depends on how much he heard. For instance, had we started talking of Aslan before he left? If not, then we may do very well, for she won't know that Aslan has come to Narnia, or that we are meeting him and will be quite off her guard as far as that is concerned."

"I don't remember his being here when we were talking about Aslan---" began Peter, but Lucy interrupted him.

"Oh yes, he was," she said miserably, "don't you remember, it was he who asked whether the Witch couldn't turn Aslan into the stone?"

"So he did, by Jove," said Peter, "just the sort of thing he would say, too!"

"Worse and worse," said the Beaver, "and the next thing is this. Was he still here when I told you that the place for meeting Aslan was the Stone Table?"

And of course no one knew the answer to this question.

"Because, if he was," continued the Beaver, "then she'll simply sledge down in that direction and get between us and the Stone Table and catch us on our way down. In fact we shall be cut off from Aslan."

"But that isn't what she'll do first," Said the Beaver, "not if I know her. The moment that Edmund tells her that we're all here she'll set out to catch us this very night, and if he's been gone about half an hour, she'll be here in about another twenty minutes."

"You're right, Mrs. Beaver," said the husband, "we must all get away from here. There's not the moment to lose."

IN THE WITCH'S HOUSE

And now of course you want to know what had happened to Edmund. He had eaten his share of the dinner, but he hadn't really enjoyed it because he was thinking all the time about Turkish Delight---and there's nothing that spoils the taste of good ordinary food half so much as the memory of bad magic food. And he had heard the conversation and hadn't enjoyed it much either, because he kept on thinking that the others were taking no notice of him and trying to give him the cold shoulder. They weren't but he imagined it. And then he had listened until the Beaver told them about Aslan and until he had heard the whole arrangement for meeting Aslan at the Stone Table. It was then that he began very quietly to edge himself under the curtain which hung over the door. For the mention of Aslan gave him a mysterious and horrible feeling just as it gave the others a mysterious and lovely feeling.

Just as Mr. Beaver had been repeating the rhyme about Adam's flesh and Adam's bone Edmund had been very quietly turning the door handle; and just before Mr. Beaver had begun telling them that the White Witch wasn't really human at all but half a Jinn and half a giantess, Edmund had got outside into the snow and cautiously closed the door behind him.

You mustn't think that even now Edmund was quite so bad that he actually wanted his brother and sister to be turned into stone. He did want Turkish Delight and to be Prince (and later a King) and to pay Peter out for calling him a beast. As for what the Witch would do with the others, he didn't want her to put them on the same level as himself--but he managed to believe, or to pretend he believed, that she wouldn't do anything very bad to them, "Because," he said to himself, "all these people who say nasty things about her are her enemies and probably half of it isn't true. She was jolly nice to me, anyway, much nicer than they are. I expect she is the rightful Queen really. Anyway, she'll be better than that awful Aslan!" At least, that was the excuse he made in his own mind for what he was doing. It wasn't a very good excuse, however, for deep down inside him he really knew that the White Witch was bad and cruel.

The first thing he realised when he got out side and found the snow falling all around him, was that he had left his coat behind in the Beavers' house. And of course there was no chance of going back to get it now. The next thing he realized was that the daylight was almost gone, for it had been nearly three o'clock when they sat down to dinner and winter days were short. He hadn't reckoned on this; but he had to make the best of it. So he turned up his collar and shuffled across the top of the dam (luckily it wasn't so slippery since the snow had fallen) to the far side of the river.

It was pretty bad when he reached the far side. It was growing darker every minute and what with that and the snowflakes swirling all round him he could hardly see three feet ahead. And then too there was no road. He kept slipping into deep drifts of snow, and skidding on frozen puddles, and tripping over fallen tree-trunks, and sliding down steep banks, and barking his shins against rocks, till he was wet and cold and bruised all over. The silence and the loneliness were dreadful. In fact I really think he might have given up the whole plan and gone back and owned up and made friends with the others, if he hadn't happened to say to himself, "When I'm King of Narnia the first thing I shall do will be to make some decent roads." And of course that set him off thinking about being a King and all the other things he would do and this cheered him up a good deal. He had just settled in his mind what sort of palace he would have and how many cars and all about his private cinema and where the principal railways would run and what laws he would make against beavers and dams and was putting the finishing touches to some schemes for keeping Peter in his place, when the weather changed. First the snow stopped. Then a wind sprang up and it became freezing cold. Finally, clouds rolled away and the moon came out. It was a full moon and, shining on all that snow, it made everything almost as bright as day---only the shadows were rather confusing.

He would never have found his way if the moon, hadn't come out by the time he got to the other river--you remember he had seen (when they first arrived at the Beavers') a smaller river flowing into the great one lower down. He now reached this and turned to follow it up. But the little valley down which it came was steeper and rockier than the one he had just left and much overgrown with bushes, so that he could not have managed it at all in the dark. Even as it was, he got wet through for he had to stoop to go under the branches and great loads of snow came sliding off on to his back. And every time this happened he thought more and more how he hated Peter--just as if all this had been Peter's fault.

But at last he came to a part where it was more level and the valley opened out. And there, on the other side of the river, quite close to him, in the middle of a little plain between two hills, he saw what must be the Queen's house. And the moon was shining brighter than ever. The house was really a small castle. It seemed to be all towers; little towers with long pointed spires on them, sharp as needles. They looked like huge dunce's caps or sorcerer's caps. And they shone in the moonlight and their long shadows looked strange on the snow! Edmund began to be afraid of the house.

But it was too late to think of turning back now. He crossed the river on the ice and walked up to the house. There was nothing stirring, not the slightest sound anywhere. Even his own feet made no noise on the deep newly fallen snow. He walked on and on, past corner after corner of the house, and past turret after turret to find the door. He had to go right round to the far side before he found it. It was a huge arch but great iron gates stood open wide.

Edmund crept up to a arch and looked inside into a courtyard, and there he saw a sight that nearly made his heart stop beating. Just inside a gate, with moon-light shining on it, stood an enormous lion crouched as if it was ready to spring. And Edmund stood in a shadow of a arch, afraid to go on.

STORY FIVE
THE SPELL BEGINS TO BREAK

Now we must go back to Mr. and Mrs. Beaver and the three other children. As soon as the Beaver said "There's no time to lose" everyone began bundling themselves into coats, except Mrs. Beaver who started picking up sacks and laying them on the table and said: "Now, Mr. Beaver, just reach down the ham. And here's the packet of tea, and there's sugar, and the matches. And if someone will get two or three loaves out of the crock over there in the corner."

"What are you doing, Mrs. Beaver?" exclaimed Susan.

"Packing a load for each of us, dearie ," said the Beaver very coolly. "You didn't think we'd set out on a journey with nothing to eat, did you?"

"But we haven't time!" said Susan, buttoning the collar of her coat. "She may be here any minute."

"That's what I say," chimed in Mr. Beaver.

"Get along with you all," said the wife. Think it over, Mr. Beaver. She can't be here for the quarter of an hour at least."

"But don't we want as big a start as we can possibly get," said Peter, "if we're to reach the Stone Table before her?"

"You've got to remember that, Mrs. Beaver," said Susan. "As soon as she has looked in here and finds we're gone she'll be off at top speed."

"That she will," said the Beaver. "But we can't get there before her whatever we do, for she'll be on the sledge and we'll be walking."

"Then---have we no hope?" said Susan.

"Now don't you get fussing, there's a dear," said Mrs. Beaver, "but just get half a dozen clean handkerchiefs out of the drawer. 'Course we've got the hope. We can't get there before her but we can keep under cover and go by ways she won't expect and perhaps we'll get through."

"That's true enough, Mrs. Beaver," said the husband. "But it's time we were out of this."

"And don't you start fussing either, Mr. Beaver," said the wife. "There. That's better. There's four loads and the smallest for the smallest of us: that's you, my dear," she added looking at Lucy.

"Oh, do please come on," said Lucy.

"Well, I'm nearly ready now," answered Mrs. Beaver at last allowing her husband to help her into her snow boots. "I suppose the sewing machine's too heavy to bring?"

"Yes. It is," said Mr. Beaver. "A great deal too heavy. And you don't think you'll be able to use it while we're on the run, I suppose?"

"I can't abide the thought of that Witch fiddling with it," said Mrs. Beaver, "and breaking it or stealing it, as likely as not."

"Oh, please, please, please, do hurry!" said the three children and so at last they all got outside and Mr. Beaver locked the door (It'll delay her a bit," he said) and they set off, all carrying their loads over their shoulders.

The snow had stopped and the moon had come out when they began their journey. They went in single file---first Mr. Beaver, then Lucy, then Peter, then Susan, and Mrs. Beaver last of all. Mr. Beaver led them across the dam and onto the right bank of the river and then along a very rough sort of path among the trees right down by the river-bank. The sides of the valley, shining in the moonlight, towered up far above them on either hand. "Best keep down here as much as possible," he said. "She'll have to keep to the top, for you couldn't bring a sledge down here."

It would have been a pretty enough scene to look at it through a window from a comfortable armchair; and even as things were, Lucy enjoyed it at first. But as they went on walking and walking---and walking---and as the sack she was carrying felt heavier and heavier, she began to wonder how she was going to keep up at all. And she stopped looking at the dazzling brightness of the frozen river with all its waterfalls of ice and at the white masses of the tree-tops and the great glaring moon and the countless stars and could only watch the little short legs of Mr. Beaver going pad-pad-pad-pad through the snow in front of her as if they were never going to stop. Then the moon disappeared and the snow began to fall once more. And at last Lucy was so tired that she was almost asleep and walking at the time when suddenly she found that the Beaver had turned away from the river bank to the right and was leading them steeply uphill into the very thickest bushes. And then as she came fully awake she found that the Beaver was just vanishing into a little hole in the bank which had been almost hidden under the bushes until you were quite on top of it. In fact, by the time she realized what was happening, only his short flat tail was showing.

Lucy immediately stooped down and crawled in after him. Then she heard noises of scrambling and puffing and panting behind her and in a moment all five of them were inside.

"Wherever is this?" said Peter's voice, sounding tired and pale in the darkness. (I hope you know what I mean by a voice sounding pale.)

"It's an old hiding-place for beavers in bad times," said the Beaver, "and a great secret. It's not much of a place but we must get a few hours' sleep.

"If you hadn't all been in such a plaguey fuss when we were starting, I'd have brought some pillows," said the Beaver.

It wasn't nearly such a nice cave as Mr. Tumnus's, Lucy thought---just a hole in the ground but dry and earthy. It was very small so that when they all lay down they were all a bundle of fur and clothes together, and what with that and being warmed up by their long walk they were really rather snug. If only the floor of the cave had been a little smoother! Then the Beaver handed round in the dark a little flask out of which everyone drank something--it made one cough and splutter a little and stung the throat but it also made you feel deliciously warm after you'd swallowed it---and everyone went straight to sleep.

It seemed to Lucy only the next minute (though really it was hours and hours later) when she woke up feeling a little cold and dreadfully stiff and thinking how she would like the hot bath. Then she felt a set of long whiskers tickling her cheek and saw the cold daylight coming, in through the mouth of the cave. But immediately after that she was very wide awake indeed, and so was everyone else. In fact they were all sitting up with their mouths and eyes wide open, listening to the sound which was the very sound they'd all been thinking of (and sometimes imagining they heard) during their walk last night. It was the sound of jingling bells.

Mr. Beaver was out of the cave like a flash the moment he heard it. Perhaps you think, as Lucy thought for a moment, that this was a very silly thing for him to do? But it was really the very sensible one. He knew he could scramble to the top of the bank among bushes and brambles without being seen; and he wanted above all things to see which way the Witch's sledge went. The others all sat in the cave waiting and wondering. They waited nearly five minutes. Then they heard something that frightened them very much. They heard voices. "Oh," thought Lucy, "he's been seen. She's caught him!"

Great was their surprise when, a little later, they heard Mr. Beaver's voice calling to them from just outside the cave.

"It's all right," he was shouting. "Come out, Mrs. Beaver. "Come out, Sons and Daughters of Adam and Eve. It's all right! It isn't her!" This was bad grammar of course, but that is how beavers talk when they are excited; I mean, in Narnia---in our world they usually don't talk at all.

So Mrs. Beaver and the children came bundling out of the cave, all blinking in the daylight, and with earth all over them, and looking very frosty and unbrushed and uncombed and with the sleep in their eyes.

"Come on!" cried the Beaver, who was almost dancing with delight. "Come and see! This is a nasty knock for the Witch! It looks as if her power was already crumbling."

3.

"What do you mean, Mr. Beaver?" panted Peter as they all scrambled up the steep bank of the valley together.

"Didn't I tell you," answered the Beaver, "that she's made it always winter and never Christmas? Didn't I tell you? Well, just come and see!"

And then they were all at the top and did see.

It was the sledge, and it was reindeer with bells on their harness. But they were far bigger than the Witch's reindeer, and they were not white but brown. And on the sledge sat a person whom everyone knew the moment they set eyes on him. He was the huge man in the bright red robe (bright as holly-berries) with the hood that had fur inside it and the great white beard that fell like a foamy waterfall over his chest. Everyone knew him because, though you see people of his sort only in Narnia, you see pictures of them and hear them talked about even in our world---the world on this side of the wardrobe door. But when you really see them in Narnia it is rather different. Some of the pictures of Father Christmas in our world make him look only funny and jolly. But now that the children actually stood looking at him they didn't find it quite like that. He was so big, and so glad, and so real, that they all became quite still. They felt very glad, but also solemn.

"I've come at last," said he. "She has kept me out for a long time, but I have got in at last. Aslan is on the move. The Witch's magic is weakening."

And Lucy felt running through her the deep shiver of gladness which you only get if you are being solemn and still.

"And now," said Father Christmas, "for the presents. There is the new and better sewing machine for you, Mrs. Beaver. I will drop it in your house as I pass."

"If you please, sir," said the Beaver, making a curtsey. "It's locked up."

"Locks and bolts make no difference to me," said Father Christmas. "And as for you, Mr. Beaver, when you get home you will find your dam finished and mended and all the leaks stopped and the new sluice gate fitted."

Mr. Beaver was so pleased that he opened his mouth very wide and then found he couldn't say anything at all.

"Peter, Adam's Son," said Father Christmas.

"Here, Sir," said Peter.

"These are your presents," was the answer, "and they are tools not toys. The time to use them is perhaps near at hand. Bear them well." With these words he handed to Peter the shield and the sword. The shield was the colour of silver and the sword was of gold and it had a sheath and the sword belt and everything it needed, and it was just the right size and weight for Peter to use. Peter was silent and solemn as he received these gifts for he felt they were a very serious kind of present.

"Susan, Eve's Daughter," said Father Christmas. "These are for you," and he handed her a bow and a quiver full of arrows and the little ivory horn. "You must use the bow only in great need," he said, "for I do not mean you to fight in the battle. It does not easily miss. And when you put this horn to your lips and blow it, then, wherever you are, I think help of some kind will come to you."

Last of all he said, "Lucy, Eve's Daughter, and Lucy came forward. He gave her the little bottle of what looked like glass (but people said afterwards that it was made of diamond) and a small dagger. "In this bottle," he said, "there is a cordial made of the juice of one of the fire-flowers that grow in the mountains of the sun. If you or any of your friends are hurt, a few drops of this will restore you. And the dagger is to defend yourself at great need. For you also are not to be in the battle."

"Why, Sir," said Lucy. "I think---I don't know---but I think I could be brave enough."

"That is not the point," he said. "But battles are ugly when women fight. and now"---here is something for the moment for you all!" and he brought out (I suppose from the big bag at his back, but nobody quite saw him do it) a large tray containing five cups and saucers, a bowl of lump sugar, a jug of cream, and a great big teapot all sizzling and piping hot. Then he cried out "A Merry Christmas! Long live the true King!" and cracked his whip and he and the reindeer and the sledge and all were out of sight before anyone realised that they had started.

Peter had just drawn his sword out of its sheath and was showing it to Mr. Beaver when Mrs. Beaver said:

"Now then, now then! Don't stand talking there till the tea's got cold. Just like men. Come and help to carry the tray down and we'll have breakfast. What a mercy I thought of bringing the bread-knife."

So down the steep bank they went and back to the cave, and Mr. Beaver cut some of the bread and ham into sandwiches and Mrs. Beaver poured out the tea and everyone enjoyed himself. But long before they had finished enjoying themselves Mr. Beaver said, "Time to be moving on now."

ASLAN IS NEARER

Edmund meanwhile had been having a most disappointing time. When the Dwarf had gone to get the sledge ready he expected that the Witch would start being nice to him, as she had been at their last meeting. But she said nothing at all. And when at last Edmund plucked up his courage to say, "Please, your Majesty, could I have some Turkish Delight? You---you---said---" she answered "Silence, fool!" Then she appeared to change her mind and said, as if to herself, "And yet it will not do to have the brat fainting on the way," and once more clapped her hands. Another dwarf appeared.

"Bring the human creature food and drink," she said.

The Dwarf went away and presently returned bringing an iron bowl with some water in it and an iron plate with a hunk of dry bread on it. He grinned in a replusive manner as he set them down on the floor beside Edmund and said:

"Turkish Delight for the little Prince. Ha! Ha! Ha!"

"Take it away," said Edmund sulkily. "I don't want dry bread." But the Witch suddenly turned on him with such a terrible expression on her face that he apologised and began to nibble at the bread though it was so stale he could hardly get it down.

"You may be glad enough of it before you taste bread again, said the Witch.

While he was still chewing away the first dwarf came back and announced that the sledge was ready. The White Witch rose and went out, ordering Edmund to go with her. The snow was again falling as they came into the courtyard but she took no notice of that and made Edmund sit beside her on the sledge. But before they drove off she called Fenris Ulf and he came bounding like an enormous dog to the side of the sledge.

"Take with you the swiftest of your wolves, and go at once to the house of the Beavers," said the Witch, "and kill whatever you find there. If they are already gone, then make all speed to the Stone Table, but do not be seen. Wait for me there in hiding. I meanwhile must go many miles to West before I find a place where I can drive across a river. You may overtake these humans before they reach Stone Table. You will know what to do if you find them!"

"I hear and obey, O Queen," growled Wolf; and immediately he shot away into snow and darkness, as quickly as a horse can gallop. In a few minutes he had called another wolf and was with him down on the dam and sniffing at the Beaver's house. But of course they found it empty. It would have been a dreadful thing for the Beavers and children if the night had remained fine, for the wolves would then have been able to follow their trail---and ten to one would have overtaken them before they had got to the cave. But now that the snow had begun the scent was cold and even the footprints were covered up.

Meanwhile the Dwarf whipped up the reindeer and the Witch and Edmund drove out under the archway and on and away into the darkness and the cold. This was a terrible journey for Edmund who had no coat. Before they had been going a

5.

quarter of an hour all the front of him was covered with snow---he soon stopped trying to shake it off because, as quickly as he did that, a new lot gathered, and he was so tired. Soon he was wet to the skin. And oh, how miserable he was. It didn't look now as if the Witch intended to make him a King! All the things he had said to make himself believe that she was good and kind and that her side was really the right side sounded to him silly now. He would have given anything to meet others at this moment---even Peter! The only way to comfort himself now was to try to believe that the whole thing was a dream and that he might wake up any moment. And as they went on, hour after hour, it did come to seem like a dream.

This lasted longer than I could describe even if I wrote pages and pages about it. But I will skip on to the time when snow had stopped and morning had come and they were racing along in daylight. And still they went on and on, with no sound but the everlasting swish of snow and creaking of reindeer's harness. And then at last the Witch said, "What have we here? Stop!" and they did.

How Edmund hoped she was going to say something about breakfast! But she had stopped for quite a different reason. A little way off at the foot of a tree sat a merry party, a squirrel and his wife with their children and two satyrs and a dwarf and an old dog-fox, all on stools round a table. Edmund couldn't quite see what they were eating, but it smelled lovely and there seemed to be decorations of holly and he wasn't at all sure that he didn't see something like a plum pudding. At the moment when the sledge stopped, the Fox, who was obviously the oldest person present, had just risen to its feet, holding a glass in its right paw as if it was going to say something. But when the whole party saw the sledge stopping and who was in it, all the gaiety went out of their faces. The father squirrel stopped eating with his fork half-way to his mouth and one of the satyrs stopped with its fork actually in its mouth, and the baby squirrels squealed with terror.

"What is the meaning of this?" asked the Witch Queen. Nobody answered.

"Speak, vermin!" she said again. "Or do you want my dwarf to find you a tongue with his whip? What is the meaning of all this gluttony, this waste, this self indulgence? Where did you get all these things?"

"Please, your Majesty," said the Fox, "we were given them. And if I might make so bold as to drink your Majesty's very good health---"

"Who gave them to you?" said the Witch.

"F-F-F-Father Christmas," stammered the Fox.

"What?" roared the Witch, springing from the sledge and taking a few strides nearer to the animals.

STORY ONE

Winnie shoved the second piece of gum into her mouth. She crushed the wrapper in her fist and flicked it over her shoulder. A long low sigh escaped from somewhere inside her. She rested her elbows on the window sill and cupped her face in her hands. Kneeling in one position in front of the window for hours and hours wasn't easy. Especially on the hot and sticky August morning. But she hadn't moved. Not an inch! Except when her left foot fell asleep and she had to jump up and down to get rid of the prickly feeling.

Now her knees were sore. Winnie reached over to her rumpled bed---the same old bed she'd been sleeping in for the last eight of her eleven years---grabbed the pillow and stuffed it under her legs. She chewed her gum as hard and fast as she could. It cracked better that way. Winnie was being disgusting---that's what her mother said about gum cracking. And this morning being disgusting helped her to feel less miserable. Earlier, she had slammed the bedroom door shut and hung out her BEWARE---PRIVATE sign.

The light rain had stopped and the breeze brushed against Winnie's cheek. It felt cool and refreshing. But even that didn't help ease the empty feeling. And staring down the block at Iggie's house didn't help either. Even though she could see only parts of it---the driveway, the gray stone chimney, the speck of the red front door. Just enough to remind Winnie that her best friend in the whole world was gone and wouldn't be back. There was nothing she could do about it. This was, without a doubt, the loneliest, sadest, most horrible week of her whole life!

Winnie heard a gentle tapping at her bedroom door. "What Mom?" she called, turning away from the window.

The door opened and her mother stood there, one hand on her hip. "Winifred Bates Barringer!"

Winnie cringed. Mom's voice got very loud. "Just look at this room. It's a mess."

Winnie agreed privately, but said nothing, She studied her mother, standing like a statue in the doorway. Mom was wearing her work clothes----an old blue denim skirt and a faded striped shirt with the sleeves rolled up. Her face was smudged with dirt.

Mrs. Barringer did not smile, but she softened her voice. "Winnie," she said, holding the tissue to her nose and sneezing. (Mom always sneezed a lot after she'd been gardening or cleaning the basement.) Mrs. Barringer blew her nose and continued. "You've been cooped up in the room all morning and I haven't said a word. Now, I know how you feel about Iggie moving away, but I certainly didn't expect you to mope around for the whole week. This is ridiculous! You haven't had a thing to eat today. At this rate you're going to fade away into nothing."

Winnie turned back to the window. "I'm not hungry and I'll clean up my room later. Okay?"

Her mother did not answer. Winnie sensed that she was standing there waiting for the better explanation. "I'm busy Mom. I'm watching for the new people. The moving trucks were here early this morning, but I haven't seen the new people anywhere."

"It's a wonder you can see ANYTHING with all the hair in your eyes," her mother answered. "You look like the overgrown sheep dog, Winnie. Why don't you try putting on some clothes and brushing your hair. It's after twelve already."

Winnie tossed the hair out of her face and looked down at the pink night shirt. She cracked her gum louder.

"Winifred! That is DISGUSTING."

Winnie smiled. "It's sugarless gum Mom. No cavities!"

"I was talking about the noise, not the gum." Mrs. Barringer reached into the pocket of the skirt. "Here's the letter from your brother. As soon as I clean up I'm going down to fix lunch. I expect you to join me in ten minutes. And please Winnie, do SOMETHING about that hair."

Mrs. Barringer made a military turn and left the room. Winnie opened her brother's letter. But it was practically impossible to read the squiggly writing so she slipped the letter back into its envelope.

Matthew would be home from camp in a week and then summer would really be over. It felt funny to have a brother going into ninth grade. That was kind of old! Most kids Winnie knew couldn't stand their brothers and sisters, but she didn't mind Matthew. Not since last year when he started to talk to her as if she were a real person, instead of just the child. Which was more than she could say for her parents most of the time.

But Iggie's family, now that was a different story. At Iggie's house she hadn't been treated as a child. And she's spent plenty of time there, too. She has slept over practically every Saturday night for the two years. It was another world. Iggie's mother always put candles on the dinner table. She said Saturday was the most special night of the week. And she and Iggie were allowed to sample the wine. Winnie had pretended to like it but it tasted kind of bitter. After dinner they would move into the living room where Iggie's father lit the fire. She and Iggie would sit on the furry rug in front of the fireplace, then they would talk for hours and hours. Sometimes Iggie's mother would read to them. Other times there were guests for dinner.

Iggie's folks knew people from all over the world because they traveled so much. Iggie's father was always flying to the different countries on business. Winnie would listen to everything they had to say. Sometimes Iggie's father used to ask, "What do you think about that, Winnie?" Imagine! He actually wanted to hear the opinion. She found out not everybody thought the way the Barringer's did. There were plenty of other ideas floating around. And her folks didn't mind her spending the nights away from home. Of course not! It left them free to go to the movies.

Winnie felt that she belonged at Iggie's house.

She wandered away from the window and over to the dresser where she took out the freshly washed jeans. They were beginning to unravel at the edges where she had cut them off, but they still fit fine. She wondered if she was ever going to grow. She wanted to be tall like her father and curvy like her mother (although she wouldn't admit that to anyone). But so far, she wasn't much of either.

She pulled on her blue sweatshirt, regarded her hair in the mirror and stuck tongue out at her reflection. She decided it was easier to hide all that thick hair inside her sailor hat than to brush it out. With a final check out her window she left her room and skipped down the stairs. She didn't realize she was barefooted until she reached the kitchen. The tile floor felt like ice cubes on the bottoms of her feet. She whirled around and ran back up the stairs, nearly knocking over her mother's prize plant at the top. She searched frantically for her new plaid sneakers. "Yick! They must be in the junk pile under the bed," she said to herself, giving up. She grabbed her loafers from a bookcase shelf instead, knocking over the giant copy of the world atlas in her hurry.

Winnie paused for a moment, but did not pick up the atlas. Was it only a week ago that she and Iggie had carefully measured the distance from New Jersey to Tokyo?

Racing down the stairs for the second time, Winnie smelled eggs. Her stomach rolled over noisily, but she had a feeling if she ate she's get sick. "Just an apple for me Mom," she said.

"An apple is no lunch, Winnie. Or breakfast either," Mrs. Barringer said. I'm making us some egg salad."

"I know Mom. It smells awful!" Her mother gave her a look but Winnie ignored it and hopped over to the refrigerator on the foot that already had a loafer on it. She selected an apple with no visible bruises and sat down before sliding the other foot into its shoe. "I'm going out Mom. I want to see what's going on. Maybe I'll go down to Iggie's house."

Mrs. Barringer turned away from the egg salad. "Winnie, the new people may be awfully busy today. I really don't think this is the time to meet them. Wait until tomorrow and I'll bake some brownies. Then you'll have an excuse to ring the bell and say hello."

"I only want to have a look, Mom. They won't even know I'm there." She was on her feet now, ready to move. "Bye," she called and dashed out a kitchen door before her mother could stop her.

Winnie stuffed her mouth with an apple. She felt like one of those fancy pigs in a delicatessen window, but she needed both hands to raise the heavy garage door to get her bike. She walked her red bike down the driveway, finished the apple and threw its core through a sewer grating. Then she rode eight houses down the block and stopped.

Iggie's house sat high on the curve of Grove Street. That was why Winnie was able to see it from her bedroom window. It was an old house---forty or fifty years old, Iggie had said. Winnie hadn't been near it all week. She was almost afraid to look up at it now. Her favorite house in the whole world. At least it had been for the three years that Iggie lived there. Winnie knew every little corner---from the attic down to the basement. And now strangers were coming to live in it. But it would still be Iggie's house. No matter what! It would always be Iggie's house.

Leaving her bike near the foot of Iggie's driveway, Winnie walked slowly toward the big, gray stone, two story house. The same potted geraniums that Iggie's mom cared for so lovingly were still on the front stoop. The bright red front door was closed. Winnie turned away from the house, holding back the tears in her eyes. An unfamiliar green station wagon rounded the corner of Grove Street and headed her way. Winnie ducked behind the evergreen bushes surrounding Iggie's house, just in case. She didn't think about the morning rain until it was too late. Her shoes sank into the wet ground and made a soft squishing sound. Her mom would have a few words to say about that!

She crouched and her heart started to beat faster and louder. Iggie hadn't told her anything about the people who bought the house. She said it would be a big surprise. Winnie didn't know what that meant.

The green station wagon rolled into Iggie's driveway. Winnie peeked out from between the bushes. The car stopped. The back door opened. Two boys and a girl jumped out and ran toward the house. Winnie's mouth fell open. She couldn't believe her eyes. In her excitement she leaned so far forward that she lost her balance and fell over into the mud. She covered her mouth with a muddy hand and kept her eyes on the new people. The mud was soaking through her jeans. She tried not to think about it. The three kids were followed by two grownups. Winnie guessed they were the parents. They were talking and laughing as they hurried toward the house.

As soon as the new people unlocked the red front door and stepped into Iggie's house, Winnie took off like a rocket. She didn't stop until she was almost home. Then she remembered her bike. She practically flew back to Iggie's, jumped on her bike and pedaled furiously down the block. She collapsed on the back stoop and yelled, "Mom....HEY MOM!"

Her mother rushed to the door, wiping her hands on her apron. "My goodness Winnie, what happened to you? Are you all right?"

"Fine Mom, fine."

"But you're all covered with mud! Don't you dare come into the house like that."

Winnie shook her head impatiently. "Mom, never mind about the mud. I saw them, Mom. I saw the new people. And guess what Mom? They're Negro! All of them. The kids and the parents. The whole family's Negro!"

"Yes, I heard about that," Mrs. Barringer answered quietly, without smiling.

"Already?" Winnie asked, disappointed. "Who told you?"

"Mrs. Landon phoned just before you came home."

Winnie muttered, "She would know already. She always knows everything.

4.

Usually before it even happens."

"I don't like to hear you talking that way about the grownups, Winnie. Especially Mrs. Landon."

"Okay, okay." Winnie scratched the right leg. "Never mind Mrs. Landon. I should have known Iggie's family wouldn't sell the house to just anybody. I should have known it would be someone special."

Mom's face looked strange. She started to say something, then changed her mind. She brushed her hair away from her face and shrugged. "Frankly, I don't see anything to be so excited about, Winnie. Not anything at all." Mrs. Barringer stalked back to the kitchen and to the roast she was preparing for dinner.

Winnie sat there, still shaking her head and scratching her leg. Then she stood up and took a good look at the house. This was the only place she had ever lived. Right here...the same old house since the day she was born. She wished she could go somewhere or do something exciting. While Iggie's folks were discussing the world, her mom and dad were talking about who shopped in her father's hardware store and who did what on Grove Street. Yick!

Well, she was excited now, even if her mother wasn't. Maybe the new people were from Africa or someplace like that. Maybe they were world travelers too. Maybe they were like Iggie's family.

Winnie's mom convinced her that the bath and shampoo before dinner would be a good idea. Once a week Mrs. Barringer insisted on supervising Winnie in the bathroom to make sure not the inch was neglected. Ears, the nails and feet. Winnie was not happy about having an audience. She especially hated having her hair rubbed dry with the towel. It gave her the feeling that her whole head might come off at any moment.

"Winnie, I want you to do me a big favor," Mrs. Barringer said.

"Can't hear when you're rubbing. Did you say something to me Mom?" Winnie asked, poking her face out from inside the huge towel.

"I said," her mother repeated in a much louder voice, "that I want you to do me a big favor and not mention the new neighbors to your father until after supper."

"But Mom," Winnie protested, "it's so exciting! Why can't I tell him before?"

"Now, Winnie. You know how Daddy is after a hard day at the store. He's all worn out. And surprises go over better on a full stomach. Okay?"

"If you say so Mom." Winnie glumly wondered if that meant both of her parents were going to be unenthusiastic about the new neighbors.

Mrs. Barringer brushed out Winnie's long hair and tied up with a ribbon. "You look so nice Winnie. I wish you'd wear it like this all the time. Nice and smooth."

Winnie glanced at herself in the mirror. "Yick! I look like Clarice Landon!"

After her mother left the bathroom Winnie put on fresh underwear and the white eyelet robe. She ran down the stairs to greet her father at the door. He twirled her around to get a better look. "Well, it's nice to see your face for a change, Winnie. I've been wondering what you look like lately." He kissed her on the top of the head. Winnie winced. Just because she'd had a bath and had the ribbon tied in the hair did not mean she was a different person. Underneath the frilly bathrobe was the same old Winifred Bates Barringer!

Winnie ate heartily at dinner and smiled to herself all through the meal. She couldn't help the growing excitement inside her. She was practically bursting with the news she wanted to tell her father. Finally, the bowl of chocolate pudding was emptied and Mrs. Barringer nodded that now was the time to let it all out. "I saw the new people today!" Winnie announced. And when Dad looked puzzled, "The ones who bought Iggie's house. They have three kids. Two boys and a girl. I haven't met them yet but I will...tomorrow."

"Well, that's nice Winnie." Mr. Barringer pushed back his dining room chair and strolled into the den. Winnie followed. She watched as her father picked up the newspaper and adjusted the ballgame on T.V. "Maybe now you won't miss Iggie quite so much," he said, as he got comfortable in his favorite chair.

"Oh Daddy," Winnie sighed. "This has nothing to do with missing Iggie. I'll always miss Iggie. She'll always be my best friend and favorite person in the world.

Her father buried his nose in the paper. "Daddy, I still didn't tell you the most exciting part about the new people. They're Negro.

Her father looked up. "They're what?"

"Negro. you know, colored."

Mr. Barringer opened his mouth to say something, but was interrupted by a call from the kitchen. "Paul...garbage is ready!" He got up without his usual grumble and headed for the kitchen. Mr. Barringer referred to himself as the garbage man of Grove Street. He said he couldn't understand why his wife never took it out. It wasn't that heavy. But Mrs. Barringer maintained that putting out the garbage was a man's job. Same as mowing the lawn.

Winnie had no trouble making out the conversation in the kitchen, even though the door was closed.

"So that's why Iggie's family was so secretive about who bought their house. They didn't want any trouble around here before they moved away," Dad said.

"Some news, isn't it?" Mom asked, sarcastically. "Colored people on Grove Street!"

Winnie had heard enough. She ran upstairs and into her room, slamming the door behind her. She flopped down on the bed, then rolled over and stared up at the ceiling. Her parents never discussed important things with her. Anyway, there were no Negro families living in their end of town. And only a very few in the other end. So her folks had nothing to say on the subject. Besides, they liked to pretend everyone was just like they were. But Winnie read the papers and she had seen plenty on T.V. And just last spring her teacher had assigned the whole class to do a paper on "What I Can Do to Improve Racial Relationships." That was pretty funny, she had said to Iggie's family. What could she possibly do when she hardly knew anybody of another race?

Winnie closed her eyes and tried to think of all the Negro people she knew. There weren't many. None in the class. There was the kid in third grade but Winnie didn't know him. She knew Bert, the mailman. She knew Irma, who helped her mother spring clean every year. But she didn't know any Negro kids her own age.

Winnie jumped off her bed and sat down at her desk. She took the piece of new yellow stationery from the top drawer. She and Iggie had promised each other a letter a day, but she hadn't even mailed one yet. There hadn't been anything to say until now. Winnie took the cover off her ballpoint pen and wrote:

Dear Iggie,

How are you? I'm fine. I'm so excited about our new neighbors. You were right when you said it would be a big surprise. Was it ever!!! First thing tomorrow I'm going over to meet them. I can't wait!!! I'm going to do everything I can for them. I'm going to make sure they're really happy here. Remember how your father said that people had a lot of waking up to do? Well, I'm going to show them that some of us are waked up already!!!

She folded the letter in half and placed it inside the dictionary. She'd finish it tomorrow.

She was out on her bike before ten the following morning. She passed Iggie's house. The three kids were on the front stoop. Winnie started to call to them and then remembered her mother's brownies. She rode home and came bursting through the back door. "Mom...hey Mom!" she yelled.

"What is it Winnie? I'm upstairs."

"I forgot the brownies Mom."

"What brownies Winnie?"

"For the new people. Her mother didn't answer. "MOM," Winnie yelled louder. "DO YOU HEAR ME?"

Mrs. Barringer came to the top of the stairs. "I hear you Winnie. Stop shouting!"

"Well...where are they?"

"I uh...I didn't bake them Winnie. I forgot."

"Oh Mom! You promised!"

"Well, I just didn't have time Winifred. Now, that is that!"

Winnie hopped on her bike. She wasn't going to let her mother spoil her fun. She

STORY TWO

After lunch Winnie made three trips to <u>the</u> house. One riding her bike. One riding Matthew's bike. And one pulling <u>the</u> red wagon she used to play with when she was a little kid. She left <u>the</u> equipment in <u>the</u> driveway and sat at <u>the</u> curb. Now they'd have to see what a good neighbor she was.

"What's all that stuff for?" Glenn asked when <u>the</u> three of them finally came out of <u>the</u> house.

"Why walk, when you can ride?" Winnie answered with a smile, standing up. "You can ride <u>the</u> bike?"

"Yeah. We can ride," Herbie said.

"Well, this is my brother's bike," Winnie said, hanging onto <u>the</u> big, blue one. It's for Glenn to ride."

Glenn tried it out, making a few wobbly turns. Winnie breathed a sigh of relief.

"Now, for you two," Winnie began, turning to Herbie and Tina. "I figure Tina should ride in the wagon 'cause she's so little and Herbie. . ."

Herbie interrupted her. "Oh, that's just great. Everybody rides and Herbie pulls. Some fun!"

"You didn't let me finish, Herbie," Winnie hollered. "We'll take turns pulling <u>the</u> wagon. If you want, I'll start pulling and you can ride first." He sure is touchy, Winnie thought.

"No, no! I wouldn't want to spoil <u>the</u> plans. I'll pull first." Tina arranged herself in <u>the</u> wagon and Herbie pulled it.

"Follow me," Winnie called, jumping on her bike.

<u>The</u> daily softball game was already in progress when they got to <u>the</u> park. A group of girls sat in <u>the</u> shade of a clump of trees, to <u>the</u> side of <u>the</u> ball field. One of them looked over at Winnie and the Garbers and nudged <u>the</u> others. They all stared. Winnie waved at them and <u>the</u> girls waved back.

"Aren't there any black kids around here?" Tina asked.

"Oh sure there are!" Winnie lied. "Just not today." She didn't know how she was going to get out of that one because when school started they'd find out <u>the</u> truth. But school was still two weeks away.

"Go on over there Tina," Glenn said. "Take your wagon and sit down by <u>the</u> girls."

"I don't want to." Tina shook her head and stamped her feet. "I want to stay here with you."

"I said go on Tina. Don't be <u>the</u> big baby." Glenn gave her a gentle shove.

"No!" Tina sniffled.

"Oh, for crying out loud!" Herbie said. "Come on. . .I'll take you over there."

Tina sat down in <u>the</u> wagon and Herbie pulled her toward <u>the</u> girls.

"Hey, Big Red!" Winnie called out.

"Hey, Winnie!" <u>the</u> tall and well built redheaded boy yelled back.

"Come here. I want you to meet somebody," Winnie shouted. While he was trotting from the ball field to where Winnie and Glenn stood, Winnie whispered, "I'm going to play <u>the</u> joke on Big Red. So just don't say anything, okay?"

Before Glenn could answer, Big Red was standing next to him.

Winnie said, "This is my new neighbor, Glenn Garber."

"You've got to be kidding," Big Red said, staring at Glenn.

"I'm not kidding! And he's from Africa too!" Winnie said. Glenn poked her in <u>the</u> back.

"Well, now," Big Red said, shaking hands with Glenn. "I sure do know a lot about Africa. I did <u>the</u> whole project on Africa last year. Took me a long time but I sure did learn a lot. Winnie was in <u>the</u> class. She heard me give <u>the</u> report. Got <u>the</u> good mark on it too; Right, Winnie?"

"Right, Big Red," Winnie Said. Glenn made <u>the</u> face but didn't say anything.

"You speak English?" Big Red asked Glenn.

Herbie joined them as Glenn nodded to <u>the</u> Red's question.

2.

"She didn't cry," Herbie reported to Winnie and Glenn. "You'd think by now she'd stop acting like the baby!"

"This is Herbie Garber," Winnie said to the Big Red. "Glenn's brother."

"Would like you two guys to play on the team this afternoon. Would be the real pleasure. . . Let's go Winnie," Big Red called out as he ran back to his position on the field.

"I thought you said the girls don't play, they just watch," Herbie said.

"I'm an exception," Winnie bragged. "I told you I'm not really a girl. I told you I can do the things just like a boy!"

Winnie spoke softly to Glenn as they walked toward the field. Herbie ran ahead of them. "Big Red never lets the kids play. No matter what! That's just the way it is. He's really tough on the kids. And Herbie is . . . well . . . you know . . .well, I just didn't want him to get the wrong idea. So it's just a little joke on Big Red 'cause he thinks he knows so much!"

"You're a nut Winnie. A regular nut!" Glenn said.

Winnie figured that was the compliment.

One hot and sweaty hour later the game was over. Actually the game was never really over. It continued from day to day. Sometimes they didn't even keep score. Winnie was disappointed in Glenn and Herbie, but she tried not to show it. She thought they would be the athletes. But Glenn didn't play any better than she did. And she as a girl! Herbie ran fast but he dropped two fly balls in the field.

The rain that had cooled things off yesterday had given way to the bright sun beating down on the bare heads. Winnie put a rubber band around her hair to hold it on top of her head. It stood up like a big, floppy brush. She always wore the rubber band around her ankle, just in case she needed it. Her mother told her that was a very dangerous thing to do. It could stop all the blood from circulating and then she'd be dead! But Winnie didn't believe it.

They collected Tina and the wagon. As they were leaving the park grounds Glenn paused and called to Big Red. "Bye. Thanks for the game. Oh, by the way . . . we're really from Detroit. That's Michigan, not Africa!" Glenn and Winnie laughed as Big Red's mouth fell open. They didn't hang around long enough to give him a chance to reply. Winnie figured he'd be hopping mad for a few days, but he's get over it.

On the way home they rode down Sherbrooke Road, where the new houses were going up. There was plenty of noise and lots of action, so they stopped to watch. Winnie spotted one workman up on the roof eating something Maybe his lunch. He waved down at them and Winnie giggled. He looked like the monkey at the zoo, doing funny tricks. They stood there enjoying the show until one of the men told them to be on their way. He didn't want to be responsible for any accidents.

In fifteen minutes they were back on Grove Street. Little beads of perspiration stood out on all the faces, except Tina's. She was cool and content riding in the wagon.

Winnie was exhausted. That Herbie Garber was pretty smart to volunteer to pull the wagon on the way to the park. Why hadn't she thought of that!

Three houses before Iggie's Tina called out, "Stop!"

"What's the matter, Tina?" Winnie asked.

"Up there. . . on the porch," Tina pointed.

Winnie looked up and groaned. Clarice Landon was perched like a kitten in the corner of her front porch, playing with paper dolls. Usually she sat in a rocking chair, like a little old lady.

"Who's that?" Tina asked. "She's pretty."

Winnie whispered. "That's Clarice Landon and she's awful. So's her mother. I can't stand them."

Winnie was used to the way Clarice looked all right. Only she didn't call it pretty. Immaculate! Mrs. Barringer said. Naturally Clarice was always a big hit with mothers and teachers, in her starched dresses and ribboned hair. Yick!

Winnie started to pull the wagon again, but before she got past the Landon's house, Clarice put down her paper dolls and skipped down the front walk.

"Hi, Winnie."

Winnie muttered, "Hi, Clarice. This is Glenn, Herbie and Tina. They just moved into Iggie's house."

"I know," Clarice said. "I know all about them from my mother." She grinned sheepishly at Winnie while stealing a glance at the Garbers.

Winnie couldn't help making a face at the mention of Mrs. Landon. There was something about that woman . . something underneath the soft voice and the smile. Maybe it was that all the grownups on the block thought she was the greatest . . . including the Barringers! Winnie had heard her father say dozens of times: "Dorothy Landon is the sensible woman. She has a real head on her shoulders." And Mrs. Barringer agreed. "I don't know how she does it! All the meetings and still the best housekeeper I know." Yick! No matter what the parents thought, Winnie knew for sure that Mrs. Landon was the old busybody. Just last month her mother forced her to go to Clarice's birthday party (and in a new dress too!) Mrs. Landon had flashed the phony smile and said. "What a perfectly lovely dress, Winifred. It looks so expensive. Was it?" Now that was plain old "nosey." And there was the rainy day when Mrs. Landon had driven her home from the bus stop. "I saw so many cars at your house Saturday night, Winifred. Did your parents have the party?" And when Winnie told her, yes, they had, Mrs. Landon said, "How nice! Anyone there I know?" Well, that was "nosey" too! Even if Winnie's mom thought Mrs. Landon was just being sociable and making conversation. Winnie knew better. And Mr. Landon! He was always saying: "Yes dear. Of course dear. Whatever you say dear." Yick! It was sickening. Princess Clarice was supposed to be on the lookout for germs all the time. She wasn't supposed to eat or drink anything at the people's houses. Oh, Winnie knew all about them all right! Little Miss Germ-Head and the mother, Germs, Incorporated!

But did Tina take the advice? No! She went right on talking to Clarice. "Want to come over to play?" Tina asked.

Clarice answered so softly no one understood her.

Tina continued. "It doesn't have to be today. How 'bout tomorrow?"

This time there was no mistaking Little Miss Germ-Head's reply. "My mother says I can't play with any colored kids." Clarice ran back up the front walk, to her rocking chair and the dolls.

Winnie felt sick. How could anybody say a thing like that?

"Herbie started up the Landon's walk. Man! I ought to give the no good lousy little kid a . . ."

Glenn grabbed him by the sleeve. "Cut it out Herbie. Forget it."

"Sure . . . forget it! Just like that!" Herbie snapped the fingers. "Well, I warned you about Little Miss Germ-Head."

"I don't have the germs," Tina whispered. "No germs at all."

"Everybody has germs," Herbie said.

"I don't!" Tina insisted.

"Sure you do," Glenn told her "We all do. Even Miss Germ-Head has germs."

"Especially Miss Germ-Hean!" Herbie agreed.

"No point in hanging around here," Winnie said. "Come on Tina . . . I'll pull you home."

The boys left the bikes in Iggie's driveway but Winnie pulled Tina all the way to the back of the house.

Herbie yelled through the screen door. "Hey Mom! How about some lemonade? We're beat!"

"Lemonade!" The voice shouted from inside the house. "I've got eight million things to do and you come home hollering for lemonade!"

Herbie flapped his arms and raised his eyes to the sky. Mrs. Garber came to the back door. She saw Winnie and laughed. "Oh, I didn't know you had company." She seemed embarrassed as she wiped her hands on her slacks.

"This is Winnie, Mom. From down the street," Glenn said.

"Hello Winnie." Her voice was gruff, like Herbie's. She had a pretty smile. "I'm, uh, sorry about the lemonade." Winnie had the feeling the apology was for her benefit. "I'm just so busy trying to get unpacked. We do have some grape juice. Would you like some?"

"I'm really not too thirsty," Winnie lied. "I wouldn't want to put you to the trouble."

"It's no trouble. Tina will help me. Come on Tina."

Tina and her mother disappeared into the house. They came back with a big can of juice and some paper cups. Winnie gulped down two cups of grape juice and told Mrs. Garber that she had to be going, using what she considered her very best manners and most charming voice. She forgot to take home Matthew's bike and the red wagon. She rode home slowly wondering if Tina or the boys would tell their mother about Little Miss Germ-Head.

After dinner Winnie sat in the room reading the letter to Iggie. It didn't sound right now that she'd met the Garbers. She ripped it up and threw the pieces into the waste basket. She took out a fresh piece of paper and began again.

Dear Iggie,

How are you? I'm fine. You wouldn't believe what happened here.. First of all I met the Garbers (people who bought your house) and they have three kids. Anyway, the day started out pretty good. I was really nice and friendly and took the new kids to the park but then on the way home who should we bump into but Clarice and she had to open her fat mouth and say how her mother (Good Old Germs) said she can't play with any colored kids. Well, I'm telling you I wanted to die. I mean, what could I say? And anyway the Garbers don't even say colored . . they say black.

Winnie heard the chime of the front doorbell. She wrote "to be continued" and jumped up and headed for the hall.

"I'll get it!" she hollered as she practically flew down the stairs. She liked to be the first one to the door and the phone. That irritated her father when he was expecting the business call, but she kept on doing it anyway. It was fun to be the first to know what was going on. As soon as Winnie opened the front door she was sorry she had been in such a hurry. She stood face to face with Mrs. Dorothy Landon. Germs, Incorporated!

"Good evening, Winifred. Are your parents at home?" asked Mrs. Landon.

Winnie tried to concentrate on Mrs. Landon's eyeglasses. They hung from a gold chain around her neck, and rested a few inches below the chin. That way Winnie could avoid looking directly at Mrs. Landon's face. Germs, Incorporated only wore her glasses on her eyes when she had to see something really important. Winnie sniffed. Mrs. Landon smelled like beauty parlor. The usual sweater was thrown over the shoulders. She always wore one . . . even if it was boiling hot.

"I said, are your parents at home, Winifred?"

"Oh. Wait a second and I'll see," Winnie answered, knowing very well that her mom and dad were out on the back porch. She yelled as loud as she could (without turning away from Mrs. Landon). "MOM! DAD! . . .ANYBODY HOME?"

Mrs. Landon backed away from Winnie. "My, my," she said, talking through the teeth and turning on the smile. "Don't we have healthy lungs this evening."

Mr. Barringer walked in from the porch and Winnie raced up the stairs, with the tongue stuck out. No one noticed, but it made her feel better about being polite (well, almost polite) to Mrs. Landon.

At the top of the stairs Winnie crouched behind the big potted plant. She peeked out through the openings in the wooden bannister. She didn't want to miss the thing. Mrs. Landon never "just dropped in." There was always the reason.

Mrs. Barringer came in from the porch too. "Dorothy . . . hello. I haven't seen you in the while. How are you?"

"Yick!" Winnie whispered to herself.

"I'm upset, Helen," Mrs. Landon told Winnie's mother.

"Well, what can we do to help, Dorothy?" Mr. Barringer asked.

Mrs. Landon's smile disappeared and Winnie thought the face looked like she had just finished sucking the lemon.

"I have a petition with me, Paul. I hope that you and Helen will be sensible and sign it immediately. Every minute counts."

Winnie had to strain to hear. Mrs. Landon's voice was so low.

Mr. Barringer laughed good naturedly. "And what are we petitioning for this week, Dorothy?"

"I'm afraid it's rather unpleasant," Mrs. Landon answered. "But someone has to do something."

"About what, Dorothy?"

"About the Garber family."

"Oh," Mr. Barringer said. "I just don't know, Dorothy. I just don't know . . ." Mr. Barringer confessed.

Winnie whispered from the top of the stairs, "Tell her off, Daddy. Come on . . .tell her what she really is. . ."

Mrs. Landon put on her glasses. "Look Paul, if we sit around and talk about it, nothing is going to be accomplished. What we need is the little action." She flashed the smile and the voice cooed. "Now, I just want the lovely neighborhood to stay the way it is As I'm sure you do."

Winnie's dad coughed, but Mrs. Landon continued. "Face it Paul. . .things won't stay the same if the Garbers live here. You know as well as I what will happen to the schools . . .the community . . .to everything! Once the element takes over, forget it! We've got to act now."

"What do you have in mind, Dorothy?" Mrs. Barringer asked.

"For a start . . .the petition Let the Garbers know that they won't be happy here. People rarely stay where they aren't wanted."

Winnie groaned softly to herself. "Oh, Daddy! Don't be nice to her. Please don't even let her think you might sign the thing. Please Daddy! Please."

"Of course I'll be pleasant about it," Mrs. Landon promised. "We don't want the headlines."

"Naturally!" Winnie practically spat. "Good old Germs! Always pleasant!"

"I see," Mr. Barringer said. "And if the petition doesn't work. . .then what?"

"Well . . ." Mrs. Landon tapped the petition with the red marking pen. "Then we'll have to put on the pressure, Paul. We'll have to let them know that we really mean business. I'm sure they'll understand.

"What does Fred think about all of this?" asked Mr. Barringer.

"Fred Landon is behind me one hundred per cent!"

Winnie muttered, "Yes, dear. Of course dear. Whatever you say dear."

"Well, Dorothy . . . Helen and I haven't had a chance to talk this over yet. But I'll think about it. And I'll be in touch with you when I reach the decision."

Winnie whispered. "Tell her you'll never reach that kind of decision, Daddy. Go ahead and tell her."

Mrs. Landon carefully removed her glasses and let them hang around her neck again. "Fine Paul. I knew I could count on you and Helen You're sensible people."

"We'll see, Dorothy," Mr. Barringer said, walking Mrs. Landon to the door. "Good night."

"Good night, Helen. Good night, Paul," Germs called.

Mr. Barringer closed the door quietly.

"Why didn't you sign it?" Mrs. Barringer asked angrily.

6.

"I don't know if I want to," Mr. Barringer said.

"But there can't be any doubt, Paul. You should have signed it right away. Dorothy Landon always knows what she's talking about when it comes to <u>the</u> community.

"I'm not so sure," Mr. Barringer said.

"But Paul, you've always valued <u>the</u> opinion."

"I supported her when she fought <u>the</u> higher teachers' salaries, yes. I voted for her three times for <u>the</u> board of education, yes! But I'm not so sure about this. Everything she had to say was <u>the</u> lot of double talk."

"I got her point," Mrs. Barringer said.

"I'm sure you did, Helen."

"Well, I hope Winnie didn't hear anything. Children shouldn't have to know about <u>the</u> problems."

"Ha!" Winnie said as she crawled along <u>the</u> floor, back to her own room. Why didn't parents ever do what you wanted them to do? She felt like screaming, but then they would know she had been listening and she wasn't in <u>the</u> mood for a lecture. She took off <u>the</u> shoes and flung them across her room. Then she flopped onto her bed, punching her fists into <u>the</u> pillow.

Finally she calmed down enough to go back to <u>the</u> desk. She picked up her pen and wrote after "to be continued":

Guess what? A minute ago Germs, Inc. left <u>the</u> house. She came here with a petition to get rid of <u>the</u> new people. I wanted to kick her in <u>the</u> guts!!! I'm so mad I don't know what to do.

Winnie folded <u>the</u> letter and put it in <u>the</u> middle of <u>the</u> world atlas. She didn't know how to finish it.

She undressed and climbed into bed. She didn't bother brushing her teeth or washing her face. She put out <u>the</u> light and tried to sleep. Maybe things would seem better in <u>the</u> morning.

Winnie sat at <u>the</u> kitchen table and pretended to eat her breakfast. She used her

STORY THREE

<u>The</u> next morning Winnie got up at eight. She read over <u>the</u> letter she'd started to Iggie It sounded stupid. She ripped it up and started again:

Dear Iggie,
How are you? I'm fine. You'll never believe this but <u>the</u> Garbers (our new neighbors who moved into your house got a sheep dog. Anyway, <u>the</u> name is Woozie and today he ran off and where did he run to of all places? You guessed it---<u>the</u> Landon's!!! Well, Mrs. Germs was really mad. Actually she was really mad because she doesn't like <u>the</u> Garbers. Well, it isn't exactly that she doesn't like them because she doesn't even know them. It's just that she doesn't want them around because they're Negro. (They say black.)

"Winnie! Breakfast," her mother called.

Winnie folded <u>the</u> letter and put it under <u>the</u> school papers in her middle desk drawer.

Later that morning Winnie, Herbie, Glenn and Tina sat on <u>the</u> curb, in front of <u>the</u> sewer grating that was next to Iggie's driveway. Winnie reached over and picked up some pebbles from <u>the</u> hole at <u>the</u> foot of <u>the</u> driveway. Iggie's folks had been planning to fix up that hole in <u>the</u> fall. Winnie threw <u>the</u> little pebbles into <u>the</u> sewer, one by one. They made a clinking sound.

<u>The</u> Garbers looked glum. Nobody had anything to say. Winnie wished she had stayed home and slept all morning. "What's eating you guys?" she finally asked.

"Nothing much,' Glenn answered.

"Well, it must be something," Winnie said.

Herbie jumped up, imitating his brother. "Oh nothing much . . .nothing much is wrong , , ,like fun it's nothing much!" His voice got very gruff and <u>the</u> fingers automatically went up to <u>the</u> mouth. He started gnawing away at <u>the</u> nails and it was hard to understand what he was saying. "Just a little old piece of paper with a lot of names on it telling <u>the</u> Garber family to get lost. That's about all! Nothing much!"

<u>The</u> petition! They knew about Mrs. Landon's petition. Winnie didn't know what to say. I'm uh . . .I mean I . . .uh . . ." she stammered.

Herbie slapped his leg. "Didn't I tell you? Didn't I tell you she wouldn't be surprised. I told you she'd know about it!" he said to <u>the</u> brother.

Glenn held up <u>the</u> hand. "Don't try to explain, Winnie. Please! We don't want to hear <u>the</u> lot of excuses."

Explain! That was funny. How could she explain <u>the</u> Mrs. Landon? How could she explain why her own mother didn't want them on <u>the</u> block? How could she explain anything? She didn't even understand it herself. "How did you find out?" she asked.

Glenn reported, "Germs, Incorporated paid <u>the</u> little visit last night. My mother invited her in."

"But didn't you tell her about <u>the</u> Mrs. Landon? About how she told Clarice not to play with any . . ." Winnie stopped.

"Well, go ahead. Go ahead and say it!" Herbie shouted. "<u>The</u> colored kids!" He spit <u>the</u> words out.

"Leave her alone Herbie. It's not her fault."

Winnie spoke to Glenn, ignoring Herbie. "But why didn't you tell your mother? You should have warned her."

'We should have, but we didn't. She's so jumpy lately that we decided not to give her <u>the</u> news."

"So your mother just let her in. Just like that?"

"Yeah," Herbie said, joining <u>the</u> conversation again. "Mom thought Mrs.Landon was being polite and calling on <u>the</u> new neighbor."

"You should have seen <u>the</u> Germs," Glenn said. "She was taking it all in. Couldn't look around fast enough. Then she announced that she wants to talk privately to <u>the</u> folks. That means me and Herbie are supposed to take off."

"What about Tina?" Winnie asked.

"I was in the bathtub," Tina sighed. "I always miss everything!"

Glenn continued. "So me and Herbie slammed the back door, pretending to go out into the yard. But we really stayed in the kitchen and we heard the whole thing."

"What'd she say?" Winnie asked.

"Oh, how she's sure we're lovely people and that it's nothing personal, but we'd be happier somewhere else. For the children's sake and all the jazz."

"Then what?" Winnie asked Herbie.

"Then my father says he's heard enough. And would she please leave. All very nice and quiet . . .Man! You'd have thought they were talking about the weather or something. Then Mrs. Landon says,'Oh, I almost forgot . . . we've gotten the petition together so that you can see how we really feel about the situation.' And she hands it over to my father."

"Did you see the petition?" Winnie asked. She'd absolutely die if her parents signed it.

"Yeah," Herbie said. "I snitched it out of my father's desk this morning."

"How many signed it?" Winnie was petrified.

"Only nine," Glenn said.

"ONLY?" Herbie raised the voice.

"Nine out of thirty two . . . that's not the lot," Glenn argued.

"Man! It's enough!"

"Do you remember all the names?" Winnie whispered. She's faint if the family's name was on it.

Herbie picked up the handful of pebbles and threw them into the sewer. "If you want to know if your parents signed it. . .they didn't!"

"I never even thought of that, Herbie Garber!" Winnie hollered. She hoped the relief she felt didn't show. "What are you going to do about it?" she asked.

"I know what I'd like to do," Herbie said. "For a start I'd break up the windows on the Germ House. Then maybe I'd dump the paint on the nice green grass. And I'd train Woozie to make on all the bushes!"

"And what would that prove, big shot?" Glenn asked.

"Maybe nothing. But man! It would sure make me feel good!"

"I meant what are the folks going to do about it?" Winnie asked.

Herbie scratched his head. "Who knows? They don't let us in on anything. We're not supposed to know about the petition. It's called 'protect the children from everything bad in the world.' Just close your eyes and it'll all go away."

"I know the feeling," Winnie admitted. "Do your parents whisper a lot at night . . .when you're all supposed to be asleep?"

"Yeah," Glenn said.

"Why can't they ever be honest?" Winnie muttered.

"Who knows!" Herbie said. "Who can figure out parents."

Winnie stood up and brushed off her shorts. "Well, we can't just sit here all day. What do you guys want to do?"

"How 'bout the park?" Tina asked.

"Too crowded on Saturdays," Winnie answered.

"We could take Woozie out for a walk," Herbie suggested.

"Say! I know . . .the tree house," Winnie said. "Have you guys discovered it yet?"

"What tree house? Where is it?" Tina asked.

"In the yard, silly. Come on. . .follow me." Winnie and Tina ran into the backyard. Glenn and Herbie followed slowly. The tree house was practically invisible among all the leaves of the tall trees. "Iggie's father built it for us last summer. All by himself, except for me and Iggie. We helped him," Winnie said, pointing it out.

"Do you have binoculars?"

"What's binoculars? Tina asked.

"Binoculars are what you look through to see things far away. It makes every-

3.

thing look close. Right, Glenn?" Herbie asked, turning to the brother.

"Right, Herbie. But I don't think we have any," Glenn said.

"Okay. Wait here and I'll go get mine," Winnie told them, running off toward the house. She was in and out in about two and a half minutes. Just long enough to dash up the stairs, take her binoculars lovingly from the dresser drawer, where she kept them hidden under the pajamas, and fly back down the stairs and out the kitchen door with them. When she got back she sniffed in the delicious smell of Iggie's mom's flowers. They were all in bloom. She hoped Mrs. Garber would take good care of them.

"Hello down there," Glenn sang out.

Winnie looked up. Herbie and Glenn were already in the tree house. Winnie felt kind of funny about it. It used to be her's and Iggie's special place. But she guessed Iggie wouldn't mind. Probably her father was busy building her a new tree house in Tokyo. If they had trees there!

"Where's Tina?" Winnie asked the boys as she climbed up the rope ladder to the wooden planks that made up the floor of the tree house.

"She went inside for a minute, with our Dad," Herbie said. "He's off on Saturdays. Isn't your father?"

"No. Saturday's the big day for hardware stores." Winnie said. She never thought much about Mr. Garber. She had only seen him once. The day she was spying on them when they moved in.

"Well, here's my binoculars," Winnie announced. "Want to see?"

Herbie took them and held them up to the eyes. He moved them around and handed them back disgustedly. "Some fun. All I see are tree tops and leaves."

"Oh Herbie," Winnie laughed. "You're not looking in the right places. Here Glenn, have a turn."

Glenn put the binoculars to the eyes and adjusted the focus. Boy! These are really powerful!"

"I know it." Winnie agreed. "Iggie gave them to me for my birthday last year. They used to belong to her uncle who's in the Marines. Here, give them to me a minute and I'll show you something." Glenn handed them to her. Winnie stood up and waved the free hand around, while holding the binoculars in the other. "Points of interest up and down Grove Street are . . ." she announced in the deep and dramatic voice.

"Number one: The man who lives behind here and three doors down. I forget his name, but he mows the lawn in a red bathing suit every week. On Thursdays, I think. And he's real fat and the belly jumps all around when he pushes the mower. He's not out today. . .too bad!

"Number two: Pay attention please, Herbie Garber." Herbie took his fingers out of his mouth and looked at Winnie, who then continued her speech.

"Three doors down and on the right. Mrs. Axel's yard. Completely fenced in. Nobody knows what Mrs. Axel does all day in her fenced-in yard but me and Iggie. You want to know? Well, she sunbathes in there. Sunbathes and talks on the phone. She's got this outside phone connection and she gabs, gabs, gabs all day long. You know what she wears? A towel! That's it. Just a towel and the telephone. That's Mrs. Axel!"

Winnie turned and faced the other way. She pointed with one hand as she peered through the binoculars. "Number three: Billy Mesler. One and a half years old. We just discovered him this summer. He climbs out of the playpen which is in the middle of the yard. He crawls into the flower beds and eats. He eats flowers, dirt and stones. Sometimes all three at once. Mrs. Mesler comes outside screaming when she discovers Billy is out of the playpen. She finds him eating dirt and stuff and then she starts to cry. She picks him up, washes out the mouth, puts him back into the pen and pretty soon the whole thing starts over again."

"You sure do know a lot about what goes on around here!" Glenn said.

"Yes, I sure do!" Winnie agreed.

4.

<u>The</u> back door slammed and Tina and Woozie came out. "Hello down there," Winnie called to them.

"Hi Winnie," Tina answered. 'Come on down here for a second. I want to show you something."

Winnie handed <u>the</u> binoculars to Glenn, instructing both boys to be very careful with them, but to holler if they saw anything special. She climbed down <u>the</u> rope ladder and ran over to Tina and Woozie who were still standing by <u>the</u> back door. She bent down to scratch Woozie behind <u>the</u> ears but backed away. "Yick! What's <u>the</u> matter with him. He smells funny and <u>the</u> fur's all sticky!"

"That's what I wanted to show you. It's the stuff called No-Shed. Daddy got a bottle of it for Woozie 'cause his fur is shedding all over <u>the</u> house already and we've only had him one day! So I rubbed it all over him. And now look---he's a mess! What do you think?"

"I think you're right. He's a mess. You better ask your father about him," Winnie suggested.

Tina yelled into <u>the</u> house. "Daddy, could you come out for a second?"

"What is it now Tina?" a deep voice called up from <u>the</u> basement.

"It's Woozie, Daddy. I think he needs you!" Tina hollered.

Winnie heard heavy steps coming up from <u>the</u> cellar. Then Mr. Garber appeared, looking both hot and tired.

"Daddy, this is Winnie, from down <u>the</u> street," Tina said, still staring at <u>the</u> dog.

"Hello Winnie," Mr. Garber said, glancing from Winnie's face to <u>the</u> sticky fur. "Whatever happened to him?" Mr. Garber asked, looking up at Tina, from where he kneeled beside <u>the</u> dog.

"Oh Daddy!" Tina sniffled. "I wanted to help take care of him so I rubbed <u>the</u> whole bottle of No-Shed on <u>the</u> fur. To make him stop shedding Daddy. So Mom wouldn't be mad at him for messing up <u>the</u> house."

Mr. Garber sat down on the back stoop, threw <u>the</u> head back and laughed. He laughed deep and loud. Winnie and Tina looked at each other. If there was a joke they didn't know what it was. "What's so funny Daddy?" Tina finally asked.

"Tina, come over here," her father said between laughs. She sat down on her father's lap. "Tina, you don't rub No-Shed on <u>the</u> fur. You put a teaspoon of it into <u>the</u> drinking water each day."

"Oh Daddy!" Tina wailed. "Did I hurt him? Will Woozie die?"

"I'm sure he'll recover Tina He'll need a good bath and then he'll be fine. But next time you want to help, Please ask first, okay?"

"Okay, Daddy." Tina hugged her father.

"Hey down there," Herbie called. "Something's up. Germs, Incorporated is carrying some kind of sign and heading our way. Have a look, Glenn."

"Yeah, here she comes---marching down <u>the</u> street. And Clarice is right behind her. Just skipping along. I can see them real good. Mrs. Germs is wearing <u>the</u> red hat with cherries on top of it."

"I can't read <u>the</u> sign---she's got it turned <u>the</u> wrong way," Herbie announced, without bothering to look through <u>the</u> binoculars. "Come on," he called, let's go see!"

Both boys scurried down <u>the</u> rope ladder from <u>the</u> tree house and joined Winnie and Tina, Who were already hiding behind one of <u>the</u> big evergreen bushes. Mrs. Landon was hammering <u>the</u> sign into <u>the</u> lawn with her shoe. <u>The</u> cherriee were dangling from her red hat and Clarice stood by, sucking <u>the</u> lollypop. Mrs. Landown stood back to admire <u>the</u> work, brushed off <u>the</u> hands, put <u>the</u> shoe back on and continued marching down <u>the</u> street. Clarice followed like an obedient little lamb.

Winnie, Tina and <u>the</u> boys ran down to have a look. Mr Garber came around to <u>the</u> front just as Herbie picked up a stone and hurled it at <u>the</u> sign. I HATE HER!" he screamed. "I hate her, I hate her, I hate her! She doesn't even know us. She's never even talked to us! I wish I was back in Detroit where everybody's black!" Herbie ran sobbing toward the house.

Glenn read the sign in a hoarse and whispery voice, as if he needed to say it out loud to believe that it was real.

GO BACK WHERE YOU BELONG. WE DON'T WANT YOUR KIND AROUND HERE!!!!!

Mr. Garber grabbed the sign, yanked it out of the ground and broke it in half over the knee. Winnie felt her cheeks burning. She was shaking all over. "We're not all like that," she heard a small voice say. "we"re not . . . we're not. . . we're not." She realized the voice was her own and that she was crying. She turned and fled, tears streaming down her face.

Winnie opened her eyes and looked around. For a second she was not quite sure where she was. Then she remembered running home from the Garbers. She remembered the way she had burst through the back door of her house and how her mother had chased her up the stairs, two at a time. She knew that now she was sprawled out on her bed and that no one had taken the time to fold back the blue quilted spread. Her mother was bending over her and there was a cold, wet washcloth on the forehead. Winnie rolled her eyes from side to side.

"Thank heavens, Winnie!" Mrs. Barringer sighed. "Can you tell me what hurts?"

"Everything hurts," Winnie moaned.

The expression of relief left Mrs. Barringer's face. She got up off the bed. "I'm going to call the doctor," she announced, "and I'll be right back."

Winnie reached out and caught the mother's arm. "Don't leave Mom. Please stay here," she whimpered.

"It will only take the minute, Winnie."

But Winnie sat up and shouted, "I don't want him Mom. I don't need the doctor. I'm not sick like that!" She put her head back down on the pillow and moaned again.

"Are you sure you're not sick Winnie?" Mrs. Barringer sat down on the bed beside her, feeling the forehead.

"No, I am not sick!" Winnie insisted.

"Well then, what happened? You came into the house screaming and crying. Something must have happened. Let's talk about it.'"

Winnie sat up again. "Do you know what she did Mom? Do you know?" she asked breathlessly. "She put a sign in the grass. A SIGN! Can you imagine! She's the most horrible person that ever lived! And I hate her!" Winnie flopped backwards and stared up at the ceiling.

"What are you talking about?" Brs. Barringer asked, shaking the head. "I haven't any idea. You're not making sense." She handed Winnie the tissue. "Here, blow your nose and let's start over again."

Winnie sat up. She blew the nose hard, took the deep breath, and blurted out the whole dreadful story. When she had finished, her mother studies the face for a moment without speaking. Then Mrs. Barringer sighed and said, "What an awful thing to do." She put the washcloth back on Winnie's forehead, and brushed some loose strands of hair off the face. "But I certainly am relieved to find out there's nothing wrong with you. You had me worried Winnie!"

Winnie jumped back up. "Nothing wrong? How can you say that! Didn't you hear what I just said? I ran away when I read the sign. I ran away Mom. I didn't even say anything. I just ran. They'll probably hate me now. I could just die!"

Mrs. Barringer laughed softly. "Oh Winnie! You're being ridiculous. I think you're making too much out of the whole thing. Why should they hate you?"

Winnie looked straight into the mother's eyes. "Why should they hate me?" she asked. "That's easy. I'll tell you why. Because I'm white!"

"Winifred! You are not thinking. Mrs. Landon is one person. You are another! No one is going to hate you for running away!" Mrs. Barringer insisted.

"But Mom . . .maybe they'll think we're all like Mrs. Landon. She hates the Garbers and she doesn't even know them! So maybe the Garbers will think we're

6.

all the same! We've got to prove it to them Mom."

"Prove what, Winnie?" Mrs. Barringer asked.

"Prove that we're not all like the Landons," Winnie said, throwing her hands up into the air.

"Winnie!" Mom sighed, annoyed. "You're carrying the thing too far. You're devoting all your time and energy to the Garber cause. You've got to learn to think things through. You're always jumping into the situations with both feet, before you know what you're jumping into!"

"But Mom . . ." Winnie began.

"Just the minute. Just the minute, please. I'm not through yet," Mrs. Barringer said. "Do I have to remind you that the year you started the Freedom for Turtles Club? And as President you went around ringing all the doorbells on Grove Street, telling people how wrong it was to keep the turtles cooped up inside the house. Well, do you remember that Winnie?"

Winnie felt her cheeks redden. "Oh Mom! I was only ten then. And anyway, it's true about turtles. They should be free to walk around outside."

"But my point is that it's still the same thing. You're jumping into something that you know nothing about." Mrs. Barringer shook a finger at the daughter.

"The same thing! How can you say that?" Winnie asked furiously. "Turtles are turtles! But these are people Mom. PEOPLE! Sometimes I think you're just like Mrs. Landon," Winnie mumbled disgustedly.

"That is completely unfair of you Winnie!" her mother answered angrily. "Why, I would never dream of behaving the way Mrs. Landon has."

"Well, then, why don't you do something?" Winnie asked.

STORY FOUR

Winnie clenched Aunt Myrna's dollar bill in her sweaty hand. She kicked open the door of the screened-in refreshment stand and stepped inside, out of the hot sun. Here it was dark and cool. It took a minute for her eyes to adjust to the change before she was able to look around for a familiar face. There was none. She went up to the counter and waited for her turn. Two little kids were ahead of her. They were trying to decide between the ice-cream sandwich to share or a small candy bar for each of them. They counted their money again and again. Winnie began to tap her foot at them. She was starved. Her stomach was rumbling. The little kids looked up at her and finally asked for one bag of potato chips and a small raspberry sherbet. Winnie ordered a hot dog, french fries and a coke. She carried the lunch to a table in the corner. She had missed the usual Saturday lunch crowd and was glad of that. She hated to wait in line and get shoved around.

Winnie carefully decorated the french fries with just the right amount of ketchup and bit into the hot dog. It tasted marvelous. She patted her red pocketbook several times and then opened the clasp to make sure the petition was still here. It was.

"Well, look who's here," a familiar voice boomed. Winnie looked up just as Big Red pulled over a chair and sat down. "I'll join you," he announced, banging the coke down on the table.

"Are you asking me or telling me?" Winnie grinned.

"Um. . . don't mind if I do!" Big Red said, paying no attention to her. He helped himself to some of Winnie's french fries. After tasting one he reached for the ketchup. He smothered the rest of the potatoes in it and continued nibbling.

"Those WERE my french fries, you know," Winnie said. "And they WERE fixed the way I like them!"

"Oh, sorry Winnie. Didn't mean to spoil your lunch," Big Red said, munching.

Winnie sulked and concentrated on her hot dog. When Big Red had finished stuffing himself with Winnie's potatoes he wiped the mouth with the back of the hand. "Why'd you feed me that goofy story about the colored kids? Why'd you tell me they were from Africa when you knew all the time they were just ordinary?" he asked Winnie. "And from Detroit!" he added disgustedly.

"Because I know how you are. That's why," Winnie said quietly, not looking up.

"What do you mean, how I am?" Big Red wanted to know.

This time Winnie looked directly into Big Red's blue eyes. "How you are about the kids. You never let the kids play right away. You make them suffer until you think they deserve the great privilege of playing ball with you."

"So you lied on purpose!" Big Red accused.

"It was just a joke, Big Red. Forget it!" Winnie said, sipping her soda.

"I hear you're real friendly with them," Big Red mumbled.

"So?"

Big Red shrugged and said, "So nothing! I just wondered. They seemed okay to me. I mean, what do I care what color they are, right?"

Winnie slammed her hand down on the table. "Right! What'd your folks say?" she asked.

"Nothing much. My mother said next thing you know some nice girl from town will probably marry one."

"Oh. . .that's just great!" Winnie said, sarcastically.

"Yeah!" Big Red agreed. "But me, I'm not like that."

I'll bet Winnie thought to herself, as Big Red got up and left the table. Winnie finished up her coke, threw the paper plates into the garbage can and walked out into the sunshine.

She parked herself on a chair at the side of the pool and pulled off her sweat shirt. She hung her nose clips around her neck, shaded her eyes from the sun and looked around. The swimming instructor, Mr. Berger, was on the far side of the rectangular pool. Winnie smiled and waved, but he didn't notice her.

2.

Mr. Berger taught physical education at the high school. Two years ago Aunt Myrna had given Winnie a present of a whole series of swimming lessons from him. He didn!t approve of the nose clips, but she liked them because she never got water up the nose that way. Mr. Berger was walking in Winnie's direction. She stood up and held the pocketbook tightly.

"Hi Mr. Berger," she called out, waving.

"Well, Winnie! Glad to see you're doing all right without Iggie. Still got those old nose clips? Time to get rid of them." He smiled good naturedly at her.

"Do you have a minute, Mr. Berger?" Winnie asked timidly.

Mr. Berger checked the watch. "Sure I do Winnie. The next lesson's not for another ten minutes." He sat down on the chair beside her.

"We've got the new neighbors Mr. Berger. In Iggie's house. They're uh. . . they're uh. . . Negro," Winnie waid quietly.

Mr. Berger kept smiling at her. "Oh. . ."

"Yes. . . we're very good friends," Winnie said excitedly. Then she paused and added, "At least we were until the morning. Mr. Berger, I've got the petition and uh I'd like you to sign it for me. Would you?"

Mr. Berger looked at Winnie for what seemed to be a very long time. Then he said, "Well, I can't answer that until I see it. Where is your petition?"

Winnie whipped it out and presented it to him. "Here it is and here's the pencil," she said, fumbling in the bottom of her pocketbook for the one she had sharpened so carefully.

Mr. Berger read the paper thoughtfully. "This is more of a questionnaire than a petition, Winnie. But I'll fill it out for you. He reached for the pencil and Winnie held her breath, wondering if he would check Like . . .Don't Like. . . Don't Care. . .or Don't Know.

Mr. Berger handed the questionnaire back to her. She was almost afraid to look. "Go ahead and read it Winnie," he said.

Winnie turned away from the sun and studied the paper. Mr. Berger had signed his name in the proper space: Frank G. Berger. To the question "Feelings about Colored People" Mr. Berger had written across the whole line. . . What color? Green or purple?

"Mr. Berger!" Winnie sighed, embarrassed. You know what I mean!"

"Yes, I think I do Winnie. But I can't answer the question like that by checking the box I have many feelings. And the feelings are different for each person."

"That's just it Mr. Berger!" Winnie raised the voice. Then she leaned over closer to him and explained softly, "You see, Mrs. Landon is being mean to the Garbers without knowing them, because of the color. And the folks, well, I'm disappointed in them too. And I'm all mixed up, Mr. Berger. And I just wish Iggie was here. And I wish somebody would help me understand!" Tears came to the eyes and she looked away.

"Winnie, Winnie," Mr. Berger said gently, putting the arm around her. "Sometimes life is like that. I'll tell you one thing though. I'm proud of you." And then with a grin he added, "Even if you do wear the clips!

"You think I'm right then?" Winnie asked, returning the smile.

Mr. Berger nodded. "I think anybody who cares about people is right Winnie."

They were interrupted by a shrill voice screaming, "Don't put your face near the water. Don't go in so deep. Come back here Clarice! You'll drown. No splashing! You'll ruin the hair. Please children!"

Winnie groaned, as she turned toward the voice. Mrs. Landon and Clarice. Yick! Winnie heard that they recently joined the pool. "I can't stand her," Winnie confessed to Mr. Berger. "And the itsy-bitsy precious-wecious little princess of hers!"

"I can understand how you feel about Mrs. Landon, Winnie. But try not to take it out on Clarice. It isn!t easy to go through life with the mother like that. Why don't you talk to Clarice? Give her another point of view. The way

3.

Iggie did for you."

"I can't Mr. Berger. I just can't!" Winnie insisted.

"Well, think about it Winnie. I've got to give the lesson now. Keep your chin up!" Winnie nodded and watched Mr. Berger walk away.

She folded the questionnaire and tucked it into the pocketbook. Mr. Berger was right. . .you can't expect people to answer a question like that with a check mark. There had to be another way.

Winnie sat down on the edge of a lounge chair. She watched Mr. Berger jump off the diving board with a little boy. He used to do that with her too. She felt the sweat trickle down her chest inside her bathing suit. She decided as long as she was at the pool she might as well have a swim.

Winnie sat down next to the ladder at the deep end of the pool and dangled her feet in the cold water. She read the printed sign stating WOMEN AND GIRLS MUST WEAR BATHING HATS AT ALL TIMES--MANAGEMENT. She held hers in her lap, not wanting to put it on until the last possible second. The hat squeezed her head and she hated it.

Since she had passed the deep water test last summer she was allowed to use all sections of the pool. She even had a badge to pin on her bathing suit saying GUEST: DEEP WATER. Winnie was thinking about the things she and Mr. Berger had discussed when someone suddenly shoved her from behind and sent her splashing down into the cold water, totally unprepared. She came up choking and spurting water, her nose clips still hanging around her neck. The life guard stood up furiously blowing his whistle at her. He pointed at her head, indicating that she was in the pool without a bathing cap. Wonderful! she thought! She might have drowned and all the life guard cared about was that her hair wasn't covered. She looked up into Big Red's laughing face.

"Oh, that was just great Winnie! I really surprised you, didn't I?" He laughed hysterically and slapped his thigh. "Oh boy, I really caught you off guard!"

Winnie muttered under her breath and considered how good it would feel to chop off the big red head with a sharp hatchet!

She climbed up the ladder, stepped out of the pool and sat down in the sun, hoping her hair dried before she had to go home. Mrs. Landon was still sitting on the chair right up close to the shallow end of the pool. She was wearing a bathing suit but had the sweater over her shoulders anyway.

Clarice was floating inside the tube. She twirled around and around but didn't get her face wet. At that moment Winnie felt sorry for her. Having a mother like Germs, Inc. was pretty bad. Mr. Berger was right. It really wasn't Clarice's fault that she was the way she was. Maybe when she got older she's change. Maybe, but probably not, Winnie decided.

She took out the questionnaire again. She simply could not resist the temptation to approach Mrs. Landon. She walked over slowly and just stood there, waiting for Mrs. Landon to notice her.

"Hello, Winifred. Do you want to swim with Clarice?"

"No. . .I. . .uh. . .it's just my questionnaire, Mrs. Landon. I'd appreciate it if you would fill it out please," Winnie said, making her voice as gentle and sweet as she possibly could.

"Questionnaire! Now what are you up to young lady?" Winnie handed her the paper. Mrs. Landon read it and sucked in her breath. She kept her voice low, almost swallowing every word. "Winifred Barringer. . .I feel sorry for you! And for your parents!" Mrs. Landon shook the questionnaire in Winnie's face.

Winnie grabbed it and went to search for the aunt. She was afraid if she stayed she would cause a commotion. Then Aunt Myrna might be mad at her, and she was, after all, only a guest.

"Glad you're here Winnie," Aunt Myrna waid, as Winnie approached the bridge table. "It's almost four o'clock, and I have to be going. Let's get the things

4.

together now."

Winnie opened the car door on the driver's side. She slid over into the bucket seat, and fastened the safety belt. Aunt Myrna backed out of the parking lot and headed for Grove Street.

Winnie asked her aunt to drop her off at the Garbers, instead of at the home. Aunt Myrna agreed. Winnie got out of the little red car, thanked her aunt for the afternoon, and skipped up to the Garbers' front door.

She pressed a bell and looked around. There was no green station wagon in the driveway. Winnie wondered if anybody was home. She pressed the bell again and listened for footsteps. She didn't know just what she was going to say to the Garbers, but she had to face them.

Glenn answered the door. Hi, Winnie," he said, munching a chocolate chip cookie.

"Hi. Can I come in?"

"Sure. Why not?"

Winnie realized that she hadn't been inside the house since the Garbers moved to Grove Street. A thought gave her a sinking feeling, but she swallowed hard and stepped into it. "Isn't anybody else at home?" she asked.

"Tina and my father took Woozie to a vet. He needed some shots." Glenn's voice was almost a whisper. Winnie had to lean close to hear every word. "And Herbie's upstairs sleeping." Glenn finished his cookie and brushed off his hands.

"Sleeping? At quarter to five in the afternoon? How come?"

"He puked after lunch. After uh. . .after Mrs. Landon... . oh, you know." Glenn looked at his sneakers.

"Yeah," Winnie said, and then tried to brighten things up. "Say! I threw up on a bus once. Spaghetti! All over the place. The people on the bus weren't very happy about that at all. Winnie laughed nervously. She certainly hadn't planned to tell anyone that story.

Glenn didn't laugh. He just looked at her kind of funny. I'm doing something in the kitchen . . .come on."

Winnie followed Glenn through the long hallway leading to the rear of the house. The kitchen looked out on the back yard. A folding table and three chairs were set up in one corner of a bright sunny room. Winnie sat down on a chair. The yellow countertops were cluttered with grocery bags. Somebody must have been shopping. Glenn reached into bag after bag, coming up with a variety of cans, jars and boxes, which he banged down on a counter. Winnie watched silently. She noticed that the Garbers used the same kind of peanut butter that her mother bought for her. The creamy kind. She hated the kind with lumps.

Glenn opened the cabinet over the counter and started putting in all the cans and jars. He didn't make rows like Mrs. Barringer did. He practically threw them in every which way. Winnie's mother lined everything up so you could read the labels.

"How come you're putting all the stuff away? Where's your mother?" Winnie asked.

"Upstairs," Glenn mumbled.

"What's going on around here anyway?"

Glenn faced her. "Okay, you might as well know, Winnie," he said disgustedly. "My mother's packing."

"Packing! For what?" Winnie asked.

"To leave here . . .to move. . .that's what!"

"But why?"

"Why!" Glenn raised his voice. "How can you ask why? You know why."

"You mean you're going because of . . .of . . .the sign and Mrs. Landon?" Winnie didn't want to believe it. How could the Garbers give up so easily?

5.

"I don't know if we're really going or not. All I know is my mother's been screaming and carrying on all afternoon. She's had it! That's all I know."

"But what about you?" Winnie asked.

"Me!" Glenn laughed "Do I matter? Does anybody ever care about what I think?" He turned back to the bundles.

"I do," Winnie said softly.

"The lot of good that'll do!" Glenn clunged two cans of tuna fish into the cabinet. "For all I know my mother's going to take us back to Detroit and leave my father here."

"Why would she do a thing like that?"

"Because my father's not going to want to move. I just know it. He's got the job he's been after . . . the one he's been working for."

"Your father's not mad?" Winnie asked.

"Mad!" Glenn slammed the cabinet door. "This is more than just getting mad. I don't think you understand."

Understand? What did he think anyway? Hadn't she been understanding right from the start. Wasn't she the one who wanted to be the good neighbor!

She heard somebody run down the stairs and tear through the hallway into the kitchen. It was Herbie. He looked awful. The eyes were red and swollen. He had the blue terry bathrobe wrapped around him. He was barefoot. Winnie hoped he wasn't going to throw up again. That was something she couldn't stand.

"Oh . . .it's you!" Herbie looked at her, then turned away.

"Come off it, Herbie," Glenn said. "There's no point in taking it out on Winnie."

"Good old Winnie!" Herbie slapped her on the back and made the cough. "The Do-Gooder Herself!"

Who did he think he was? Here she was trying to help . . .trying to do the best for them and this is where it got her. "Do you have to be so nasty all the time?" she asked Herbie. "What'd I ever do to you?"

Herbie dropped to the knees, pretending to pray. "Lord. . .oh Lord! Thank you for sending the Garber family the Great Do-Gooder, Winifred. Now that she's discovered us, she's going to save us, Lord. All by herself! And after we're gone, Lord. . .then she'll be able to tell everyone how she's had the black friends. Now isn't that wonderful! I ask you. . .isn't that just too. . ."

Winnie jumped to the feet. "SHUT UP!" she yelled. "Just shut up." She smacked Herbie across the face, as hard as she could. "YOU CREEP! She screamed. "The rotten, lousy creep!"

Herbie grabbed her by the arm. "Shut up yourself!" he hollered back.

Glenn stepped between Herbie and Winnie, forcing them apart. "Cut it out. . . both of you!"

"You know what I think, Herbie Garber," Winnie cried. "I think you're as bad as the Landons. I used to think you picked on me 'cause I'm the girl. But I just found out the truth. You hate everybody who's white! I feel sorry for you!" She stormed out of the kitchen before the tears came. They tasted hot and salty.

Glenn caught her at the front door. "Hey, take it easy Winnie."

"Easy? Ha! Did I start it? Did I?"

"Look, all Herbie means is he doesn't think you'd be so interested in us if we weren't black. He doesn't want to be used by somebody who thinks it's groovy to have the black friends."

"Want to be used! Well, I don't know what that's supposed to mean! I just don't seem to understand anything anymore!" She was crying hard now and she didn't care who knew it.

She ran home sobbing. Whatever made her think they were the special. They were just ordinary. That's all! Plain, old ordinary! And no matter how much she wanted to be friends. . .no matter how hard she tried. . .the Herbie Garber was hard to take! He was more than hard to take. . .he was IMPOSSIBLE.

6.

Dear Iggie,

How are you? I have tried my absolute best to make friends with the Garbers (who bought your house). I have done everything I could for them. And do you think they apreciate anything???? They do not!!! Especially one impossible one named Herbie. I just smacked him. He's lucky I didn't kill him. I felt like it!!! What would you think of your best friend spending the rest of her life in jail?

Winnie took the bath before dinner. Nobody told her to, but if the folks saw how upset she was they'd want to know about it, and she wasn't going to go through that again. Not after the morning's scene with her mother.

She didn't feel like eating dinner. But her mother said, No dinner. . . no dessert!" And Winnie had seen the cherry tarts sitting in the refrigerator. Her favorites! So she forced herself to nibble on the main course. She gagged on the mouthful of lima beans before she managed to wash them down with the glasses of water.

Just as her mother carried in the cherry tarts the doorbell rang. I'll get it!" Winnie said, already out of the chair. "But don't start the tarts without me."

It was Mrs. Landon,, wearing the glasses and looking stern. "Good evening, Winifred. Are your mother and father at home?"

"Yes, but we're in the middle of the dinner," Winnie said.

Mrs. Landon raised the voice. "Well then, I"ll wait!"

Winnie could tell that Mrs. Landon was not about to leave so she went back into the dining room and announced the arrival of Germs, Incorporated.

"I guess our cherry tarts will have to wait," Mr. Barringer said, as they went to the front hall to greet

STORY FIVE

Winnie didn't sleep well that night. She was angry at her mother for behaving the way she did. Just like Herbie Garber! And furious that nobody got to eat the cherry tarts because of the awful Mrs. Landon.

The next morning when Winnie got up the house was perfectly still. No morning noises at all, even though the clock on the dresser said ten after nine. Then Winnie remembered it was Sunday. That was the trouble with summer. One day was just like another. It was hard to keep track of which was which. She dressed slowly and crept downstairs to the kitchen where she discovered her father, his nose buried in the Sunday papers. "Where's Mom?" Winnie asked.

"Sleeping," the father replied.

"Oh. She okay?"

"She will be. Just the little upset. Nothing to worry about."

"Oh."

"Your mother wants to move."

"But Daddy---we're not going to, are we? Last night you said . . ."

Her father interrupted her. Sometimes people think more clearly in the morning."

It was the mother's fault. She'd gotten to him all right. Probably with one of those whispering campaigns. Everything her father stood up for last night was gone this morning. Vanished! Poof! Just like that!

Well, if they were going to move they were going to be in for the big surprise, because she wasn't going with them. She'd leave town . . .run away! She'd run to Iggie in Tokyo. At least Iggie's folks would understand. They'd take care of her. They'd never make her go back! And it wouldn't be heard. She'd hide on the ship. Hitch a ride to New York and then hide on the ship. She read about people who did that all the time. The only problem would be how to find Iggie once she got to Tokyo. Of course she had the address. All she'd have to do was find somebody who spoke English. Somebody to give her directions to Iggie's new house. Once she was there she'd never see the folks again. Maybe Matthew would join her. Yes, that was a good idea. She'd wait until Tuesday when Matthew came home from camp then they'd go together.

"Winnie! Why are you staring into space like that?" Mr. Barringer asked.

"What? Me? Oh, nothing!" Winnie poured pineapple juice from the can into the glass. "I think I'll make some plans if it's okay with you."

"Fine. Go ahead. No need to hang around here," her father answered.

She swallowed the juice in one gulp and walked out to the hall where she picked up the phone. Without thinking, Winnie started to dial Iggie's number. Of course it would have been changed! She called information and asked for GARBER . . . the new listing on Grove Street. She jotted down the number on the milk bill, which was lying face up on the telephone table.

She couldn't leave town without explaining it to them. Then Herbie would really have something to talk about! She'd show him. She'd show the Herbie Garber! She'd plan the day to remember.

The Garbers' phone rang twice before a gruff voice answered. "Hello. . . hello. . ."

Winnie hung up. She hadn't expected Herbie to answer. She waited a minute, then dialed the second time. "Hello . . .hello. . ." Herbie again.

Finally Winnie managed to say, Hello Herbie. This is Winnie. May I please speak to Glenn?"

Silence on the other end. "Uh. . .Herbie. . ." Winnie continued. "Are you there?"

"Yeah. I'm here."

"Well, may I please speak to Glenn?"

"Just the second."

"Hello?" It was Glenn's voice.

"Hi. It's me. . .Winnie."

"I know."
"Oh. Well, it's a nice day and I was wondering what you were doing."
"Don't know."
"Oh."
"Why were you wondering?"
"Well, I thought we could do something together."
"Like what?"
"Maybe a picnic."
"Your house?"
"No, in the park."
"I thought you said the park's too crowded on weekends."
"Too crowded for ball . . . not to eat."
"Just you and me?" Glenn asked.
"No, everybody."
"Even Herbie?"
"Sure."
"Just a second." Winnie heard the lot of muffled voices in the background. Then Glenn said, "Okay, we'll go."

"Good!" Winnie was pleased. "Come over here as soon as you can. And Glenn, I'll bring everything we'll need for the picnic. Bye"

She hung up and raced back to the kitchen. Her father was gone. She slapped some peanut butter on eight slices of bread and carefully cut the sandwiches in half. She stepped back to admire her work. Yick! Whenever she cut with a knife it looked like she'd done the job with a dull scissors. The peanut butter sandwiches were no exception. She wrapped each sandwich in Saran, took an unopened box of chocolate-chip cookies from the pantry shelf, threw in a few napkins and put everything into a big brown paper bag. They could buy soda and ice cream at the stand in the park and if the Garbers had no money with them. . . well, Winnie would just treat them. She had plenty of allowance saved up.

She searched frantically for the picnic blanket but she couldn't find it upstairs or down. No use asking her father, who was in the den. Daddy never knew where anything was around the house. Instead, she pulled the blanket from her own bed, rolled it up, carried it downstairs, grabbed the brown bag of lunch and announced, "Daddy, I'm going to the park for a picnic. Just tell Mom I'll be home later this afternoon. Okay?"

"Fine. Bye," Mr. Barringer said without looking up. Winnie packed the red wagon with the blanket and lunch. She was outside and ready when the Garbers arrived. She couldn't look at Herbie. She'd never slapped anyone in the face in her whole life. She wondered if she should apologize, or what! But Herbie deserved that slap. He really did. . . so why apologize? She wasn't the one who started it. She'd do what her mother did after a fight with her father. Pretend it hadn't happened. Just act natural. "Hi," Winnie said.

Tina and Glenn answered, but Herbie was busy kicking a stone down the street.

"Let's go," Winnie said, pulling the wagon.

When they turned off Grove Street and onto Sherbrooke Road Winnie couldn't stand the suspense any longer. Well, are you moving? she asked Glenn.

"Nope."

"How come? What happened?"

"You've never seen our father when he's made up his mind about something! Glenn said.

Herbie gave the stone a big kick, then turned around to face the others. He pretended to be the father. He shook the finger at them and growled. "I've worked for years to get the job and I'm not giving it up now!"

"That's what he yelled at my mother," Tina whispered to Winnie.

Herbie continued his act. "Grow up honey! You've got to grow up and face life! Running away isn't the answer."

"That started my mother on the crying jag that lasted all night," Glenn added.

3.

"But this morning she came down and gave us breakfast. She sniffled the lot but she didn't cry once," Tina reported.

"Man! Will I be glad when school starts. Anything to get out of the house!" Herbie kicked the stone.

"The Landons are moving," Winnie said, quietly.

"No kidding?" Glenn looked at her.

"Good riddance!" Herbie hollered. "Good riddance to the Germ family!"

"Mrs. Landon wants the folks to sell the house too."

They stopped walking. Winnie sat down on the edge of the wagon. Herbie, Tina and Glenn gathered around her.

"And?" Glenn asked.

"Well, I don't know yet," Winnie confessed.

Herbie bent over, picked up the stone and threw it. "Maybe we can start the nice little ghetto right on Grove Street. That's what it's all about, isn't it? Get out before we take over?"

"Look, I don't want to get into another fight, Winnie explained. I just wanted to tell you that if the folks move away I'm not going with them."

"Where you going to live? In the tree house?" Herbie laughed.

Very funny! I'm going to Tokyo. To live with Iggie's family."

"Oh, just like that! That's just great!" Herbie laughed at her again.

"Herbie, if you'd stop being the impossible for a minute. . ."

"Come on, Winnie!" Glenn said. "Going to Tokyo isn't exactly the practical idea."

"We'll see about that!" Winnie told them. "I already have my plans. I know how to do it. All you have to do is stow away on a ship. People do it all the time." Winnie jumped up off the wagon. She started to walk.

Sherbrooke Road was quiet today. No hammering, digging, or any of the usual building sounds. Winnie stopped in front of the first new house. She shaded her eyes from the sun and wondered who was going to live in it. "Want to go in and have a look around?" she asked.

"I don't think that's a very good idea," Glenn said. "Suppose we get caught?"

"It doesn't belong to anybody yet," Winnie said. "No one's working. And we're not going to do anything wrong anyway."

Glenn agreed. "Okay, but leave the wagon here, under the trees. Hey Herbie! We're going exploring. Come on!"

The four of them stepped along a wooden plank that had been stretched out like a walk so people could inspect the new houses without stepping on a muddy ground. At the end of the planks was a ladder, propped up against a brick porch. They climbed up one at a time.

The house was partitioned into rooms, but had no inside walls. They prowled through the first floor arguing about which room was which until they came to a kitchen. There was no doubt about that---a kitchen was a kitchen no matter what. Even without things like a refrigerator, stove and sink, they could still tell a kitchen. Next to it was a hole, leading to the cellar. They peered down into the darkness. There were no steps yet. Glenn held onto Tina's hand and motioned for them all to get away from the hole.

"Hey, let's play house," Tina said. "Winnie, you be the mother and Glenn's the father and Herbie's a baby and I'm Woozie. Woof - Woof."

"Okay doggie," Winnie said, chasing Tina up the stairs. "You know the rules--no dogs in the bedroom!"

Herbie and Glen followed the girls to the second floor where they continued their exploring. There were two bathrooms back to back. They could tell because of the pipes. Winnie sat down on the floor in the corner pretending she was taking a bath. Herbie made a loud gargling sound.

They all laughed together and Winnie felt mighty pleased with herself. She took the credit for getting everyone friendly again. She really was a good

4.

neighbor ehe started out to be, wasn't she? Wait until she got to Tokyo and told Iggie's folks the whole story. Wouldn't they be proud of her!

'Let's go, Herbie called, after a few more minutes. "I'm hungry!"

"Me too," Winnie agreed.

They scrambled down the stairs and back outside, to where they had left a wagon with the blanket and the food.

When they got to the park Winnie led them to a grassy area under some tall trees. She spread out the blanket and opened a bag of sandwiches, handing one to each of her guests.

"This blanket itches me," Tina complained.

"Then sit on the grass," Glenn suggested.

"That itches me too,"

"Then stand up," Herbie said, his mouth full of peanut butter.

"I don't like to eat standing up," Tina shined.

Then don't eat!" Glenn hollered.

Tina plunked herself back on a blanket and picked up her sandwich. She finished it without another word.

"Peanut butter really makes me thirsty," Winnie said.

"Peanut butter makes everybody thirsty," Herbie agreed.

"And it sticks to the top of my mouth too," Tina said.

"Well, we have to walk down to the stand for drinks. I didn't bring them with me."

"Let's go," Glenn said, collecting the garbage into the brown bag.

Winnie led them down the path. She hummed a marching song. The day was really working out well. She was glad because she would be gone soon and she wanted Herbie and Glenn to remember her like this.

"Hey, there's a lake, Herbie called, when he reached the end of a wooded path.

"Yeah. . .and rowboats!" Glenn said.

"It's pretty isn't it?" Winnie asked, facing the round blue lake. She looked around, admiring the flower beds. This was her favorite part of the park. Glenn, Herbie and Tina hadn't seen it the other day because the ball field was at the other end.

Herbie pointed. Hey, look at those little kids fishing."

"I used to do that," Winnie said. "But I never caught anything. And they won't either." She laughed.

'Where are they?" Tina asked.

"Where are what?" Winnie answered.

"The black people."

Oh no! Tina was going to start that again! Winnie thought. "They aren't here today," Winnie told her. Why did Tina have to go and spoil things? Just when everything was going great!

"That's what you said the last time," Tina said.

"Tina, you dope!" Herbie shook his sister by the shoulders. Don't you know by now? There just aren't the black people around here!"

"That's not true!" Winnie said. There are some. And anyway, what's the difference?"

"The difference is. . ." Herbie let go of Tina and faced Winnie. "How would you like it if you lived in the place where everybody was black?"

"I don't know."

"Come off it Winnie!" Herbie looked around and lowered his voice. "You know all right. You know!"

They were going to ruin the day. It wasn't fair! "You're the one making such the big deal out of it! Just remember that," Winnie said, walking toward the refreshment stand.

Herbie walked alongside her dragging the feet. "I'm not making a big deal. I'm just trying to be honest. That's what we wanted to be. . .remember? We all wanted people to be honest with us!"

5.

"Four cokes," Winnie told the man behind the counter. She thought about what Herbie had said. It wasn't easy to be honest all the time. It really wasn't. Even if you wanted to.

The counter man put the four drinks in front of Winnie. "That'll be eighty-six cents," he said. "The six cents is tax."

Winnie fumbled around in the pocket.

"I'm paying," Glenn said, handing the man a dollar bill. "You brought the sandwiches," he told Winnie. "I'm buying the drinks."

Winnie looked up at him but didn't say a word.

When Glenn finished his soda he wiped off his mouth and said, "You know what I feel like doing? I feel like going rowing!"

"I can't," Winnie said.

"Why not? Why can't you go?" Herbie asked.

"I'm not allowed to go rowing if my folks didn't give me permission."

"Man! You're really something." Herbie took the long swallow of soda. "You're going to stow away on a ship to Tokyo but you're chicken to ride around the lake in the rowboat."

"I'm not chicken!" But Herbie was absolutely right for once. What did she care if she did't have permission to go rowing. What did it matter anymore! "Okay, let's go."

They ran to the dock at the lake, pooled all their money and rented the boat for half an hour. Glenn rowed first. Winnie and Tina sat in the back. Winnie leaned over the edge, letting her fingers skim the water. It felt good.

When they were out in the middle of the lake, Tina announded, "I have to make."

Glenn groaned. "Couldn't you have thought of that before?"

"I didn't have to before."

"Man! We're out in the middle of the lake Tina!" Herbie reminded her.

"What do you want me to do? Make in the boat?"

"You can hold it, can't you?" Winnie asked.

Tina covered her face with her hands and stood up. The boat rocked from side to side.

"For crying out loud, Tina! Sit down. I'll row in." Herbie changed places with Glenn and rowed in silently.

After Winnie took Tina to the ladies' room they decided to go home. They were out of money anyway and no one had brought the ball along. Somehow Tina and her complaints had spoiled the party mood. Herbie wasn't bad today, Winnie thought. Tina was impossible, but Herbie was okay. He even pulled the wagon home. . .without anybody asking him to. They stopped in front of the house.

"See you tomorrow," Herbie said.

"No, not tomorrow," Winnie told him. "Tomorrow I've got to go shopping. I need the shoes for school."

"What do you need new shcool shoes for if you're going to Tokyo?" Herbie asked.

"Well, I need new shoes anyway. It doesn't matter for what. My old ones are a mess." Then she remembered about how she had asked them if their father looted stores to get shoes and the face reddened. But Herbie and Glenn laughed at her, and Winnie, feeling very foolish, laughed too.

"See you Tuesday then," Glenn said.

"I don't know about Tuesday. My brother's coming home from camp and we're going into the city to meet the train."

"Oh. Well, okay. Thanks for the picnic." Herbie, Glenn and Tina started out the home.

"Hey, you guys!" Winnie called. "I'll see you on Wednesday, okay?"

That night, after the dinner, Winnie and the parents settled down in the den, in front of the T.V. After a while. Mr. Barringer put down the sports magazine he was reading and said, "We thought you'd want to know we're not moving."

6.

"We're not?" Winnie asked. She had been sure her mother would get her own way.

"No. We decided this afternoon," her father said.

"Great!" Winnie jumped off the couch. "Then maybe we can have the Garbers over for dinner or something."

Mrs. Barringer put down the dress she was working on. It was Winnie's last year's plaid cotton and the hem had to be let down. "Now look Winnie . . . just because we aren't moving away right now doesn't mean that we're going to be best friends with the Garbers. After all, Iggie's family lived in the house for three years and Daddy and I never saw them socially. "

"Oh." Winnie pushed her hair away from her face. I thought you changed your mind."

Mrs. Barringer threaded her needle. "Changed my mind about what?"

"Well, we're not moving so I thought you changed your mind about . . .you know. . ."

"Moving is just too much trouble," Mrs. Barringer sighed. She put the thread in her mouth and bit it off.

So, Winnie wouldn't be going to Tokyo after all! She was half disappointed. All those plans . . . down the drain. But if they weren't moving there wasn't any reason to run away! Winnie watched her mother sew the new hem. Then she looked at her father. He had fallen asleep in the chair. The mouth was half open and he was snoring. Winnie looked back at her mother. . .then back at her father. . .they didn't even notice.

They just don't care, Winnie thought. They don't care enough one way or the other. . .about anything! Too much trouble. . .that's what the mother said. It was too much trouble! They really took the easy way out.

Winnie got up without a word and went into the kitchen. She opened the refrigerator and grabbed a handful of cherries. She was careful not to slam the back door on her way outside.

She walked down the block, spitting cherry pits into the street. When she got to Iggie's house she hid in the shadow of the tall elm tree. The house looked cosy and inviting. But it really wasn't Iggie's house anymore. It belonged to the Garbers. Winnie remembered how Glenn said it the day they met. "This is the Garber house now."

She spit out her last cherry pit and turned away from the house. There was Woozie, wandering down the street, sniffing at trees. He wasn't supposed to be running around loose like that. Somebody might report him. "Here Woozie," Winnie called softly as she walked toward him. Woozie ran to her and licked her leg. Winnie bent down, resting her head against his soft fur. "Go on home now, Woozie. Go on. . .Glenn will be looking for you."

On Tuesday morning Winnie finished her letter to Iggie.

. . .And so the Landons are moving away but we're going to stay and so are the Garbers. Sunday night I stood in front of your house (I mean their house) for a long time and I guess I don't really know as much as I thought I did. I miss you a lot!!!

Love,
Winnie

She licked the stamp and placed it upside down on the envelope. She wondered how long it would take to reach Tokyo. She jumped up onto her bed and studied her reflection in the dresser mirror. She threw her shoulders back and stood sideways. Still perfectly straight, but not really like a boy, she thought. She had given her mother the privilege of doing her hair. It wasn't every day that Matthew came home from camp. Winnie had to admit, her hair looked kind of nice. She smoothed out her dress and hopped off the bed.

"Winnie. . .are you ready? Daddy's in the car waiting," her mother called from downstairs.

Continuous Performance Task I

CPT I

Y	C	A	N	E	I	S	X	Q	A	Z	Z	M	A	O	C
F	D	X	Z	I	I	K	C	E	X	A	E	I	X	P	O
A	A	Z	A	Z	G	A	A	A	T	C	B	I	O	N	L
X	X	D	X	F	K	X	X	X	L	N	O	R	G	Y	U
I	K	K	P	W	H	O	T	Z	C	V	P	A	F	A	A
K	C	V	O	F	B	Z	R	E	N	J	V	X	W	X	X
A	A	A	D	M	B	G	Q	A	V	G	K	A	F	R	W
X	X	X	E	W	P	E	X	X	D	I	W	X	E	O	H
G	A	M	K	A	A	R	A	Y	Q	A	A	G	H	I	A
G	X	F	O	X	X	E	K	M	Q	X	X	Z	V	T	X
V	Y	M	K	Y	A	Q	P	S	B	T	K	A	O	X	W
N	H	G	K	H	X	D	C	C	F	B	I	X	M	S	U
A	R	Y	A	V	A	A	A	A	Z	R	L	A	L	Z	I
C	F	H	X	N	X	X	X	X	Y	L	Z	X	S	G	Q
V	A	O	S	T	P	A	W	A	X	A	A	R	A	E	A
H	X	Y	S	Y	D	X	T	X	P	X	X	B	X	W	Y
N	P	P	X	Z	A	V	S	P	A	A	A	T	A	A	U
T	E	I	W	R	X	H	V	V	H	A	X	E	X	X	Q
O	A	A	W	Q	M	X	O	A	A	B	H	X	A	J	I
F	X	B	L	N	C	S	Y	X	X	U	Y	U	X	V	I
G	S	A	A	A	A	H	H	A	A	G	R	S	I	L	A
L	Z	X	X	X	X	U	B	X	X	B	D	N	M	D	X
H	A	A	B	A	A	T	X	A	Z	E	D	A	K	A	P
E	X	X	X	X	S	Y	N	X	O	Z	P	X	A	X	Y
B	A	A	L	A	A	V	W	A	K	V	A	A	F	U	A
W	X	X	Q	X	X	V	P	X	Y	T	X	X	A	B	Y
W	Z	A	A	B	A	A	A	F	A	O	P	P	T	Z	D
B	H	X	X	I	X	X	X	Y	X	Q	K	X	H	H	C
F	A	V	V	A	P	Y	A	S	D	A	A	E	A	J	A
N	X	Y	D	X	R	O	X	Z	V	X	X	H	X	Y	Y

VIGILANCE I

Y	A	R	W	A	A	A	H	G	G	V	N	A	C	A	H
M	X	O	F	X	X	X	E	B	W	W	B	F	N	X	D
A	L	K	C	A	U	F	M	A	H	R	F	A	A	P	A
X	U	S	Z	X	P	H	M	X	H	R	Q	X	X	Z	X
K	V	W	Z	A	F	M	A	A	H	A	Y	P	I	A	B
D	K	V	E	X	X	N	X	X	Y	X	Z	I	M	X	O
A	E	K	O	K	K	A	A	A	S	A	W	W	A	A	S
X	X	L	Q	K	S	X	X	X	I	X	F	W	X	X	W
A	Q	Y	A	A	N	T	Y	Z	R	Q	N	A	F	B	A
X	H	B	X	X	X	I	I	G	K	H	B	X	P	J	X
D	A	C	F	P	D	F	I	A	A	A	C	A	S	I	V
S	X	P	R	S	K	X	O	X	X	X	E	R	E	Q	D
T	M	T	A	V	H	X	S	H	A	T	Y	V	V	V	A
Y	O	X	X	I	G	T	R	Q	X	A	K	P	C	E	X
W	T	S	A	A	Y	H	A	X	A	W	P	T	O	F	A
Q	E	M	X	X	E	S	X	Y	X	S	C	H	K	W	X
P	A	Y	I	A	B	A	V	C	A	F	Y	S	A	O	R
T	X	C	N	X	D	X	Q	B	X	Z	Y	X	X	A	H
B	A	A	X	A	O	A	Y	J	S	D	V	Z	A	C	N
U	X	X	I	X	H	X	B	R	L	Y	O	A	A	B	U
A	B	A	A	V	A	O	Q	W	E	A	E	A	O	P	V
X	W	X	X	K	X	L	Z	H	Q	X	Y	X	Y	R	D
A	A	U	U	P	K	V	G	M	A	A	A	C	L	L	N
X	X	X	O	T	Z	R	B	T	X	X	X	S	N	L	R
A	A	P	X	E	H	A	A	A	A	A	W	F	A	A	A
X	X	L	S	B	E	X	X	X	X	X	M	K	X	X	X
T	H	A	A	A	P	N	A	P	A	R	O	A	T	A	A
Z	G	X	X	X	N	J	X	L	X	M	W	X	B	X	X
J	Y	C	O	L	U	D	S	A	H	P	F	W	U	A	Q
D	J	U	Q	I	I	E	E	X	Y	P	Z	D	C	X	R

J	Z	A	O	V	O	X	Y
J	L	X	Q	M	O	L	R
U	Q	G	L	A	A	K	Z
I	E	S	H	X	X	D	C
E	A	S	K	A	A	A	O
Z	X	O	E	X	X	X	V
A	A	A	A	F	A	L	Z
X	X	X	X	Y	X	W	O
B	V	A	W	A	Y	A	A
N	T	X	D	X	S	X	X
M	Q	A	Q	V	E	A	I
A	Y	X	S	R	M	X	N
C	O	A	H	A	H	C	A
C	W	X	W	X	Y	Z	X
E	B	A	A	P	A	E	S
Y	Q	X	X	K	X	Z	I
A	A	E	V	N	D	B	U
X	X	T	X	S	X	E	Z
A	S	N	L	A	A	A	A
X	T	L	T	X	X	X	X
Y	A	J	P	E	N	T	A
U	X	U	B	V	E	Q	X
Z	O	X	X	K	X	V	K
K	U.	L	W	K	B	H	O
Y	Y	N	A	Z	A	K	M
D	G	K	X	L	X	I	X
A	I	V	A	T	S	A	X
X	K	E	X	Y	X	X	S
A	X	A	W	I	F	L	E
X	D	X	J	B	P	R	Y

CPT II

1

N	M	J	A	G	J	G	V	S	A	A	Q	M	L	Z	Z
E	X	V	X	T	C	S	U	Y	X	X	T	E	F	P	E
B	Z	L	A	L	A	A	C	A	A	G	G	R	A	A	A
G	X	V	X	G	X	X	L	X	X	T	Y	S	X	X	X
M	W	C	B	A	A	P	D	B	H	Y	M	A	E	V	S
Y	V	V	M	X	X	P	B	V	J	C	H	X	A	N	Q
C	A	S	Z	Y	P	A	V	O	A	A	A	A	X	E	A
D	X	E	K	A	K	X	I	B	X	X	X	H	Y	Y	X
T	A	A	Q	N	A	F	E	A	M	H	Z	A	G	N	H
H	X	X	V	D	F	K	V	X	B	L	I	X	X	S	T
A	A	J	V	A	G	A	Q	M	F	D	A	O	M	A	M
X	X	O	F	X	N	X	T	Y	A	Z	X	L	E	X	V
M	A	M	A	I	W	B	A	R	R	Y	U	W	A	H	Z
A	X	G	X	V	K	Y	X	U	N	H	D	N	X	Q	U
M	P	A	A	A	F	A	U	L	X	X	X	V	S	Y	A
C	B	X	Z	X	F	X	O	D	O	L	F	Y	V	M	X
X	X	A	X	A	A	V	A	F	A	A	F	K	Y	P	H
V	F	X	N	X	X	M	X	H	X	X	Y	W	P	U	K
A	A	A	G	J	A	K	V	I	Q	I	L	Y	M	A	A
X	X	X	E	S	X	L	P	F	F	W	G	Q	L	X	X
O	P	B	A	K	U	Z	G	I	S	W	K	I	A	R	J
T	Z	Z	X	O	K	O	B	C	W	R	G	F	X	R	A
N	S	U	W	L	A	W	A	A	W	Q	T	Z	D	A	E
J	B	S	J	H	X	O	X	X	M	U	H	X	A	X	S
D	Q	R	A	B	K	H	A	U	A	A	F	I	X	U	B
M	I	Z	X	F	N	W	X	U	X	X	L	H	P	M	L
N	Q	A	A	A	M	U	G	A	I	A	A	F	A	A	X
F	Q	X	X	X	Q	J	X	X	A	X	X	K	X	X	R
L	M	A	Q	A	A	Z	X	A	X	A	N	A	W	A	A
S	R	X	V	X	X	N	R	X	L	X	J	X	B	X	X

CPT II

N	E	A	G	A	Y	A	A	T	H	A	W	M	A	M	A
X	V	X	P	X	T	X	X	D	M	X	M	F	X	S	X
A	Z	P	W	V	W	A	A	V	S	E	T	A	P	B	A
X	M	Q	P	Z	S	B	X	I	Q	Q	M	X	J	V	X
A	C	V	S	A	J	T	J	A	A	A	K	A	E	A	V
X	B	Z	U	X	R	Z	J	X	X	X	G	X	D	X	B
A	Z	K	Q	V	V	F	G	A	A	Z	X	N	G	E	G
X	W	J	W	R	J	S	Q	X	X	T	L	G	R	W	Y
A	N	A	A	H	I	A	B	P	A	G	J	S	K	A	A
H	B	X	X	I	Q	X	J	C	X	E	Y	D	P	X	X
F	G	A	W	A	F	F	A	A	T	Q	A	K	A	I	A
N	M	X	O	X	G	S	X	X	P	B	X	T	X	K	X
A	B	Y	A	Z	A	A	K	A	Z	O	W	O	A	W	A
X	Z	N	X	U	X	X	D	X	V	I	E	V	X	T	X
C	U	A	D	W	V	P	G	B	A	L	G	X	G	A	A
R	S	X	Q	O	B	V	O	B	X	J	M	Y	R	X	X
D	F	A	I	F	A	C	A	Z	U	U	S	Y	E	K	C
L	J	X	H	J	X	V	X	B	F	A	R	N	X	O	E
S	A	A	A	W	A	A	A	A	I	A	X	L	K	B	G
T	X	X	X	Y	X	X	X	X	Y	H	X	L	Y	R	I
W	W	R	Q	U	I	H	T	A	W	A	Q	T	A	Y	M
H	Z	E	Z	I	L	R	U	D	X	X	F	Y	X	G	K
G	A	H	F	L	C	G	N	A	A	A	A	A	O	A	N
H	X	X	O	L	W	N	V	X	X	X	X	X	I	X	Z
A	A	H	F	A	B	A	A	F	T	A	A	A	A	Y	G
X	X	E	C	X	S	X	X	P	M	X	X	X	X	N	O
A	B	A	W	B	A	A	Z	A	V	N	E	Y	N	S	T
X	H	X	Y	M	X	X	T	X	R	R	S	F	U	M	L
U	P	A	Z	E	G	G	S	Q	J	X	H	T	M	A	Z
U	O	X	H	K	T	Z	J	A	E	S	B	L	X	X	Q

CPT II 3

O	F	C	H	N	A	D	A
U	A	S	X	N	X	N	X
A	X	J	Q	A	U	O	K
X	N	O	N	X	M	T	N
Y	A	Q	A	A	X	B	L
A	T	F	X	X	Q	C	Y
X	A	A	Q	A	A	C	A
A	X	X	N	S	X	W	X
X	D	W	T	F	K	U	A
A	N	H	L	A	A	A	X
X	C	A	T	X	X	X	K
Q	A	X	H	N	E	T	C
N	A	L	R	W	A	G	H
J	A	A	Y	M	X	F	H
B	X	A	X	S	K	T	A
W	A	X	M	H	S	X	X
K	X	M	W	V	A	A	E
A	W	J	F	W	X	X	A
X	V	M	E	X	W	Q	H
A	G	A	H	Y	H	Y	Y
X	T	X	R	A	C	W	P
C	B	K	N	X	A	V	M
A	G	A	J	A	X	D	A
X	V	X	T	X	F	L	X
M	A	J	I	K	J	W	N
C	X	B	S	O	Y	P	D
A	R	G	T	X	X	N	V
X	J	B	Y	M	L	C	H
U	A	D	C	Z	A	M	A
A	X	I	Y	M	X	S	X

CPT III

1

M	E	L	F	A	D	H	X	R	N	W	A	M	F	A	A
A	P	Z	E	X	S	C	M	A	I	S	X	A	Q	T	X
X	A	T	Q	C	R	P	A	X	V	X	L	X	P	M	A
Z	X	G	G	G	I	K	X	H	M	E	D	Z	S	V	X
O	A	E	L	I	V	A	G	Z	A	X	L	N	G	G	R
V	X	S	Q	E	W	G	Y	A	X	P	T	G	A	J	Y
A	H	K	Y	A	D	K	A	X	K	A	A	X	X	T	A
X	Y	J	A	X	B	U	X	K	T	X	F	I	A	K	X
A	X	G	X	L	B	Z	V	O	I	W	E	O	X	A	Q
X	A	H	T	W	A	U	Z	B	B	F	A	L	J	Y	M
O	X	M	E	X	X	G	A	X	U	X	L	A	B	U	F
T	L	M	V	U	A	S	X	A	N	E	X	X	O	C	E
W	N	A	S	S	Z	I	Y	X	A	X	A	A	L	K	Y
H	A	X	U	B	R	A	I	A	X	W	X	X	F	Q	F
V	X	S	V	T	Y	X	L	Y	G	M	K	A	Y	A	K
Y	A	O	X	A	W	A	X	S	Q	O	I	Y	F	X	Z
K	X	A	P	X	P	X	M	Q	L	A	F	L	E	K	D
P	U	X	K	Y	N	A	A	G	K	X	R	N	R	E	S
X	Q	A	L	Y	F	X	X	S	M	T	L	Q	A	A	E
A	K	X	Z	A	S	H	B	A	A	M	X	V	R	X	Q
X	F	F	E	X	E	M	X	X	X	G	M	A	A	J	C
R	R	J	A	G	S	A	U	S	Y	C	L	X	X	Q	T
Z	A	D	N	L	A	X	E	L	A	C	L	A	O	J	I
A	X	A	A	G	X	A	Y	R	X	Y	D	X	P	A	B
X	H	X	X	B	V	X	A	Y	A	M	A	Y	A	X	K
U	M	A	A	A	T	V	X	A	X	I	X	B	A	Z	E
F	K	X	X	X	A	A	F	X	A	E	A	A	X	M	B
L	U	A	R	A	X	Z	I	A	X	G	X	J	G	Q	A
B	X	X	B	X	Y	F	A	X	Z	A	A	A	V	A	X
P	N	Q	L	B	Y	A	C	R	U	X	X	X	H	X	D

CPT III

J	D	A	I	N	X	X	A	A	U	F	I	M	O	Y	T
E	N	X	X	B	I	G	X	X	S	H	X	C	A	D	J
H	O	Y	J	A	A	Z	M	Y	E	W	N	V	X	W	S
V	T	F	J	X	X	W	P	J	A	Q	N	A	B	K	A
A	B	S	C	A	A	C	B	Y	X	A	T	E	S	J	X
X	A	A	W	X	Z	S	U	Q	F	X	U	T	Z	A	K
D	X	X	D	M	A	Z	A	G	J	N	R	V	R	X	J
M	A	S	K	K	X	A	X	R	R	Q	N	A	S	G	A
M	X	H	W	A	H	X	B	A	P	D	A	X	I	I	X
A	A	E	A	A	F	L	E	X	H	T	X	V	V	A	A
X	A	F	X	X	N	G	M	B	A	C	A	K	T	X	X
H	T	K	T	N	Q	W	O	A	X	A	H	F	S	A	A
A	G	Q	X	G	J	B	Z	N	J	X	B	A	U	X	X
E	F	M	U	A	A	B	V	L	A	R	Y	X	A	A	D
Z	T	B	A	X	X	U	S	X	H	B	W	A	X	X	B
R	X	M	X	O	Y	D	Q	K	U	X	A	X	V	G	O
H	A	M	A	F	J	A	I	K	C	A	X	F	J	I	I
H	X	A	X	I	H	X	Y	M	A	W	A	C	V	L	M
C	A	X	G	F	C	S	B	A	X	A	X	A	Y	W	H
K	X	Z	P	A	Z	A	E	X	M	X	A	X	L	U	D
A	W	Y	X	X	Z	X	A	S	C	T	X	U	A	A	L
X	V	A	A	H	X	F	X	Z	K	R	N	H	X	X	U
M	D	X	X	X	X	I	M	A	A	G	A	L	A	C	W
R	A	M	W	H	A	F	C	X	X	J	X	G	X	N	V
Y	X	N	T	P	X	B	H	M	C	K	G	K	S	B	S
A	A	A	F	I	Q	A	A	J	A	I	S	X	V	L	Y
X	X	X	A	A	U	X	X	T	X	R	J	B	A	A	P
K	C	D	W	X	X	Z	H	G	B	T	A	P	X	Y	T
D	A	G	P	T	O	F	A	A	A	Z	X	A	K	G	T
E	X	N	N	L	A	R	X	X	X	C	Y	X	Z	S	J

CPT III

N	D	Q	A	L	A	B	A
C	Q	G	X	C	X	V	P
M	A	Y	P	A	M	A	G
Y	X	Y	G	X	A	X	M
A	H	H	Y	W	N	E	X
X	I	A	T	Z	A	G	Z
J	Q	X	A	W	X	H	F
A	A	U	X	L	M	W	Q
X	X	R	G	J	Y	A	H
P	U	Q	A	C	A	X	B
L	P	A	L	A	P	H	C
J	D	X	X	X	S	L	H
O	K	T	C	V	T	X	K
A	I	D	A	X	A	G	M
X	A	X	X	A	X	U	I
A	N	R	J	X	A	X	S
X	A	L	O	I	X	H	Y
V	X	V	T	J	A	G	M
O	A	R	A	K	X	K	T
F	X	N	X	V	A	H	Y
T	Z	J	B	U	X	D	H
M	T	A	S	A	J	R	W
R	W	X	U	A	O	Y	A
F	L	Y	M	X	A	O	X
A	F	H	A	T	R	A	Y
A	U	N	X	A	V	X	Y
X	L	U	A	K	A	A	T
A	M	Y	A	R	X	X	A
X	H	A	X	A	A	A	X
Y	P	X	C	X	X	X	F

CPT IV 1

A	A	R	Z	O	V	N	A	N	N	A	T	A	H	V	Y
X	X	X	T	I	R	Z	X	A	U	X	L	X	P	E	A
S	G	A	N	H	Y	X	S	X	L	N	A	A	M	W	X
Q	K	X	R	A	F	H	M	K	A	X	X	Y	A	T	G
E	S	K	J	X	H	M	M	C	X	A	O	Y	X	M	T
F	A	D	E	O	B	A	X	A	Q	X	Q	G	E	L	A
Y	X	X	T	A	V	X	U	X	X	P	K	A	Z	E	Y
N	A	P	L	X	A	B	L	L	Z	T	G	X	P	H	Y
X	X	M	A	O	X	Z	N	X	V	R	L	G	A	Y	G
I	N	L	X	Y	O	T	A	C	G	I	E	S	X	A	W
A	U	S	A	T	E	F	X	A	X	N	G	L	G	X	B
X	H	M	X	D	A	R	A	X	W	D	B	A	A	Y	A
Z	R	A	W	W	X	N	X	S	A	S	G	Y	X	T	A
L	Y	X	H	A	P	K	A	G	X	U	A	U	G	S	Y
G	G	R	A	X	N	H	M	A	T	G	Y	A	A	A	F
A	A	J	X	G	Y	P	B	X	A	R	R	Y	I	X	Y
X	X	U	B	X	U	A	Y	J	X	F	I	A	C	R	A
B	H	Z	P	O	K	X	B	X	Y	A	A	Y	S	Q	X
S	T	J	S	A	R	Y	O	F	L	D	R	N	I	V	M
T	C	K	A	X	B	U	N	A	D	G	A	L	K	M	L
A	Y	A	X	C	B	A	A	X	U	W	X	X	E	X	P
X	A	X	F	X	E	X	X	A	O	E	V	T	M	G	C
C	X	M	I	E	G	L	R	X	Q	A	D	L	T	A	F
E	A	L	X	A	X	K	I	F	R	Y	X	M	A	L	O
H	V	V	N	X	N	M	E	O	Z	N	G	X	X	A	A
Z	K	A	Z	A	R	L	A	A	A	G	K	A	K	X	Y
A	J	X	A	X	A	P	X	X	X	T	K	X	J	B	O
L	A	Y	X	E	X	A	R	A	A	O	A	A	Y	J	G
A	X	A	T	A	A	G	A	X	X	H	X	U	A	K	Q
X	N	K	E	X	Y	J	X	J	D	P	Z	M	X	A	U

CPT IV

Y	F	E	A	I	K	A	X	G	G	V	N	A	A	V	H
M	T	O	X	A	L	X	A	B	W	A	B	A	X	X	L
K	C	E	V	X	M	Y	X	A	F	X	A	X	E	V	V
A	Z	H	P	H	M	A	A	X	Q	T	X	Z	D	K	V
X	Z	A	F	A	G	X	X	O	Y	P	I	A	A	D	K
V	E	X	A	X	S	A	Y	I	M	X	O	D	X	K	A
A	A	W	X	S	A	X	W	A	L	N	S	A	X	L	X
X	X	A	D	E	X	Z	F	X	A	M	A	X	Q	Y	H
U	A	X	Y	Z	A	Q	N	A	X	B	X	E	H	B	I
I	X	I	A	G	X	H	B	X	P	J	A	D	A	C	F
P	D	F	X	A	C	J	C	A	S	I	X	A	X	P	R
S	K	A	O	X	Z	G	E	R	E	Q	D	X	M	A	R
V	H	X	S	H	U	T	Y	A	V	V	F	Y	O	X	C
I	G	T	R	Q	X	A	K	X	C	E	Y	W	A	S	V
O	Y	H	B	X	N	A	P	T	O	F	K	A	X	M	A
Z	E	S	O	A	M	X	C	H	K	W	I	X	V	Y	X
Y	B	A	V	X	G	A	A	S	Z	O	R	T	A	C	N
V	D	X	Q	B	F	X	X	X	P	A	H	B	X	X	X
A	O	K	Y	J	S	D	V	Z	A	C	A	A	J	G	I
X	H	T	B	R	L	Y	O	A	X	A	X	X	B	E	Z
V	T	Q	R	W	A	Z	E	B	O	X	V	K	A	B	A
K	A	A	Z	H	X	R	Y	H	Y	R	D	D	X	U	X
P	X	X	G	M	I	I	R	A	A	A	A	A	Z	X	O
T	Z	R	A	T	E	X	U	X	X	X	X	X	J	A	X
A	H	X	X	O	A	F	W	F	E	H	V	O	M	X	S
X	E	N	A	L	X	I	M	A	A	F	A	T	H	D	Y
A	P	N	X	P	A	R	O	X	T	X	S	Z	G	A	W
X	N	J	A	L	X	A	W	U	A	Z	H	A	Y	X	U
D	A	W	X	A	F	X	U	A	X	A	J	X	Q	I	A
E	X	P	Y	X	Z	A	C	X	R	X	H	G	M	W	X

CPT IV

3

A	F	A	A	L	A	Y	F
X	A	X	X	W	X	W	L
F	X	A	R	J	C	A	X
V	P	T	H	V	X	X	S
S	X	Z	A	I	J	A	V
B	H	C	S	U	A	X	X
A	K	I	A	T	X	A	R
X	D	C	X	F	S	X	A
A	T	I	M	M	A	N	S
X	F	F	P	B	M	X	A
A	E	V	A	P	S	T	A
X	K	Z	X	V	A	X	X
A	A	O	Y	A	K	B	A
L	N	E	A	X	A	R	X
T	B	U	C	A	M	Z	I
V	C	A	A	X	V	Y	A
A	X	X	X	E	G	A	X
B	A	I	Q	M	H	X	L
V	X	F	W	X	A	U	X
O	A	C	B	A	X	K	H
P	R	L	A	X	R	Y	O
H	F	X	X	K	P	F	A
I	E	H	D	O	A	A	P
A	D	B	O	A	M	X	Z
X	W	A	M	X	Q	H	B
V	D	X	A	A	H	A	A
K	A	R	X	X	S	X	X
A	X	V	A	T	A	H	W
X	A	V	X	S	X	A	Y
S	X	Q	R	T	Q	X	F

CPT V

D	Z	A	A	F	A	T	Y	R	X	A	A	N	Y	P	A
C	E	X	X	J	X	L	D	F	S	B	F	A	Z	Q	Y
F	Y	A	J	A	H	Y	J	A	U	D	A	X	P	O	M
X	M	E	N	G	L	A	A	X	M	A	X	S	H	Z	A
J	A	L	Y	X	I	X	X	A	D	X	Q	D	G	Q	X
A	X	W	A	G	A.	A	S	F	O	A	W	A	X	U	T
X	F	X	X	N	X	H	A	T	W	X	L	X	A	S	Y
I	W	A	F	X	Q	F	X	P	E	J	X	O	X	P	A
A	G	N	L	A	K	S	B	Z	A	M	C	H	I	A	X
X	N	G	P	X	N	F	L	N	X	A	I	A	W	X	G
W	Z	A	A	Z	A	R	A	A	C	X	A	A	P	A	X
O	I	X	X	I	X	E	X	X	G	C	X	X	N	X	V
A	S	Z	A	A	D	U	F	I	A	S	M	U	M	A	A
X	G	A	X	X	G	N	Z	L	A	M	A	A	T	H	X

W	X	X	A	U	Q	U	X	X	X	Z	I	S	A	F	E
I	U	A	X	Z	E	S	U	A	Q	P	R	C	X	X	K
N	Q	X	Y	A	G	A	T	X	B	A	A	U	O	D	V
U	F	J	A	X	J	X	W	W	I	X	X	F	A	O	R
P	A	B	X	R	N	Y	P	Z	C	C	I	Y	M	I	K
G	X	C	M	O	D	T	A	J	L	V	Z	V	V	A	J
H	T	E	O	A	K	I	X	A	A	H	S	A	J	X	A
M	A	L	T	X	D	V	C	X	X	C	A	X	N	E	X
I	I	W	A	C	B	U	Y	A	A	F	X	M	L	A	Q
F	Q	F	X	A	T	Z	M	X	P	A	Q	S	A	X	Z
C	I	A	M	X	J	A	X	A	L	W	A	T	X	V	Q
A	N	X	R	I	W	X	Q	X	Z	U	X	K	B	C	A
X	A	A	L	A	T	A	A	G	K	P	Q	Q	A	A	E
C	I	X	T	X	F	X	X	X	T	A	L	Y	X	A	A
G	S	W	A	A	Q	Z	A	T	E	X	W	A	E	X	X
O	R	Z	X	X	S	P	X	A	W	F	H	X	Z	Z	S

CPT V

A	Q	H	X	A	A	R	A	D	X	U	N	A	R	I	K
X	F	D	V	M	X	W	X	O	A	D	E	X	H	F	J
Z	X	F	H	L	M	A	P	B	X	A	A	W	A	A	Y
Q	I	A	B	M	N	X	A	Z	P	C	X	A	X	X	T
A	E	X	A	Y	A	A	X	P	Z	K	O	X	V	E	S
P	F	A	X	A	X	T	U	N	C	A	X	U	I	K	A
S	C	X	B	X	A	X	S	H	T	X	V	A	A	B	X
X	W	A	P	T	X	F	A	A	F	W	A	X	U	A	M
E	Y	X	V	A	Y	A	Y	X	Y	E	X	B	N	X	F
A	Z	R	A	X	O	X	Q	N	R	I	F	X	I	R	A
Y	D	Z	X	A	S	T	A	G	J	H	Q	Z	X	N	X
R	R	A	A	X	H	D	T	A	F	D	H	A	D	K	T
F	A	X	X	A	A	Z	A	X	R	I	S	X	I	A	H
W	X	P	W	X	X	L	X	T	A	A	M	C	R	X	B
H	Q	X	Y	G	B	O	M	Y	X	X	A	E	A	S	Y
F	T	W	Z	A	Z	C	H	A	A	A	X	R	X	P	C
R	S	O	I	Y	I	D	X	X	X	X	H	E	M	K	F
H	H	M	W	A	V	T	I	F	A	A	X	H	S	D	E
N	A	X	N	X	R	O	L	K	X	X	W	L	A	A	Q
G	X	L	A	A	A	C	J	H	A	Y	F	B	X	X	I
V	K	M	X	X	X	R	P	W	X	K	I	A	J	O	Z
M	M	W	K	R	U	X	A	A	B	A	X	X	N	X	M
R	V	G	D	Q	E	N	X	X	O	A	Y	S	X	O	U
H	A	I	X	N	I	O	V	C	R	X	F	I	A	A	O
A	X	Z	A	A	W	R	K	O	S	W	V	L	X	X	C
X	T	U	X	X	N	Z	D	Y	H	F	C	V	Y	A	M
E	F	D	A	J	Y	G	H	M	J	P	Z	K	A	Y	W
L	A	A	X	K	K	A	L	A	Q	T	E	B	X	U	G
A	X	X	A	T	A	X	M	X	B	A	Y	A	A	S	O
X	M	A	X	D	X	U	X	A	S	X	T	X	X	Z	D

CPT V

3

P	X	D	A	A	A	E	A
V	J	T	X	X	C	O	X
Z	X	K	R	Q	V	P	L
F	O	P	O	H	N	U	A
Z	B	R	A	X	Y	A	X
X	A	G	X	C	X	X	P
L	X	A	R	M	A	Q	I
Q	B	X	Z	P	X	M	F
V	J	Z	K	A	A	A	A
E	C	A	A	X	X	X	X
H	M	X	X	J	A	A	S
O	A	A	S	U	X	X	A
M	X	X	N	X	J	A	G
V	Z	G	W	R	R	F	I
A	A	A	L	G	V	W	Y
A	X	X	Q	V	Z	S	Q
X	A	A	A	I	A	A	F
A	X	X	X	S	X	X	A
X	I	C	D	A	A	T	X
A	V	E	K	X	X	A	A
X	N	K	F	X	Q	X	I
G	W	F	G	T	U	C	A
N	A	T	T	Q	S	A	X
M	X	P	F	A	L	X	J
G	V	A	B	X	U	Z	V
Z	Z	X	K	H	J	U	D
L	B	M	W	W	N	L	C
A	U	E	G	V	G	P	X
X	F	L	V	X	Q	X	Z
A	I	O	D	W	V	T	G

Dichotic Listening Task I

TEST 1

R	L		
WAR	ONE	HAY	EIGHT
FLY	TEN	EIGHT	ARM
HIT	TEN	BAG	FOUR
JOY	NINE	MEN	THREE
SAW	EIGHT	US	FIVE
FIVE	GAS	FOUR	FIT
FOUR	SKY	YOU	NINE
TEN	AIR	FOUR	GET
FIVE	BED	FOUR	WET
THREE	TIP	BAY	TWO
CAP	THREE	LOG	EIGHT
SIX	FAR	MAP	SIX
EIGHT	OFF	TWO	DIG
LEG	NINE	EIGHT	FUN
DIE	FOUR	SIX	BAD
FOG	SIX	FIX	NINE
EIGHT	JOB	TWO	WE
ONE	BUY	ROT	ONE
EYE	TWO	ONE	BOW
TEN	CUP	TEN	BAR
AID	THREE	ONE	HER
FIVE	DID	SOME	TEN
THREE	NEW	NINE	ICE
TOP	EIGHT	MUD	TWO
FOUR	ADD	THREE	DON
FIVE	CRY	THREE	ROD
FOUR	OR	DRY	FOUR
ONE	CAN	CUT	ONE
RAW	TEN	AND	EIGHT
SAD	SIX		

TEST 1

2

R	L		
MET	TEN	THREE	FAT
PAY	ONE	SHE	SIX
TEA	FOUR	SIX	RED
TWO	GOT	EIGHT	ME
SIX	HE	HIM	TWO
FOUR	SAT	NINE	SET
BUS	ONE	BOX	TEN
PIE	TWO	FIVE	CAR
SEE	NINE	ONE	ASK
FIVE	LIE	NINE	EGG
SIX	RUN	DO	NINE
TWO	DOT	TIE	FIVE
SUN	FOUR	NINE	DAY
NINE	GUN	SIR	THREE
OLD	TWO	TEN	ROW
MAD	SIX	EAT	EIGHT
BEN	SIX	PAN	ONE
DAD	NINE	MAN	EIGHT
TEN	SIT	TWO	ACT
LAY	THREE	DOG	FIVE
FIVE	BIG	ONE	LET
EIGHT	HOT	KEY	EIGHT
ONE	DUG	TWO	RAN
LED	FOUR	ART	THREE
THREE	POT	FIVE	OUT
LOW	THREE	FIVE	JAR
FUR	FIVE	MAY	ONE
AGE	TEN	NINE	NO
SIX	LAW	GO	TWO
TEN	TRY	NINE	TAX
		TIN	THREE

TEST 2

R	L		
EIGHT	DRY	HIT	FIVE
NINE	FAT	TEA	FOUR
ONE	FOG	TWO	NO
BOX	EIGHT	FIVE	LIE
TWO	HE	TEN	MEN
LED	TEN	BUS	THREE
DOT	NINE	ROT	NINE
SIX	PIE	LEG	FIVE
BOW	ONE	BAD	TEN
TIP	FIVE	TWO	GET
EIGHT	TIN	BED	ONE
DAD	THREE	ONE	DIG
MAP	EIGHT	GOT	TWO
DID	TEN	THREE	US
EIGHT	PAY	ONE	MUD
SHE	FOUR	ONE	CUT
FOUR	RUN	SIX	WAR
TWO	ARM	BEN	SIX
THREE	CRY	NINE	SAW
SAD	FIVE	LOG	THREE
AID	THREE	ONE	MAD
TOP	NINE	LET	NINE
TEN	GO	RED	TWO
SIX	GUN	BAY	NINE
FIVE	FLY	EIGHT	ROD
LOW	SIX	ROW	EIGHT
DIE	TEN	OR	FIVE
TWO	SIR	SIX	YOU
TEN	OUT	THREE	TRY
HOT	FOUR		

TEST 2 2

R	L		
TEN	BUY	TEN	FUN
AIR	TEN	FOUR	DOG
SEE	NINE	FIVE	ICE
EIGHT	ADD	FIX	ONE
EGG	SIX	CAR	SIX
NEW	FIVE	HIM	EIGHT
THREE	BAR	CAP	TWO
TWO	BAG	TWO	AND
LAY	THREE	MAN	ONE
THREE	DO	FOUR	WE
SIT	SIX	ART	THREE
NINE	AGE	FOUR	SOME
SIX	EAT	SUN	FOUR
NINE	CAN	NINE	BIG
DAY	FOUR	FOUR	FIT
KEY	FIVE	POT	THREE
EIGHT	FAR	DUG	SIX
TWO	EYE	MAY	FIVE
ONE	OLD	EIGHT	OFF
ONE	WET	ASK	SIX
SAT	FOUR	JOY	FOUR
RAW	ONE	TEN	SKY
LAW	NINE	SIX	DON
NINE	PAN	SIX	GAS
JAR	TWO	MET	THREE
TIE	FOUR	HER	EIGHT
ONE	HAY	FIVE	JOB
TEN	RAN	ONE	SET
EIGHT	TAX	ACT	THREE
ME	FIVE	CUP	TWO
		EIGHT	FUR

TEST 3

TWO	EGG	TWO	ROT
TOP	FOUR	FIVE	DON
EIGHT	ROW	FOUR	SAT
DAY	THREE	GAS	TWO
CRY	FIVE	HIT	ONE
BED	FIVE	EIGHT	WET
WAR	ONE	KEY	TWO
CAR	SIX	FIVE	DOG
ONE	BUY	TIE	TEN
EIGHT	GO	WE	SIX
TWO	FOG	FOUR	BUS
ONE	MAY	FLY	TEN
NINE	OUT	DID	EIGHT
RAW	SIX	SEE	THREE
EIGHT	BAG	FOUR	AGE
DRY	THREE	FIVE	LEG
TWO	LET	THREE	SAW
EYE	EIGHT	FOUR	PIE
SHE	NINE	ASK	THREE
ARM	THREE	OFF	FOUR
TEN	HIM	MEN	ONE
FIVE	LIE	NINE	HAY
NINE	NO	NINE	RUN
FUR	ONE	FIVE	AND
DIG	THREE	OR	FIVE
SIX	DUG	RED	TEN
FIT	FIVE	SIX	MET
THREE	TRY	FOUR	AID
CUP	FOUR	FOUR	LAY
		SAD	EIGHT

TEST 3

HOT	SIX	EAT	FOUR
EIGHT	AIR	TEN	TIP
LAW	NINE	TEN	ICE
NINE	ADD	POT	TWO
TEN	BOX	FIVE	MUD
ME	FIVE	DOT	ONE
SIX	LOW	THREE	PAN
SIR	TEN	LOG	TWO
YOU	TWO	BEN	TWO
SKY	ONE	JAR	THREE
GUN	EIGHT	NINE	CUT
FIVE	GET	HE	SIX
FOUR	MAD	CAN	FOUR
SUN	FIVE	NINE	TIN
ONE	BAY	THREE	DO
JOY	TEN	EIGHT	SOME
ONE	TEA	THREE	CAP
US	TEN	BAD	SIX
FIVE	LED	THREE	RAN
SIX	BIG	FOUR	BOW
JOB	TWO	NEW	EIGHT
ART	TEN	MAN	TEN
ROD	ONE	EIGHT	FUN
NINE	DAD	MAP	NINE
THREE	FAR	TEN	OLD
TWO	FAT	BAR	FOUR
SIX	PAY	SIX	GOT
HER	NINE	FIX	ONE
DIE	NINE	SIT	ONE
ACT	EIGHT	SIX	TAX
		TEN	SET

TEST 4

NEW	SIX	TEN	ARM
ONE	AIR	CUP	FIVE
TWO	BOW	SIX	SUN
HOT	SIX	FIVE	EAT
SIX	OR	NINE	ROD
TIP	NINE	THREE	NO
FUR	FOUR	BAY	TWO
PAY	SIX	TWO	ME
BAG	NINE	FOUR	HE
FOUR	RED	CUT	ONE
TEN	FIT	RAN	THREE
THREE	YOU	ONE	OUT
FIVE	FAT	SIX	SAW
ART	ONE	ONE	LED
THREE	POT	JOY	THREE
BAR	ONE	BAD	EIGHT
MEN	FOUR	NINE	PIE
MET	NINE	SET	ONE
ASK	THREE	BUS	FOUR
FOUR	CAR	DO	TWO
NINE	DAD	PAN	FIVE
TWO	DAY	FUN	FOUR
SEE	TEN	TWO	RAW
FIVE	FOG	ONE	US
FAR	FIVE	MAP	TEN
THREE	AND	ONE	FLY
DID	EIGHT	FOUR	DON
		FIVE	MAY
SIT	TWO	ADD	TEN
BUY	TEN	TOP	EIGHT

TEST 4

TWO	OLD	EYE	THREE
TWO	ACT	FIVE	FIX
TEN	ICE	EGG	EIGHT
AGE	SIX	TWO	GOT
MAD	THREE	TEA	SIX
GO	EIGHT	THREE	ROW
DOG	TEN	JAR	ONE
FIVE	WAR	TEN	SAT
NINE	LET	SIX	DUG
TIN	ONE	GET	NINE
FIVE	SIR	LOG	TWO
TEN	DRY	TEN	DIE
LAY	FIVE	LEG	FOUR
EIGHT	HIT	BIG	NINE
FIVE	SKY	NINE	ROT
ONE	GAS	TIE	EIGHT
EIGHT	JOB	FIVE	LOW
FOUR	LAW	OFF	TWO
MAN	THREE	THREE	SHE
GUN	TEN	BEN	SIX
HER	ONE	SIX	WE
WET	SIX	DOT	FOUR
SOME	EIGHT	FOUR	HAY
EIGHT	MUD	SIX	DIG
BOX	FOUR	AID	NINE
LIE	THREE	TEN	TRY
RUN	ONE	BED	SIX
TWO	CRY	THREE	HIM
NINE	CAP	KEY	TWO
NINE	TAX	NINE	SAD
		CAN	EIGHT

TEST 5

ONE	BED	TIN	EIGHT
JAR	FOUR	EGG	FIVE
FIVE	AGE	FIVE	LEG
LAW	THREE	EIGHT	PIE
BIG	FIVE	NINE	DIE
TWO	SET	SIX	OUT
CUT	TEN	OLD	EIGHT
EIGHT	HIT	FIT	ONE
CRY	EIGHT	LAY	TEN
ONE	SKY	EIGHT	MAY
TEN	TIE	NINE	BUY
OR	ONE	SIX	RUN
SHE	FIVE	DON	FIVE
WAR	NINE	EIGHT	KEY
SIX	FIX	TEN	AID
TEN	ACT	JOY	TEN
NINE	FUR	WE	TWO
FIVE	DOG	THREE	ROT
DUG	TWO	THREE	BEN
POT	THREE	THREE	CAN
THREE	ME	NO	FIVE
DIG	NINE	ONE	GAS
FOUR	LOW	HAY	ONE
DRY	NINE	RAN	EIGHT
TWO	BOW	FLY	SIX
GUN	TWO	THREE	SUN
OFF	FOUR	EAT	SIX
FIVE	TRY	EIGHT	SIT
HER	ONE	DAY	NINE
ARM	EIGHT		

TEST 5 2

ONE	AND	SIX	BAY
AIR	SIX	LIE	TEN
NINE	BAR	SIR	TEN
ADD	THREE	DAD	FIVE
FOUR	BOX	SIX	DID
YOU	THREE	NINE	BAD
FOUR	EYE	JOB	FOUR
GET	THREE	FOUR	HOT
RAW	NINE	ONE	PAY
ONE	WET	TEN	MAP
EIGHT	ICE	ART	TEN
FOUR	CAR	EIGHT	MUD
FAT	THREE	TOP	NINE
ONE	CAP	SAT	FOUR
EIGHT	BUS	US	TEN
TIP	SIX	SIX	NEW
MEN	FOUR	TWO	FUN
FOUR	TEA	SAW	THREE
ASK	FOUR	FOG	NINE
PAN	THREE	DOT	ONE
TWO	SAD	FIVE	FAR
SIX	LET	THREE	TAX
TWO	SOME	TWO	GOT
CUP	SIX	ROW	FIVE
HE	FIVE	SIX	SEE
MAN	NINE	TWO	RED
EIGHT	DO	HIM	TWO
ONE	ROD	MAD	NINE
LOG	TEN	MET	TWO
TEN	BAG	GO	TWO
		FOUR	LED

Dichotic Listening Task II

INSERTION DICHOTIC II

1

L	R								
BUY	THREE	HIM	ONE L	GOT	SIX	TWO	BOX	EIGHT	FLY
TEN	TIP	THREE	NO	ROW	NINE	EIGHT	AIR	DOT	TWO L
THREE	RAW	TWO	GET	ONE	OUT	DAY	TWO	THREE	SIR
EYE	SIX	BAR	THREE	CRY	SIX R	OFF	FOUR	TEN	AGE
TRY	NINE	LAW	EIGHT	BAD	ONE	ADD	SIX	FIX	NINE
SIX	ASK L	TIE	THREE	LAY	EIGHT	NINE	EGG R	SIX	CUT
THREE	LED	AID	TWO	FIVE	FIT	LEG	THREE	OLD	TWO
THREE	SHE	ONE	FOG	GUN	TWO	POT	FIVE	FIVE	MAN
NINE	MUD	NINE	BUS	FIVE	ACT	TWO	DID	LET	TEN
SEE	EIGHT	TWO	SIT	SIX	SKY	THREE	BAG	SUN	NINE
LOG	SIX	FAT	EIGHT	TWO	TEA	DOG	ONE	THREE	DIE
KEY	FOUR R	CUP	THREE	NINE	HE	TWO	PIE L	CAR	TEN
BEN	FIVE	FIVE	AND	FAR	EIGHT	SIX	ROT	SIX	DIG R
SAT	SIX	JAR	SIX	BOW	TWO	EIGHT	DO	OR	TWO
TAX	NINE	TEN	CAN R	DRY	FOUR	TWO	DUG	ART	ONE
GO	THREE	WE	EIGHT	TEN	MEN	WAR	TEN	FOUR	RUN
ONE	JOB	US	ONE	FIVE	ARM	ONE	TOP	TEN	NEW
ONE	ICE	ONE	ROD	ONE	FUN L	FOUR	DON	PAY	FOUR
BIG	THREE	FIVE	MAY	SIX	RAN	FIVE	MAD	SIX	SAD
ONE	BAY	HOT	SIX	FOUR	SOME	DAD	NINE	NINE	MAP
TWO	FUR	SET	TWO	TEN	ME	EAT	EIGHT	TWO	MET
EIGHT	HER	TEN	WET	RED	SIX	LOW	ONE	PAN	NINE
YOU	FOUR	EIGHT	SAW	HIT	ONE	CAP	FOUR	TIN	EIGHT
FOUR	GAS	NINE	JOY	LIE	SIX	HAY	ONE	THREE	BED

INSERTION DICHOTIC II

L	R								
NINE	OFF	ART	THREE	AGE	TWO	NINE	BAG	BIG	FOUR
SIX	ACT	FOUR	ICE	ONE	ROD	TEN	LAY R	ME	FIVE
GO	TEN	RED	SIX	FOUR	BOX	DIG	SIX	WET	TEN
RAW	THREE	GUN	NINE	FIVE	US L	MAD	THREE	WE	ONE R
FIVE	BAD L	FOUR	GOT	ONE	PIE	FOUR	EYE	AND	SIX
SIX	ROT	NINE	SET R	FOUR	FUR	TWO	MAP	EAT	EIGHT
FIVE	SEE	AIR	EIGHT	EIGHT	SIR	SIT	FOUR	ONE	SAW
EIGHT	JAR	JOY	FIVE	NO	ONE	CRY	TEN	TWO	MUD
SUN	TWO	SOME	TWO	TWO	DAY	DOG	TWO	GAS	FOUR
FAR	TEN	EIGHT	ASK	HOT	FOUR	POT	FIVE	EGG	TWO
TWO	SAT	TWO	LEG	TOP	ONE	THREE	BUY	OR	ONE
CAN	ONE	THREE	FAT	SIX	DO	NINE	LET L	NEW	NINE
THREE	ARM	FIVE	CUT	FOUR	MAN	SIX	DAD	MET	TWO
FOUR	KEY	SIX	HER	TEA	NINE	NINE	JOB	DUG	FOUR
CAP	TEN	LIE	TWO	FIX	EIGHT	FIVE	OLD	RUN	SIX
LED	TWO L	FOUR	FOG	TRY	FOUR	ROW	EIGHT	THREE	YOU
ONE	GET	FIVE	TIE	ONE	BOW	FIVE	HE	TWO	HAY
NINE	BAY	TEN	DID R	FIVE	LOG	DON	SIX	ONE	MEN L
FIT	SIX	ADD	SIX	SHE	EIGHT	THREE	BAR	EIGHT	BED
SKY	FOUR	FLY	THREE	LOW	TWO R	FIVE	MAY	FOUR	DRY
EIGHT	RAN	FIVE	OUT	TIP	FOUR	WAR	NINE	PAN	TWO
SIX	CUP	LAW	NINE	CAR	SIX	DOT	TEN	PAY	THREE
TAX	TEN	TIN	TEN	EIGHT	DIE	HIM	THREE	FIVE	FUN
HIT	ONE	BEN	THREE	SAD	THREE	BUS	TWO	AID	ONE

INSERTION DICHOTIC II

L	R								
NEW	ONE	FOUR	OFF R	CAR	FIVE	ART	ONE	ROD	EIGHT
TWO	EGG L	SHE	TWO	LAW	NINE	TWO	RED	TWO	MAN
NINE	OR	CAN	TEN	FIVE	ACT	FOUR	TEA	EYE	THREE
ONE	FIX	JOY	SIX	EIGHT	SKY	DAY	EIGHT	DO	ONE
DUG	SIX	ONE	PIE	BIG	ONE	LIE	TEN	POT	TWO
EIGHT	ASK	AID	TEN	CUP	SIX	PAY	SIX	NINE	TOP
ONE	MET	GO	ONE	NINE	SAD	TIE	NINE L	SIX	AIR
GUN	SIX	TWO	SIR	THREE	LED	TEN	DOG	FIVE	LOW
BEN	ONE	GAS	SIX	FIVE	CRY	THREE	MAP	TWO	MAD
THREE	FUN	THREE	YOU	ONE	SUN L	DON	FOUR	SIX	FIT R
HIT	FOUR	NINE	BAD	EIGHT	DUG	ONE	DID	AGE	TWO
SAT	SIX	TWO	CAP	TWO	CUT	TEN	MAY	FOG	THREE
FIVE	EAT	SIX	MUD	THREE	GOT	SIX	AND	PAN	FIVE
BAY	NINE	EIGHT	KEY	LEG	ONE	WAR	NINE	ONE	BAG
EIGHT	HER	SIT	TWO	TEN	LAY	TWO	US R	TEN	HAY
ONE	FUR	FIVE	FAT	THREE	HIM	DOT	FOUR	TWO	ROT
NINE	RUN	BED	SIX	EIGHT	OUT	LOG	TWO	NINE	OLD
BOW	SIX	EIGHT	ROW	BOX	THREE	ME	THREE	FOUR	BAR L
HOT	TWO	SET	TWO R	TAX	SIX	TIN	TWO	ONE	HE
SAW	TEN R	BUS	ONE	SOME	FOUR	SIX	WE	NINE	TIP
FAR	NINE	JAR	SIX	DAD	SIX	FOUR	DIE	FOUR	FLY
BUY	TWO	ARM	TWO	LET	EIGHT L	ONE	DRY	DIG	TWO
FIVE	JOB	THREE	GET	FOUR	SEE	FIVE	TRY	FIVE	MAN
NINE	ADD	EIGHT	RAN	TEN	ICE	TEN	RAW	THREE	NO

INSERTION DICHOTIC II

4

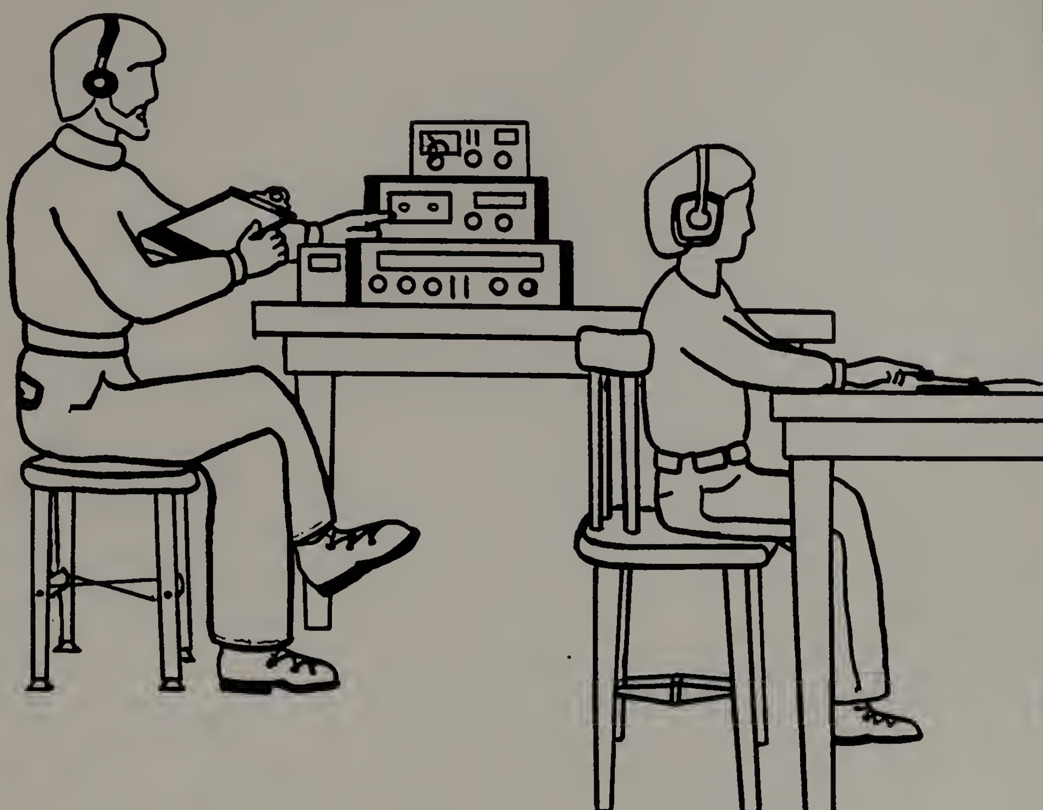
L	R								
PAN	THREE	ONE	ARM L	ASK	FIVE	TEN	AID	ACT	ONE
AND	ONE	NINE	PIE	TEN	HE	ONE	DID R	SIX	SHE
FIVE	OLD	TWO	BAG	EIGHT	SAW	WET	TWO	LOW	TEN
ROD	TEN	THREE	NO	LED	ONE	FAR	NINE	THREE	LOG
FLY	TWO	FOUR	BOW	MEN	TWO	TEN	BOY	DIE	TWO
THREE	HER	THREE	CUP	MET	THREE	FOUR	WAR	TEN	FAT
FOUR	RUN R	DAY	EIGHT	FIVE	FIX	EAT	THREE	NINE	TIN
GAS	NINE	TRY	FOUR	EIGHT	WE R	ONE	FUR	SUN	EIGHT R
OFF	THREE	DOT	TWO	GO	FIVE	TIE	TEN	BAD	SIX
ONE	HIM	TOP	THREE	ROW	THREE	EIGHT	SOME	ICE	THREE
SIX	SAD	ADD	ONE	FIVE	BUY	TWO	MUD	TEN	CAN
FIVE	BEN	HAY	FIVE	SIX	PAY	FIVE	NEW	TWO	TEA
TEN	HIT L	GET	NINE	LIE	TWO	TEN	EGG	TEN	GUN
NINE	FOG	ROT	TWO	EIGHT	DAD	GOT	FOUR	FOUR	JOY
FOUR	POT	HOT	TEN	NINE	DOG L	MAY	EIGHT	FIVE	SIR L
SAT	ONE	OR	EIGHT	SIX	RAW	DON	ONE	EIGHT	FUN
BUS	THREE	MAD	TWO	TEN	BAY	LET	THREE	THREE	SEE
EIGHT	OUT	ME	ONE	TWO	JOB	SIX	DIG L	CAP	FIVE
TWO	JAR	EIGHT	DRY	MAP	SIX	ONE	RED	AGE	TWO
SET	ONE	THREE	SKY	TEN	YOU	FIVE	FIT	KEY	NINE
CAR	TEN	TEN	BIG	FIVE	EYE	US	TEN	ONE	SIT
FIVE	LAW	SIX	AIR R	DUG	SIX	TIP	EIGHT	FIVE	BED
TEN	MAN	RAN	ONE	TAX	FOUR	CRY	FOUR	EIGHT	CUT
DO	SIX	BAR	EIGHT	ART	TWO	LEG	FIVE	TEN	LAY

INSERTION DICHOTIC II

L	R								
NEW	FOUR	SIX	CRY	GAS	TWO	SIX	DOG	ONE	DO
FIVE	TIE	BAR	EIGHT	EIGHT	LAY	EIGHT	AIR	LOG	EIGHT L
ONE	TEA R	THREE	HE	SKY	SIX	SAW	FIVE	TEN	JAR
MAD	FOUR	ONE	WAR	FOUR	MAN	TWO	YOU	FIVE	SET
SUN	THREE	KEY	TEN	SIX	BAD	THREE	FIX	TWO	GUN
CAR	FIVE	THREE	ROW	ONE	AGE	ART	SIX L	BUY	TEN
NINE	BUS	CUT	FOUR	TEN	SIR L	NINE	TRY	MEN	EIGHT
BOX	EIGHT	ARM	SIX L	EIGHT	ROT	THREE	OR	FOUR	SIT
NINE	ICE	TWO	DIG	THREE	MET	LEG	TEN	FIVE	MAP
EIGHT	BED	TEN	SEE	POT	TEN	FIT	TWO	ROD	NINE
FIVE	DOT	GET	EIGHT	NINE	ME	RAW	SIX	FUN	TEN
SAT	THREE	DID	ONE	EIGHT	LAW	BOW	EIGHT	WET	FIVE
HIM	SIX	HER	FOUR	FOG	THREE	TWO	OLD	NINE	HOT
ONE	SAD	US	SIX	RAN	ONE L	HAY	FOUR	SIX	DIE
FIVE	BAY R	FOUR	BEN R	NINE	RUN	FAR	SIX	THREE	JOB
DUG	SIX	TOP	FIVE	ONE	EGG	EIGHT	DAD	EYE	TWO
CAP	TEN	LET	FOUR	FIVE	PAN	TAX	THREE	THREE	DON
TWO	CUP	TEN	CAN	ADD	SIX	FOUR	FAT	GOT	TEN
SOME	FOUR	JOY	THREE	TWO	DAY	TEN	EAT R	LOW	EIGHT
THREE	TIP	NINE	HIT	FLY	ONE	OFF	SIX	AID	NINE R
BAG	TEN	TWO	LED	FIVE	DRY	BIG	TEN	TIN	EIGHT
WE	NINE	MUD	ONE	OUT	THREE	THREE	LIE	SHE	FOUR
FOUR	ASK	EIGHT	AND	TEN	ACT	NINE	GO	THREE	MAY
NINE	NO	FUR	SIX	PIE	TWO	EIGHT	PAY	FIVE	RED

FIGURE 6

Experimental Environment



APPENDIX F

Raters and Evaluation Sheets

All experimental tasks were evaluated by two independent raters with the following qualifications:

Rater 1 has a Master of Science degree and a Certificate of Clinical Competency in speech and language pathology, as well as ten years of experience evaluating language programs.

Rater 2 has a Master of Science degree and a Certificiate of Clinical Competency in audiology and is experienced in the evaluation of vigilance and dichotic listening tasks.

In addition to the primary evaluators, two additional raters judged the category associates for the memory recognition tasks. These raters have the following qualifications:

Rater 3 has a Master of Science degree in school psychology and has eleven years of experience as a practicing clinician.

Rater 4 has a Doctor of Education degree in mental health and has ten years of experience as a school psychologist.

CONTINUOUS PERFORMANCE TASKS I AND II

Average of Rater Evaluation (n=2)

1. What was the duration of the stimulus tape in minutes?

1	2	3	4	5
15	18	20	22	24
		(I) (II)		

2.* Using a random sample, were the stimuli presented at a rate of (in seconds)?

1	2	3	4	5
0.5	1.0	1.5	2.0	2.5
	(I)			

3. Were the stimuli audible?

1	2	3	4
none	few	most	all
			(I)
			(II)

4. Were the stimuli clearly enunciated?

1	2	3	4
none	few	most	all
			(II)(I)

5.** For children, grades 3-6, was the vocabulary

1	2	3
difficult	adequate	easy
		(II)

* only score for Task I
** only score for Task II

Legend: I = Task I; II = Task II

DICHOTIC LISTENING TASKS I AND II

Average of Rater Evaluation (n=2)

1. What was the duration of the stimulus tape in minutes?

5	5	7	8	9
			(I)	
			(II)	

2. Using a random sample, were the stimuli presented at a rate of (in seconds)?

1	2	3	4
1.5	2.0	2.5	3.0
			(I)
			(II)

3. Were the stimuli audible?

1	2	3	4
none	few	most	all
			(I)
			(II)

4. Were the stimuli clearly enunciated?

1	2	3	4
none	few	most	all
			(I)
			(II)

5. Did the stimulus pairs appear synchronized?

1	2	3	4
none	few	most	all
			(I)
			(II)

Locus of Control

1. Were the questions audible?

1	2	3	4
none	few	most	all
			x

2. Were the questions clearly stated?

1	2	3	4
none	few	most	all
			x

Additional Comments:

Legend: I = Task I; II = Task II

MEMORY TASK

Summary of Rater Evaluation (n=2)

1. Were the questions audible?

1	2	3	4
none	few	most	all
			x

2. Were the questions clearly stated?

1	2	3	4
none	few	most	all
			x

3. Using a random sample, was the rate of presentation in seconds for the initial word list?

1	2	3	4
1.5	2.0	3.0	4.0
		x	

4. Using a random sample, was the rate of presentation in seconds for the recognition word list?

1	2	3	4
2.0	3.0	4.0	5.0

x

Summary of Rater Evaluation (n=4)

5. In each recognition trial was there a rhyming associate?

1	2	3	4
never	few	most	always
			x

6. In each recognition trial was there a category associate?

1	2	3	4
never	few	most	always
			x

APPENDIX G

CONTINUOUS PERFORMANCE TASK I

Raw Data by Treatment Phase, Subject and Time Interval

Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
A[1]	1	19	15	19	18	15	18	14	18	18	19	17.3
Hits	2	17	18	19	18	16	14	17	15	13	13	16.0
	3	14	17	16	9	17	16	17	7	17	17	14.7
	4	16	20	20	17	18	20	19	19	19	17	18.5
	5	4	10	15	13	14	11	12	13	11	12	11.5
									Total	Mean		15.6
False	1	0	1	1	1	1	1	5	1	3	3	1.7
Alarms	2	7	4	4	8	6	7	5	5	9	9	6.4
	3	5	1	1	5	5	2	2	3	3	5	3.2
	4	1	0	1	2	1	0	0	1	0	3	.9
	5	7	1	0	0	2	4	2	3	6	3	2.8
									Total	Mean		3.0
B	1	20	19	20	18	19	18	19	17	19	18	18.7
Hits	2	18	20	18	18	18	17	15	13	18	14	16.9
	3	19	20	20	20	18	20	20	20	20	19	19.6
	4	20	20	19	17	20	19	16	19	18	18	18.6
	5	17	14	13	12	13	14	11	11	10	10	12.5
									Total	Mean		17.3
False	1	0	2	0	1	1	3	1	3	2	3	1.6
Alarms	2	4	4	1	3	6	10	7	5	4	1	4.5
	3	0	0	0	0	2	0	0	0	0	1	.3
	4	0	0	0	2	0	0	1	0	1	1	.5
	5	4	6	1	1	1	1	0	2	2	8	2.6
									Total	Mean		1.9
A[2]	1	17	16	15	17	19	15	14	18	16	15	16.2
	2	16	14	14	13	10	7	7	11	7	12	11.1
Hits	3	17	20	20	18	17	18	18	18	16	17	17.9
	4	17	19	20	19	19	19	19	17	19	17	18.5
	5	15	16	16	9	12	9	9	14	9	7	11.6
									Total	Mean		15.1

Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
False Alarms	1	4	4	3	2	4	4	5	1	2	3	3.2
	2	4	2	2	3	2	3	6	3	2	4	3.1
	3	2	0	0	2	3	1	2	2	5	0	1.7
	4	5	1	5	4	2	3	6	4	3	3	3.6
	5	5	3	1	9	3	7	2	2	1	5	3.8
								Total Mean			3.1	
C Hits	1	20	20	20	20	19	17	16	14	16	17	17.9
	2	18	14	7	13	13	12	9	5	9	7	10.7
	3	19	15	18	17	19	18	18	20	17	18	17.9
	4	20	19	20	19	20	19	19	19	18	18	19.1
	5	13	11	13	11	9	6	11	7	11	10	10.2
									Total Mean			15.2
False Alarms	1	0	1	0	0	0	0	0	4	3	1	.9
	2	2	1	1	2	5	1	0	3	3	1	1.9
	3	1	0	1	0	0	1	1	0	1	4	.9
	4	1	1	1	1	0	0	0	0	2	1	.7
	5	1	0	0	1	0	0	3	0	2	1	.8
									Total Mean			1.0
A[3] Hits	1	19	18	18	19	15	15	14	14	17	18	16.7
	2	18	13	15	7	6	13	6	5	7	9	9.9
	3	17	20	20	19	19	20	17	18	18	20	18.8
	4	14	17	15	20	18	17	17	15	19	18	17.0
	5	17	12	12	10	8	8	13	10	11	13	11.4
									Total Mean			14.8
False Alarms	1	1	3	1	1	5	4	4	6	3	3	3.1
	2	6	7	7	8	5	4	7	7	4	8	6.3
	3	3	0	1	2	1	1	4	3	4	0	1.9
	4	0	1	3	1	2	3	3	6	1	2	2.2
	5	5	5	1	3	5	4	3	3	1	2	3.2
									Total Mean			3.3

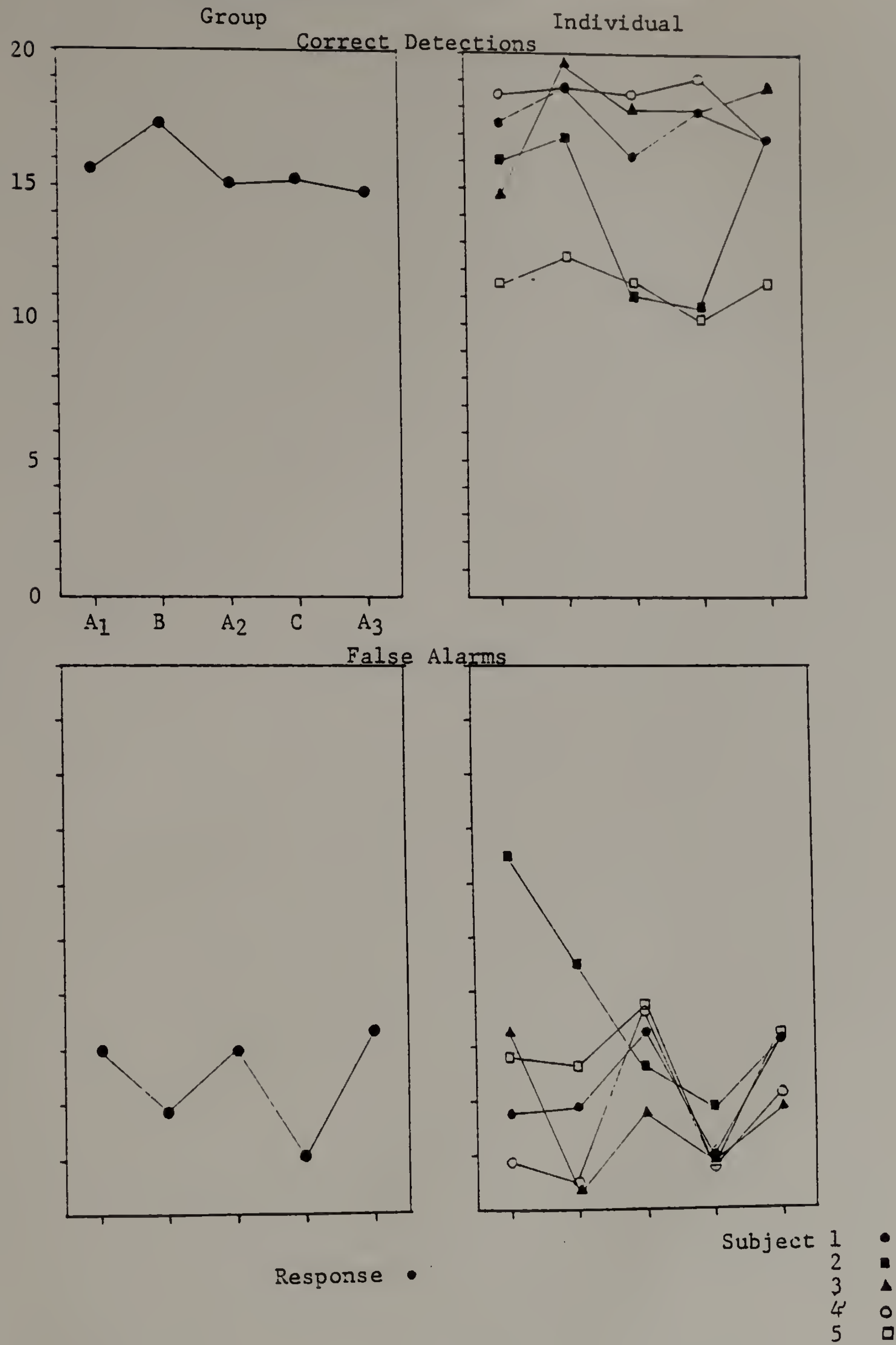
CONTINUOUS PERFORMANCE TASK II

Raw Data by Treatment Phase, Subject and Time Interval

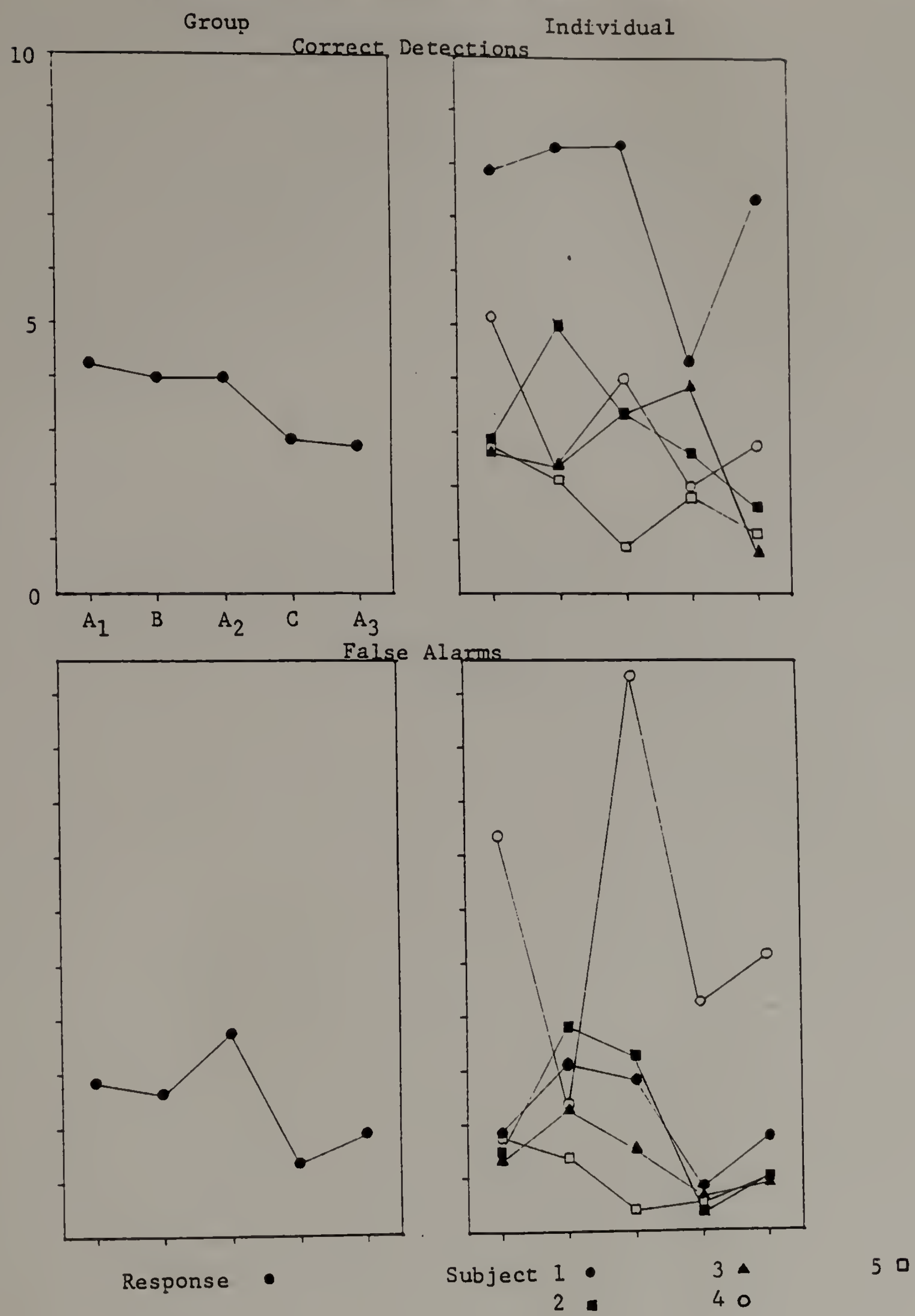
		Time										
Phase	Subject	1	2	3	4	5	6	7	8	9	10	Mean
A[1]	1	8	8	6	10	7	9	8	7	8	8	7.9
	2	1	0	3	2	1	6	4	2	6	2	2.5
Hits	3	6	6	4	1	1	2	3	1	1	1	2.6
	4	6	5	8	3	3	5	1	7	5	8	5.1
	5	2	0	2	4	1	2	2	3	5	5	2.7
									Total Mean			4.2
False	1	5	2	1	2	1	0	0	3	1	4	1.9
Alarms	2	1	2	0	2	1	0	5	1	1	2	1.5
	3	3	2	2	1	2	0	0	0	1	2	1.3
	4	2	6	17	9	4	4	8	5	10	9	7.4
	5	0	0	0	2	2	1	1	2	8	1	1.7
									Total Mean			2.8
B	1	12	9	8	7	8	12	4	12	10	1	8.3
Hits	2	4	8	6	3	6	5	5	1	5	7	5.0
	3	1	2	2	3	2	4	1	2	3	4	2.4
	4	5	3	2	1	2	2	2	4	0	2	2.3
	5	5	2	2	1	2	6	2	1	0	0	2.1
									Total Mean			4.0
False	1	4	3	2	2	1	4	4	4	5	2	3.1
Alarms	2	7	9	5	3	2	4	2	2	3	1	3.8
	3	2	2	6	2	2	3	2	1	1	1	2.2
	4	3	4	3	2	0	1	4	4	0	3	2.4
	5	0	6	1	1	0	1	2	0	2	1	1.4
									Total Mean			2.6
A[2]	1	8	9	10	9	9	9	8	6	9	7	8.4
	2	4	7	0	8	2	1	3	0	7	2	3.4
Hits	3	6	2	1	4	2	4	4	0	3	7	3.3
	4	2	8	2	3	7	3	4	4	5	2	4.0
	5	1	2	0	0	1	1	0	1	0	3	.9
									Total Mean			4.0

Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
False Alarms	1	4	1	3	0	2	5	3	5	1	4	2.8
	2	5	3	3	4	0	3	3	3	5	3	3.2
	3	0	1	1	0	2	1	2	4	3	2	1.6
	4	11	11	12	11	17	4	8	14	7	8	10.5
	5	0	0	0	1	1	0	0	2	0	0	.4
									Total Mean			3.7
C Hits	1	7	5	6	4	4	3	2	4	5	3	4.3
	2	3	2	2	2	2	4	3	2	2	4	2.6
	3	2	4	3	4	3	7	4	4	4	2	3.7
	4	2	3	2	3	0	2	3	1	1	3	2.0
	5	4	0	2	1	4	2	0	2	0	3	1.8
									Total Mean			2.9
False Alarms	1	0	2	2	1	3	0	0	0	0	0	.8
	2	1	0	0	0	0	1	0	0	1	0	.3
	3	3	0	1	0	0	0	0	2	0	0	.6
	4	3	2	6	4	10	4	2	0	7	4	4.2
	5	1	1	1	0	0	0	1	1	0	0	.5
									Total Mean			1.3
A[3] Hits	1	8	11	7	8	5	8	4	5	8	10	7.4
	2	2	1	1	2	1	2	1	2	3	1	1.6
	3	0	1	1	1	0	2	0	2	0	0	.7
	4	4	6	2	7	0	1	2	2	2	1	2.7
	5	2	0	0	2	1	1	3	0	0	2	1.1
									Total Mean			2.7
False Alarms	1	0	1	1	1	3	4	3	2	1	1	1.7
	2	1	1	1	1	1	0	2	1	1	1	1.0
	3	0	1	1	1	0	2	0	2	0	0	.9
	4	5	7	6	3	7	3	3	7	3	7	5.1
	5	0	0	1	1	0	2	1	2	1	1	.9
									Total Mean			1.9

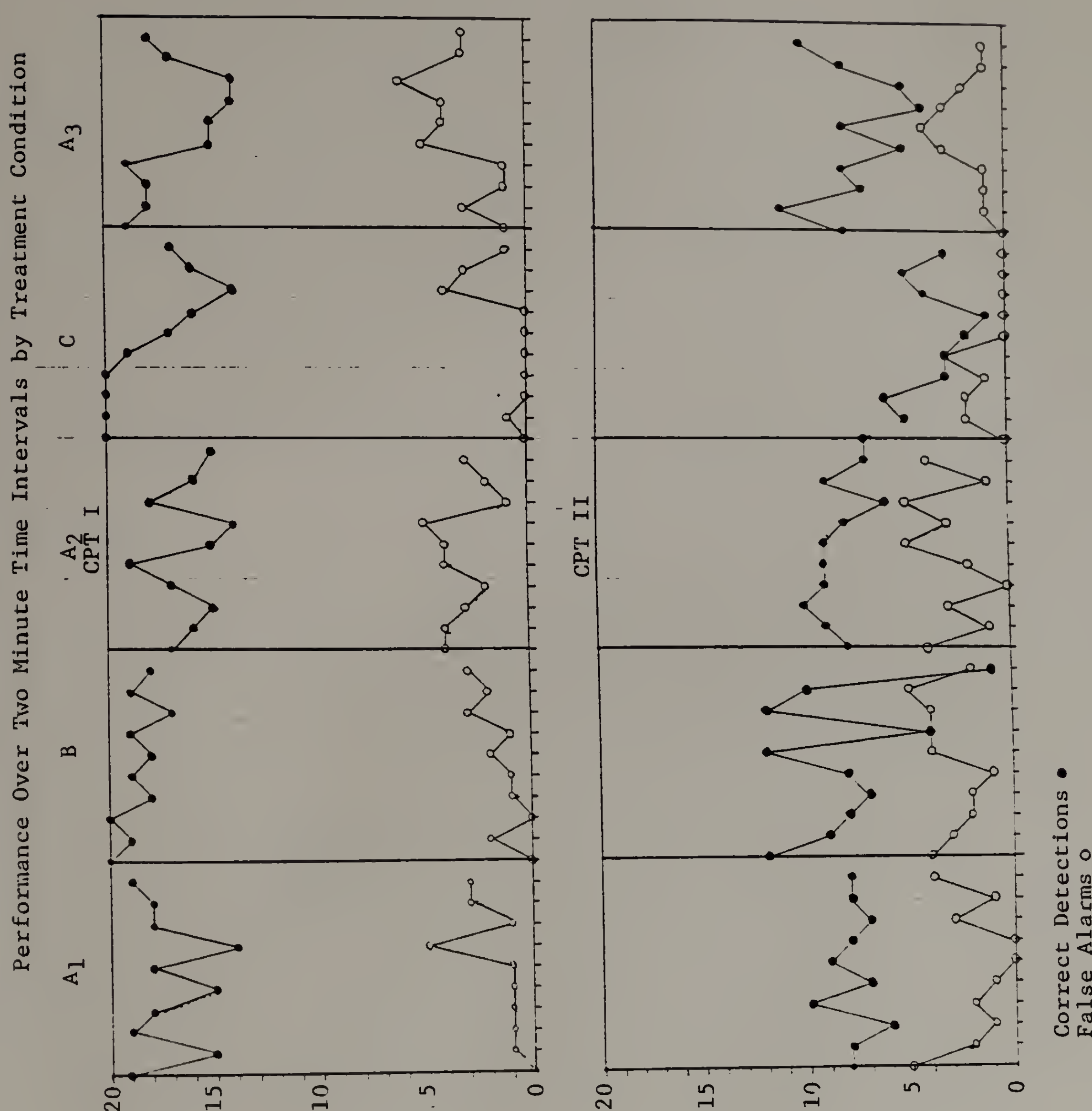
Continuous Performance Task I: Individual
and Group Results across Treatment Phases



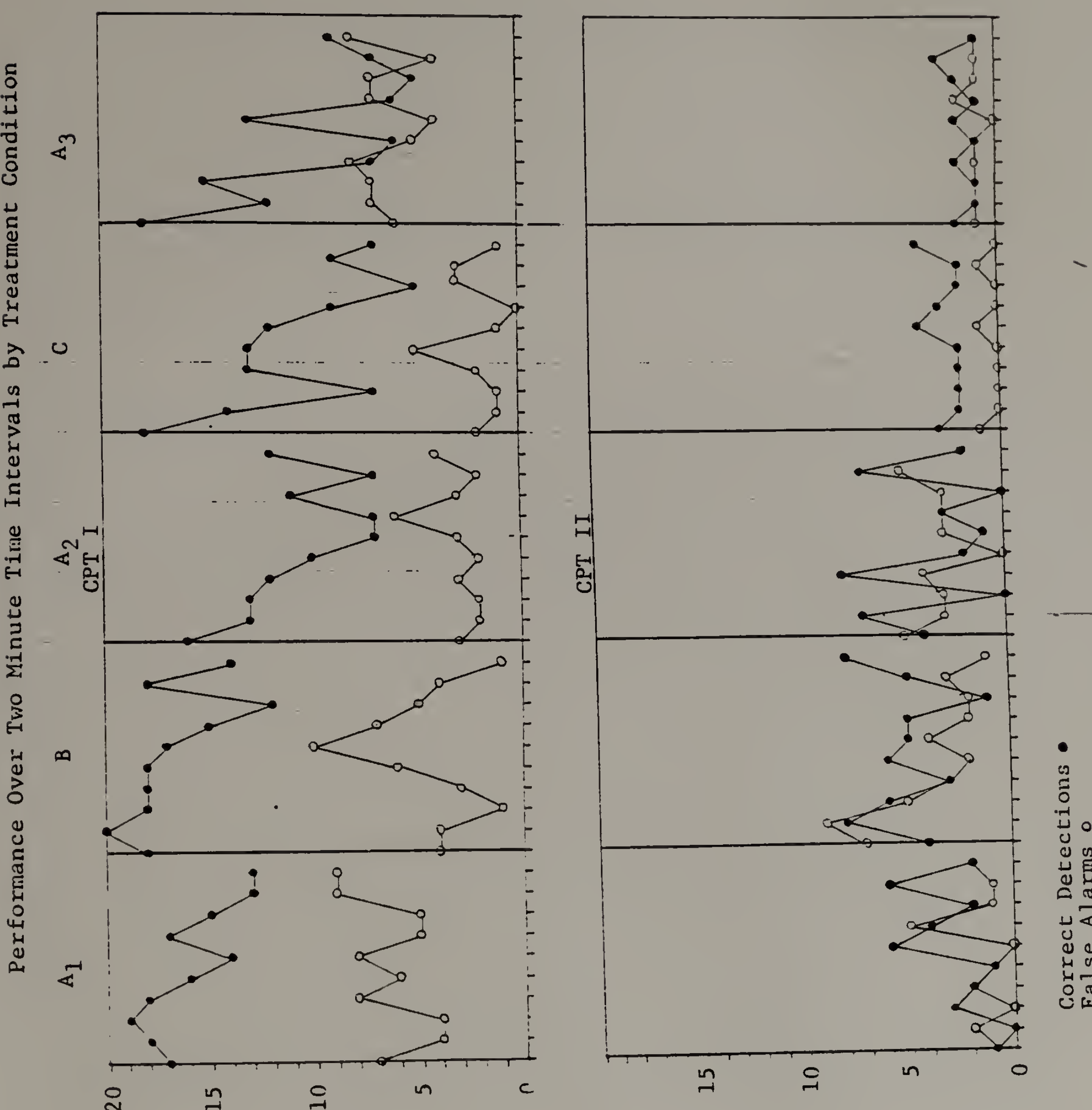
Continuous Performance Task II: Individual and Group Results across Treatment Phases



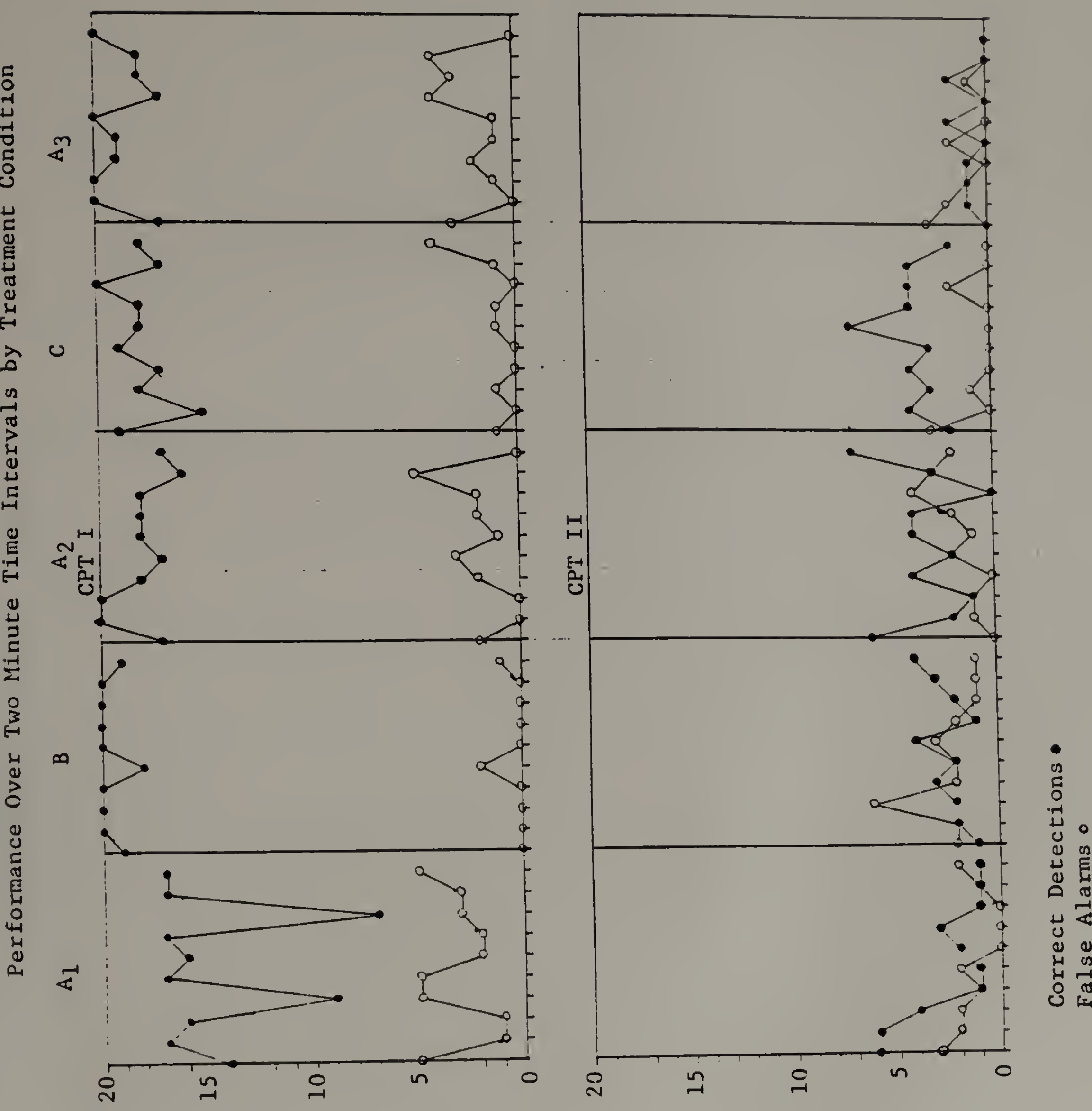
Continuous Performance Tasks I and II: Subject 1



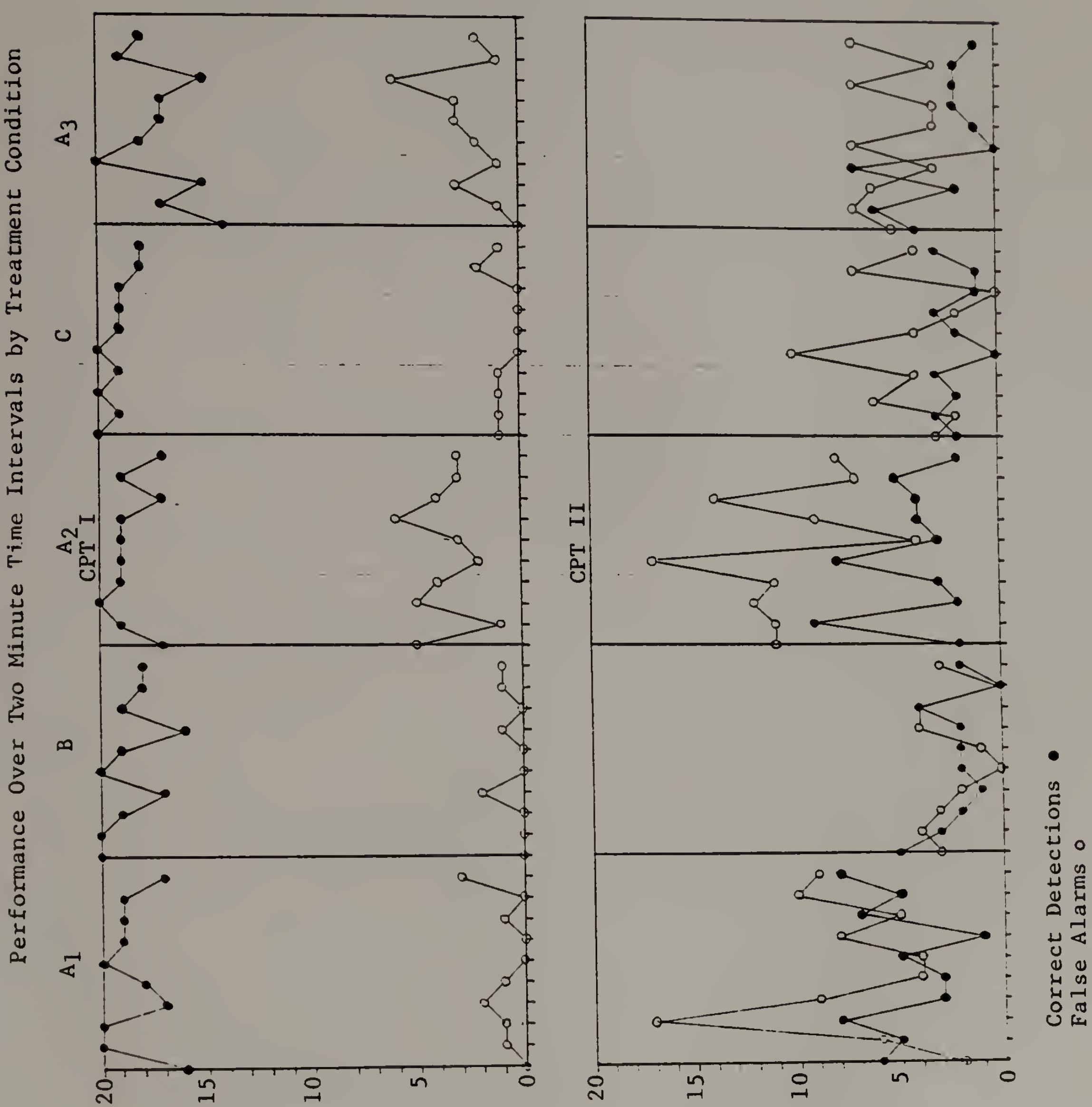
Continuous Performance Tasks I and II: Subject 2



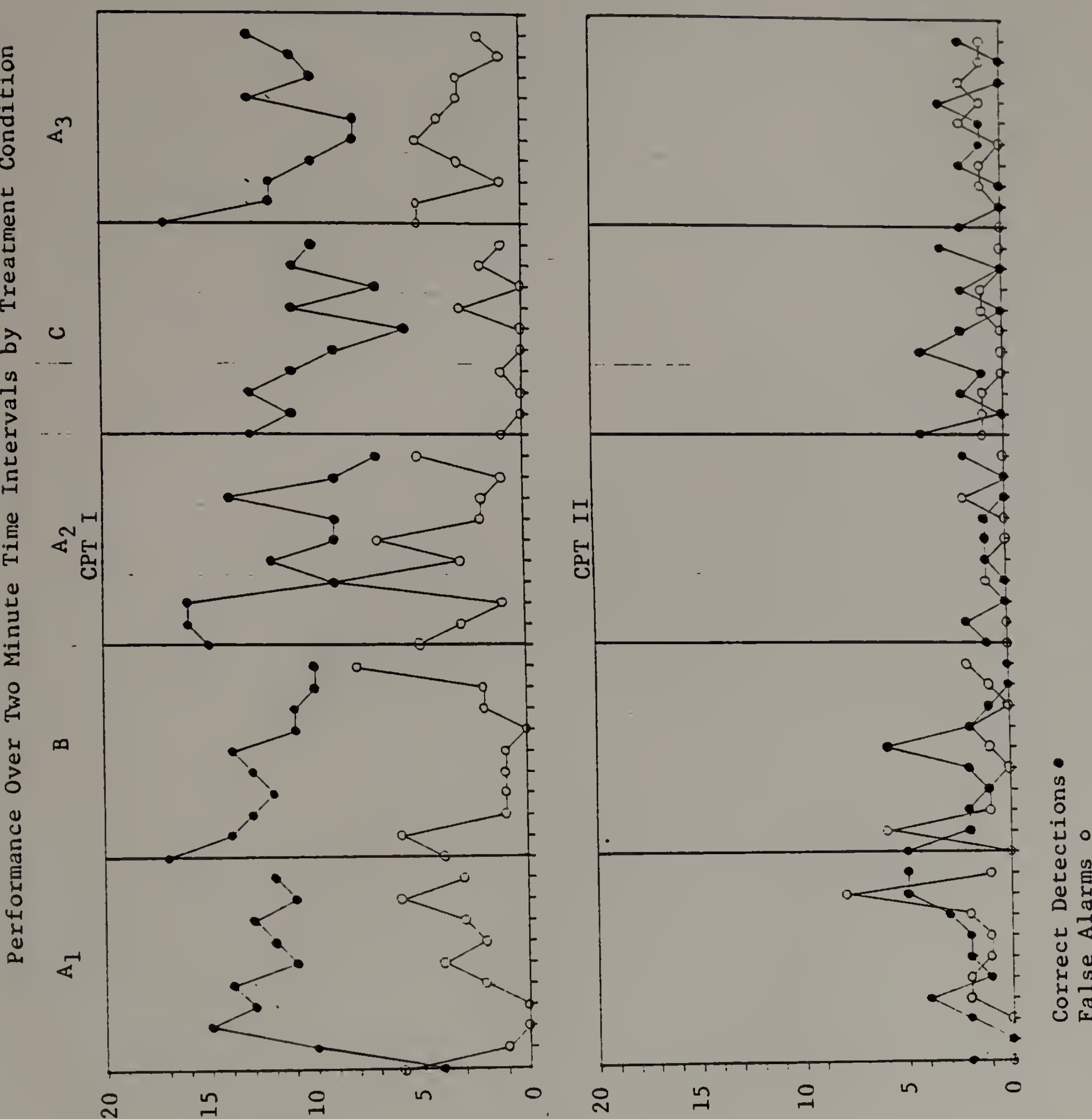
Continuous Performance Tasks I and II: Subject 3



Continuous Performance Tasks I and II: Subject 4



Continuous Performance Tasks I and II: Subject 5



DICHOTIC TASK I

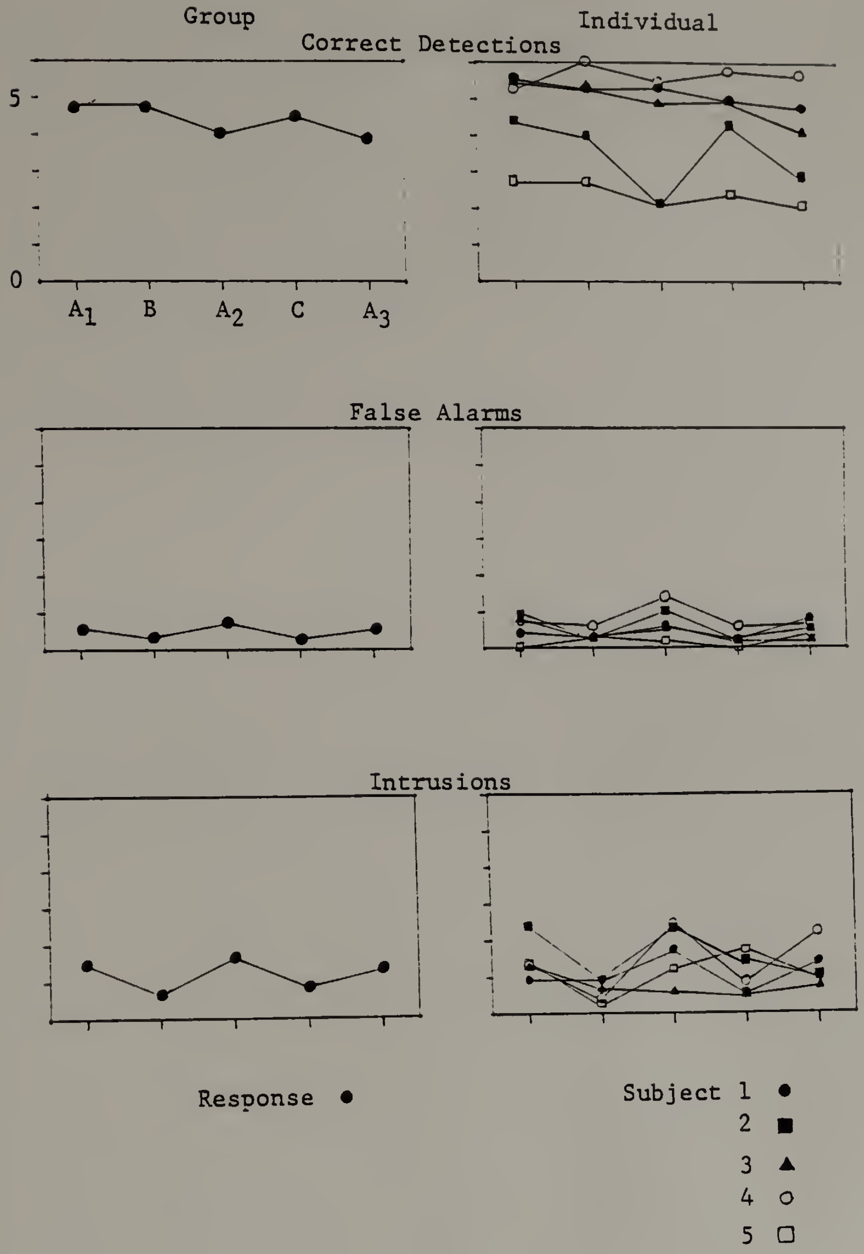
Raw Data by Treatment Phase, Subject and TimeInterval

					Time							
Phase	Subject	1	2	3	4	5	6	7	8	9	10	Mean
A[1]	1	6	5	4	6	6	6	6	6	5	6	5.6
	2	5	5	5	6	6	5	6	3	3	3	4.4
Hits	3	5	6	4	6	5	4	6	6	6	6	5.4
	4	6	6	6	6	6	1	6	5	5	6	5.3
	5	3	3	3	4	1	3	3	2	3	2	2.7
									Total		Mean	4.15
False Alarms	1	0	0	0	0	1	1	1	1	0	0	.4
	2	0	1	1	0	1	2	1	2	1	0	.9
	3	0	1	3	0	3	0	0	0	0	0	.7
	4	1	0	0	0	1	2	1	0	1	1	.7
	5	0	0	0	0	0	0	0	0	0	0	0.0
									Total		Mean	.54
Intru-sions	1	3	0	1	1	1	1	1	0	1	0	.9
	2	5	2	0	3	2	4	0	3	3	2	2.4
	3	4	3	0	0	0	3	2	0	0	0	1.2
	4	2	0	1	0	0	3	3	2	1	1	1.3
	5	3	1	0	2	2	0	1	1	3	0	1.3
									Total		Mean	1.42
B	1	6	4	6	5	6	6	4	5	5	6	5.3
Hits	2	5	6	3	4	5	3	3	4	4	3	4.0
	3	6	6	6	6	6	3	4	5	6	6	5.4
	4	6	6	6	6	6	6	6	6	6	6	6.0
	5	4	6	2	2	4	2	3	0	1	3	2.7
									Total		Mean	4.68
False Alarms	1	0	0	1	1	0	1	0	0	0	0	.3
	2	0	1	0	0	0	1	0	0	0	1	.3
	3	0	0	1	0	0	0	0	0	0	1	.2
	4	0	1	1	0	1	0	0	2	1	0	.6
	5	0	1	0	0	1	0	0	0	0	0	.2
									Total		Mean	.32

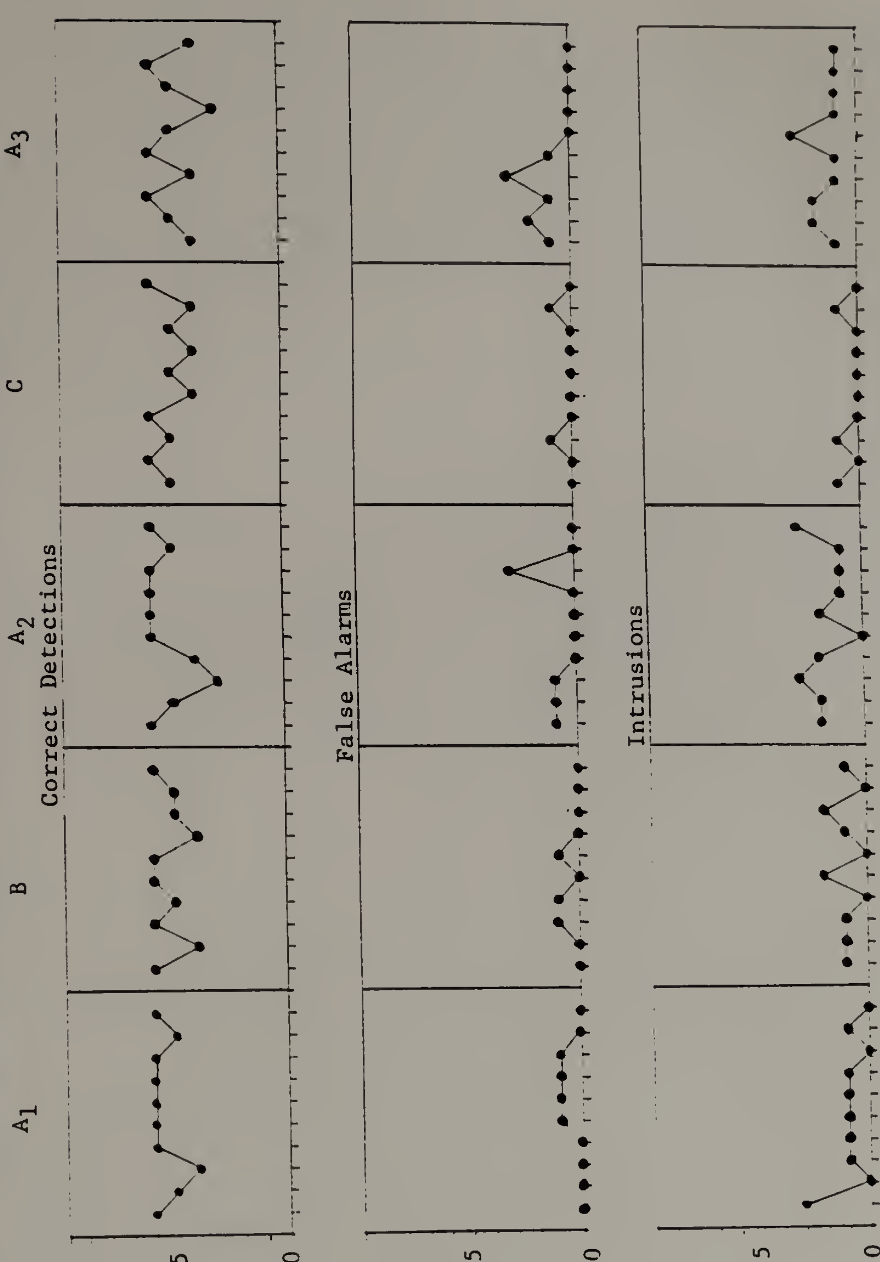
Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
Intru-sions	1	1	1	1	0	2	0	1	2	0	1	.9
	2	1	0	2	0	1	1	1	1	0	2	.9
	3	1	0	1	0	0	1	0	2	0	1	.6
	4	0	1	2	0	0	0	0	0	0	1	.4
	5	1	0	1	0	1	0	0	0	0	0	.3
									Total	Mean		.62
A[2] Hits	1	6	5	3	4	6	6	6	6	5	6	5.3
	2	2	2	0	2	2	3	1	3	4	2	2.1
	3	6	4	4	5	6	4	4	5	6	4	4.8
	4	4	6	5	6	5	6	6	6	5	6	5.5
	5	3	4	2	0	1	2	4	0	1	4	2.1
									Total	Mean		3.96
False Alarms	1	1	1	1	0	0	0	0	3	0	0	.6
	2	1	0	1	0	4	1	1	1	1	0	1.0
	3	1	0	2	1	0	0	0	0	0	1	.5
	4	5	1	3	1	2	1	0	1	0	0	1.4
	5	0	0	1	0	0	1	0	0	0	0	.2
									Total	Mean		.74
Intru-sions	1	2	2	3	2	0	2	1	1	1	3	1.7
	2	5	6	3	0	2	1	1	2	2	1	2.3
	3	0	2	1	0	0	1	1	0	0	0	1.5
	4	0	1	2	2	4	3	4	3	2	3	2.4
	5	3	3	2	0	1	2	1	0	0	0	1.2
									Total	Mean		1.82
C Hits	1	5	6	5	6	4	5	4	5	4	6	5.0
	2	5	6	6	4	4	4	3	2	4	5	4.3
	3	6	5	4	5	4	5	4	6	5	5	4.9
	4	6	6	6	6	6	5	6	6	6	5	5.8
	5	2	5	2	2	1	3	4	3	1	1	2.4
									Total	Mean		4.48
False Alarms	1	0	0	1	0	0	0	0	0	1	0	.2
	2	1	0	1	0	0	0	0	0	0	0	.2
	3	0	0	0	0	0	0	0	1	0	0	.1
	4	1	1	1	0	2	0	0	0	0	0	.5
	5	0	0	0	0	0	0	0	0	0	0	0.0
									Total	Mean		.20

Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
Intru-sions	1	1	0	1	0	0	0	1	0	1	0	.5
	2	1	4	1	1	0	2	0	1	2	2	1.4
	3	0	0	1	0	0	0	1	1	1	0	.4
	4	0	0	1	0	0	0	1	2	2	2	.8
	5	1	1	1	0	0	0	1	1	1	1	.7
									Total	Mean		.76
A[3] Hits	1	4	5	6	4	6	5	3	5	6	4	4.8
	2	2	2	5	3	2	3	4	3	4	1	2.9
	3	4	5	4	3	4	4	3	6	6	2	4.1
	4	5	6	6	4	6	6	6	6	6	6	5.7
	5	4	1	1	1	4	1	4	1	3	1	2.1
									Total	Mean		3.92
False Alarms	1	1	2	1	3	1	0	0	0	0	0	.8
	2	0	0	0	1	0	0	1	0	3	0	.5
	3	0	0	0	0	2	0	0	0	0	0	.2
	4	1	0	0	0	1	1	0	2	1	1	.7
	5	1	1	0	1	0	0	1	0	0	0	.4
									Total	Mean		.52
Intru-sions	1	1	2	2	1	1	3	1	1	1	1	1.4
	2	1	0	1	3	1	1	1	0	1	1	1.0
	3	0	0	2	0	1	1	0	0	2	1	.7
	4	3	4	2	4	2	1	2	1	1	2	2.2
	5	1	1	0	1	3	0	1	1	0	2	1.0
									Total	Mean		1.26

Dichotic Listening Task I: Average
Individual and Group Results
across Treatment Phases

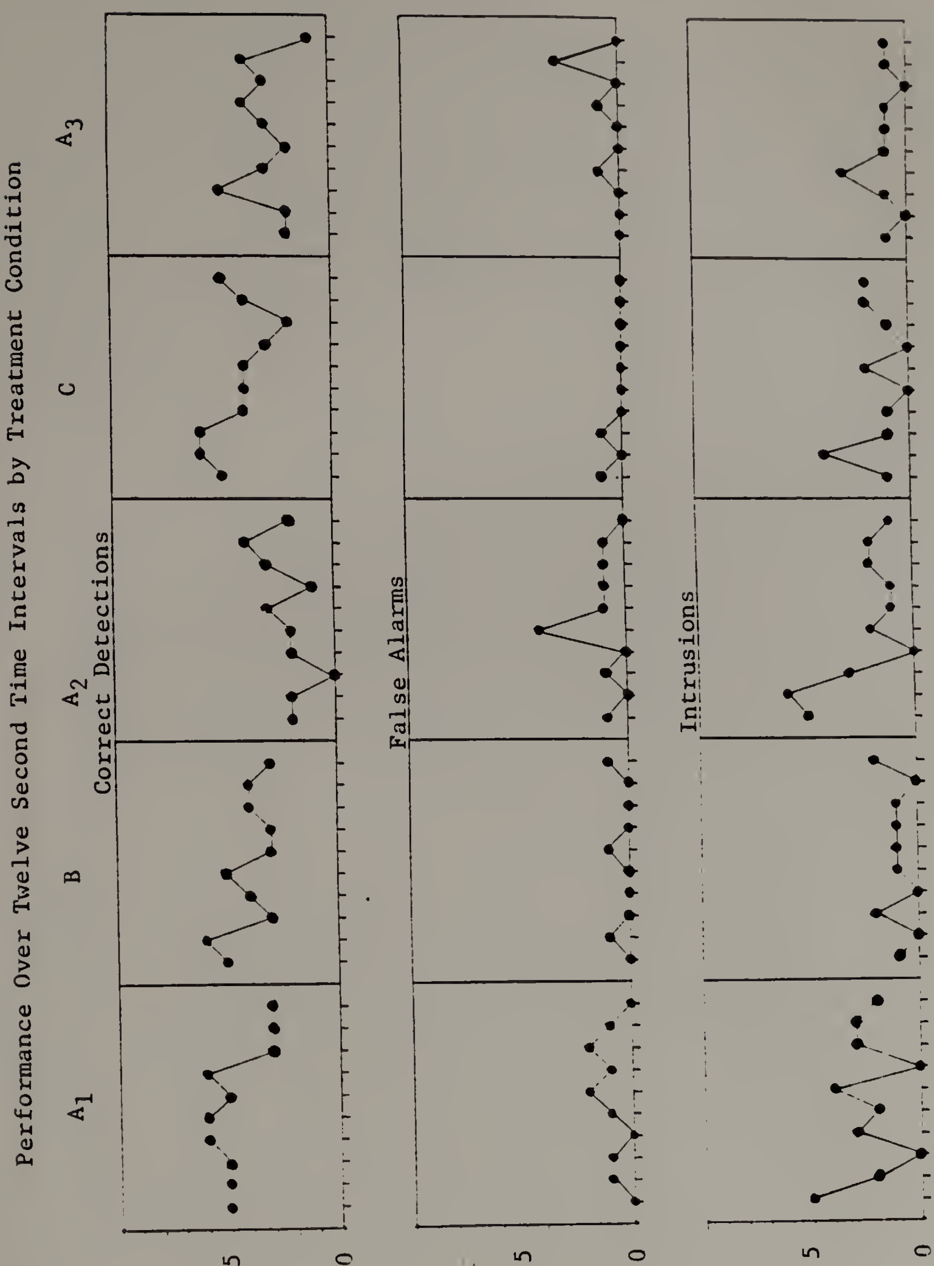


Dichotic Listening Task I: Subject 1

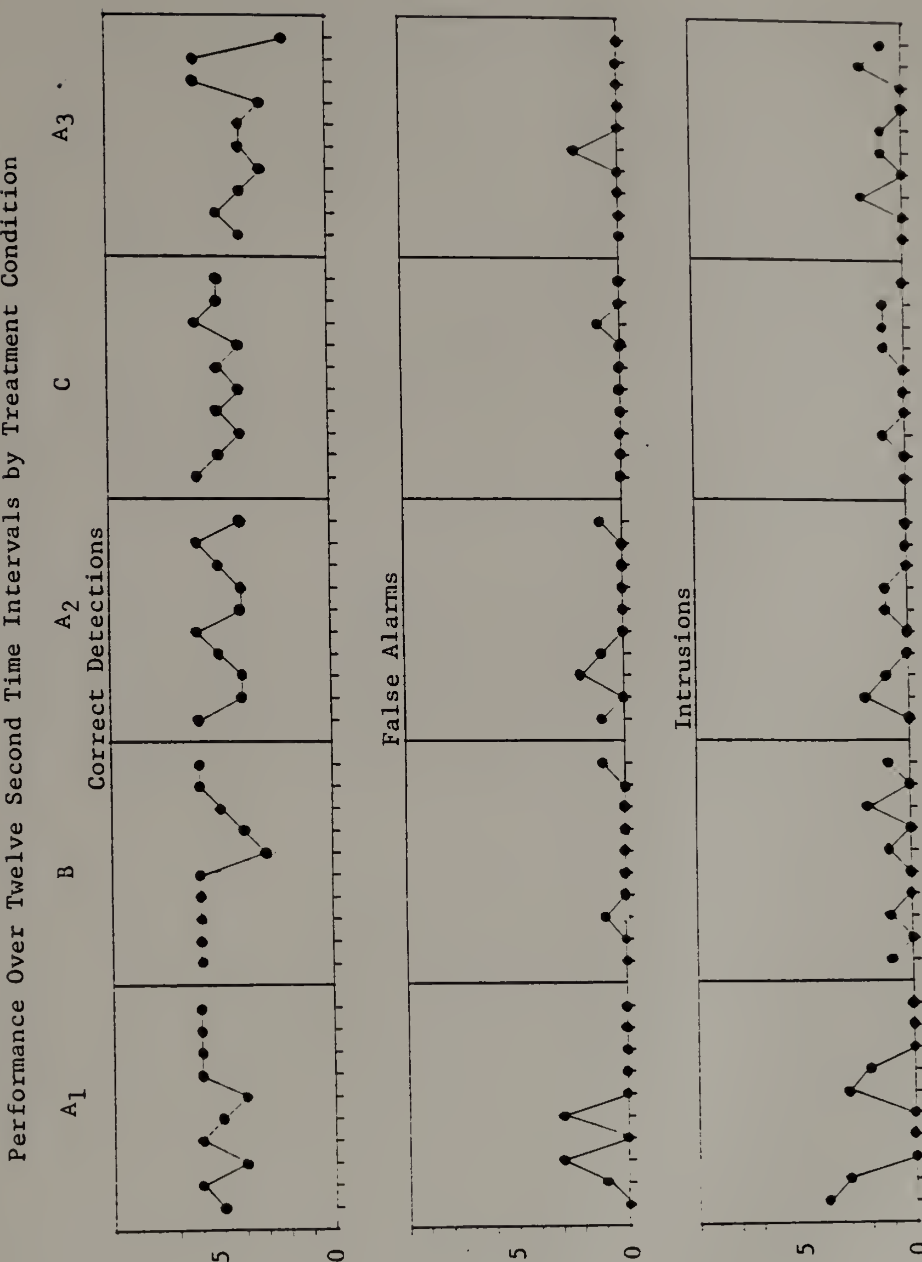


Performance Over Twelve Second Time Intervals by Treatment Condition

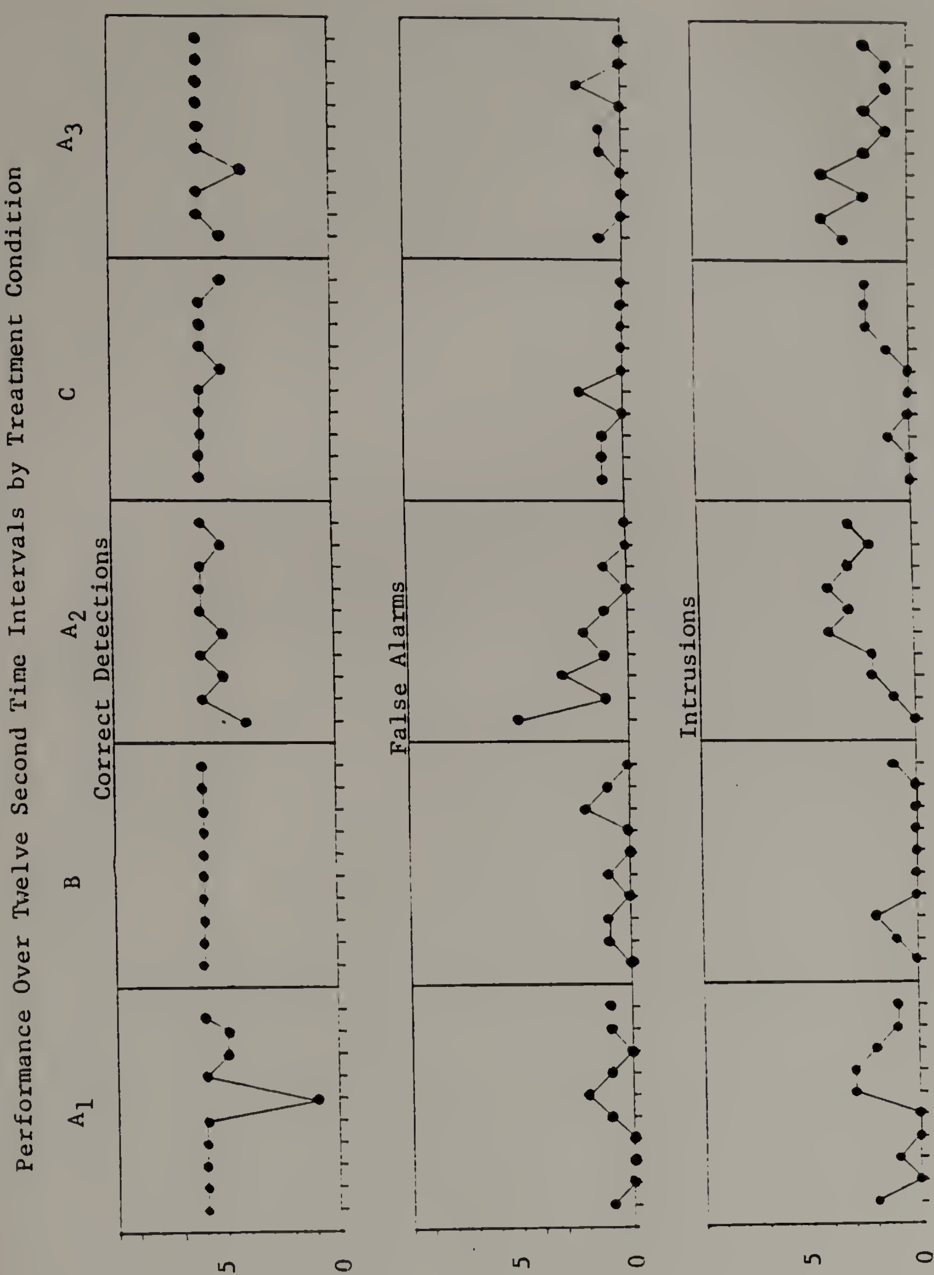
Dichotic Listening Task I: Subject 2



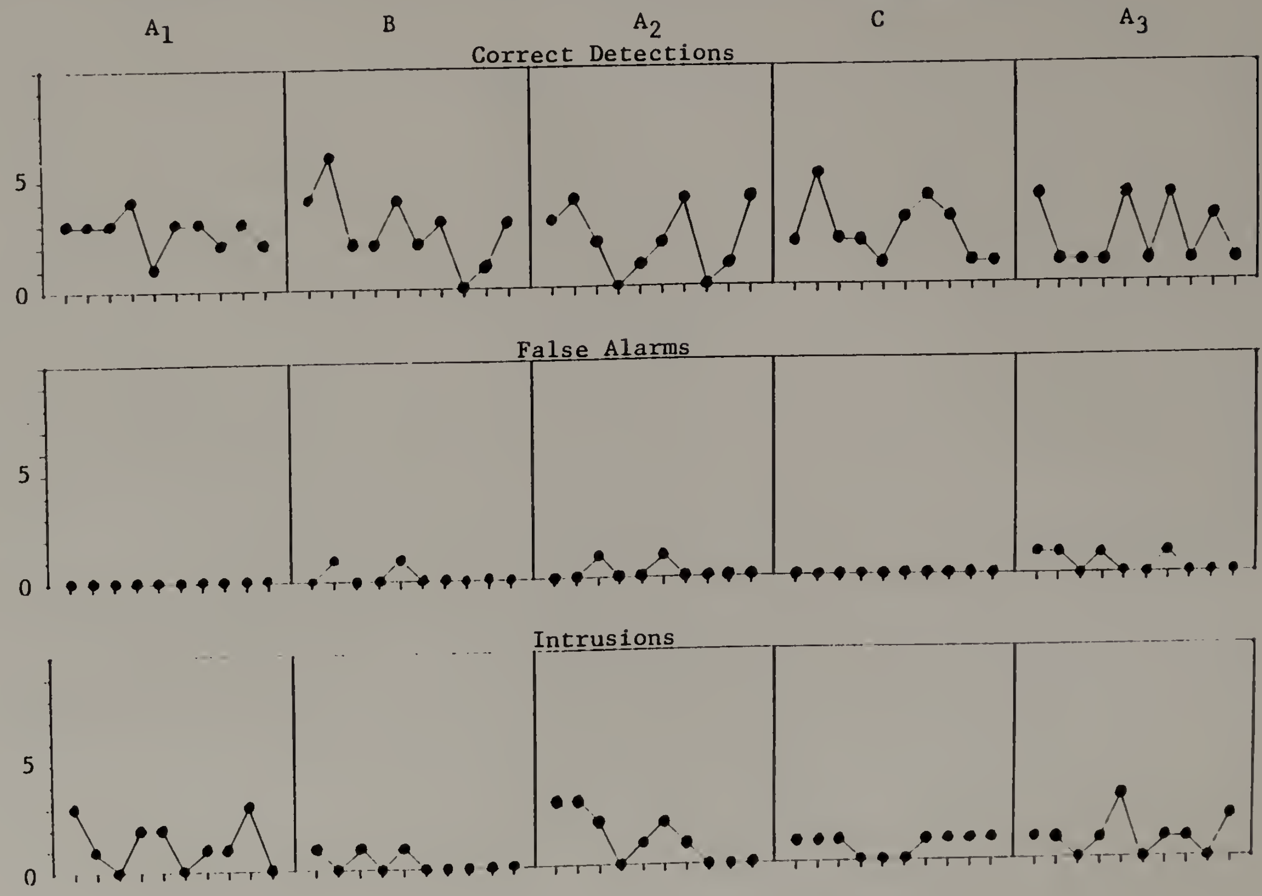
Dichotic Listening Task I: Subject 3



Dichotic Listening Task I: Subject 4



Performance Over Twelve Second Time Intervals by Treatment Condition



Dichotic Listening Task I: Subject 5

DICHOTIC TASK II

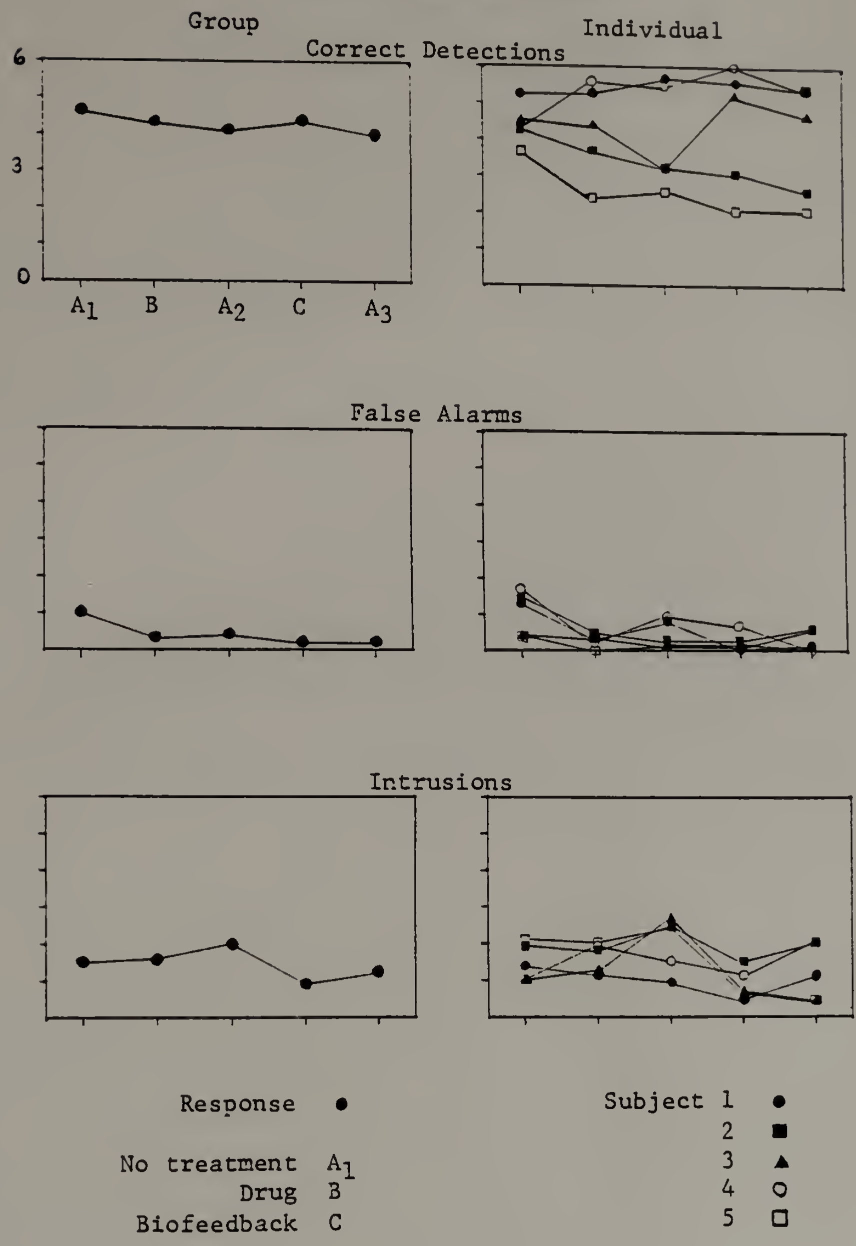
Raw Data by Treatment Phase, Subject and Time Interval

Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
A[1]	1	5	4	5	5	5	5	6	6	6	6	5.3
	2	6	3	2	5	5	4	5	5	5	3	4.3
Hits	3	6	4	4	3	2	4	5	6	5	5	4.4
	4	6	6	4	5	4	6	6	5	6	5	5.3
	5	5	4	1	3	4	6	5	4	2	3	3.7
									Total	Mean		4.60
False Alarms	1	3	3	0	1	0	0	1	1	2	2	1.3
	2	1	1	2	1	1	2	1	3	1	1	1.4
	3	0	0	0	0	0	0	0	1	0	3	.4
	4	1	4	0	1	2	1	1	2	3	2	1.7
	5	0	0	0	0	0	0	1	1	1	1	.4
									Total	Mean		1.04
Intru-sions	1	1	1	2	2	0	3	3	1	1	0	1.4
	2	4	1	5	2	1	1	5	0	0	0	1.9
	3	1	0	0	2	4	0	0	0	1	2	1.0
	4	3	0	1	1	1	0	2	0	1	1	1.0
	5	1	1	1	1	4	2	4	2	4	1	2.1
									Total	Mean		1.48
B	1	4	5	4	6	5	6	5	6	6	6	5.3
Hits	2	5	2	1	6	3	3	5	4	4	4	3.7
	3	6	5	5	6	5	3	3	2	6	3	4.4
	4	6	6	6	6	6	5	6	5	6	4	5.6
	5	6	2	1	5	2	3	0	0	4	1	2.4
									Total	Mean		4.28
False Alarms	1	0	2	0	0	1	0	0	0	0	0	.3
	2	0	0	0	2	1	1	1	0	0	0	.5
	3	1	0	1	0	1	0	0	0	0	0	.3
	4	0	2	0	0	0	0	0	0	0	0	.2
	5	0	0	0	0	0	0	0	0	0	0	0.0
									Total	Mean		.26

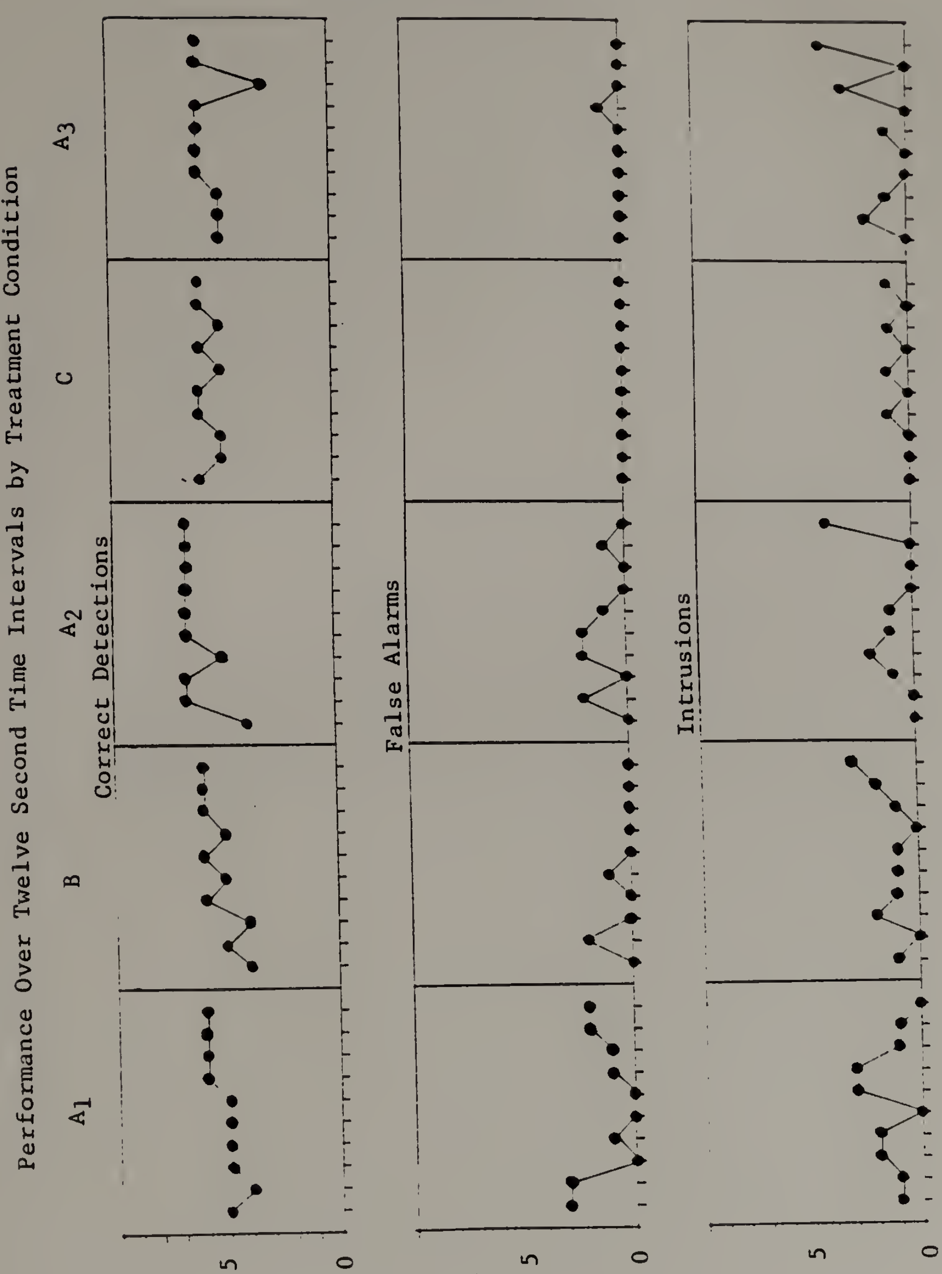
Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
Intru-sions	1	1	0	2	1	1	1	0	1	2	3	1.1
	2	2	3	4	1	1	1	3	1	0	2	1.8
	3	0	0	0	1	1	1	6	3	0	0	1.2
	4	0	0	1	1	1	4	3	4	1	4	1.9
	5	4	3	1	2	0	1	1	3	2	1	2.0
									Total	Mean		1.60
A[2]	1	4	6	6	5	6	6	6	6	6	6	5.7
	2	1	3	5	4	4	2	4	6	2	2	3.3
Hits	3	3	5	6	4	3	0	2	0	3	6	3.2
	4	4	6	6	4	6	6	6	6	5	6	5.5
	5	3	2	6	3	2	3	2	3	1	1	2.6
									Total	Mean		4.06
False Alarms	1	0	2	0	2	2	1	0	0	1	0	.8
	2	2	0	0	1	0	0	0	0	0	0	.3
	3	0	0	0	0	1	0	0	0	0	0	.1
	4	1	3	0	1	0	0	0	0	2	2	.9
	5	0	1	0	0	0	0	0	0	0	0	.1
									Total	Mean		.44
Intru-sions	1	0	0	1	2	1	1	0	0	0	4	.9
	2	4	1	3	1	1	2	2	4	2	5	2.5
	3	6	0	0	1	4	4	4	5	2	0	2.6
	4	2	0	1	1	1	2	1	3	3	1	1.5
	5	1	2	3	2	3	3	4	0	3	3	2.4
									Total	Mean		1.98
C	1	6	5	5	6	6	5	6	5	6	6	5.6
Hits	2	4	3	5	2	3	1	4	1	6	2	3.1
	3	6	6	4	4	4	6	6	5	6	6	5.3
	4	6	6	6	6	6	6	6	6	6	6	6.0
	5	2	5	2	4	1	0	1	4	2	0	2.1
									Total	Mean		4.42
False Alarms	1	0	0	0	0	0	0	0	0	0	0	0.0
	2	0	0	0	1	0	0	1	0	0	1	.3
	3	0	0	0	0	0	0	0	1	0	0	.1
	4	0	1	1	0	0	1	0	3	0	1	.7
	5	0	1	0	0	0	0	0	0	0	0	.1
									Total	Mean		.24

Phase	Subject	Time 1	2	3	4	5	6	7	8	9	10	Mean
Intru-sions	1	0	0	0	1	0	1	0	1	0	1	.4
	2	1	0	3	1	1	1	4	0	3	1	1.5
	3	0	0	2	2	0	0	0	3	0	0	.7
	4	1	0	1	4	0	1	1	0	1	2	1.1
	5	0	0	2	1	0	1	0	1	0	1	.6
									Total Mean			.86
A[3]	1	5	5	5	6	6	6	6	3	6	6	5.4
	2	3	4	2	3	3	3	2	0	6	0	2.6
Hits	3	6	4	4	6	5	4	6	3	5	4	4.7
	4	5	6	5	6	6	5	5	4	6	6	5.4
	5	3	2	2	0	2	3	2	3	3	1	2.1
									Total Mean			4.04
False Alarms	1	0	0	0	0	0	0	1	0	0	0	.1
	2	0	1	2	1	0	0	0	0	1	1	.6
	3	0	1	0	1	1	1	0	0	0	1	.5
	4	0	0	0	0	0	0	0	0	0	0	0.0
	5	0	0	0	0	0	0	0	0	0	0	0.0
									Total Mean			.24
Intru-sions	1	0	2	1	0	0	1	0	3	0	4	1.1
	2	2	1	0	1	3	4	2	1	3	3	2.0
	3	0	0	0	1	0	0	1	1	0	1	.4
	4	1	0	2	0	2	3	3	5	2	2	2.0
	5	0	0	0	0	3	0	0	0	0	1	.4
									Total Mean			1.2

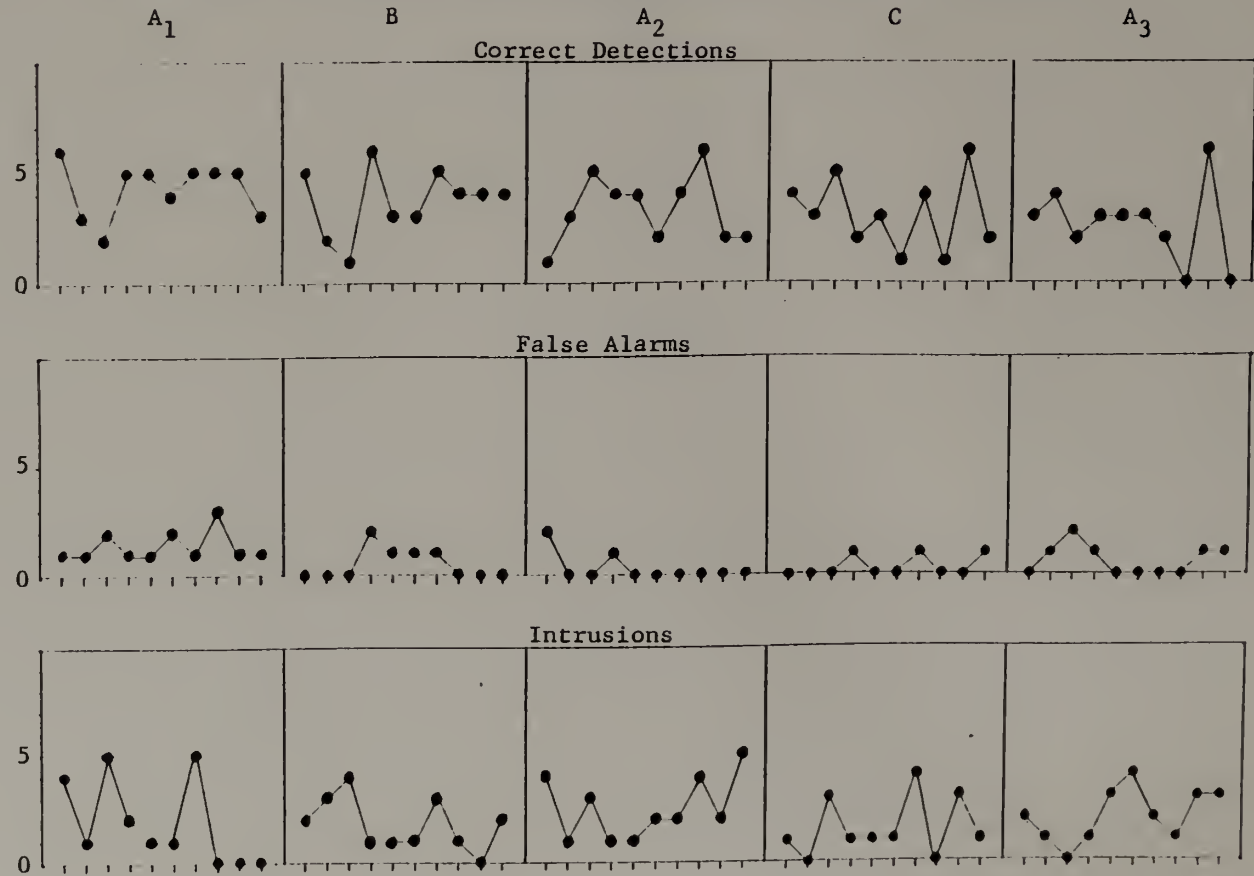
Dichotic Listening Task II: Average
Individual and Group Results
across Treatment Phases



Dichotic Listening Task II: Subject 1

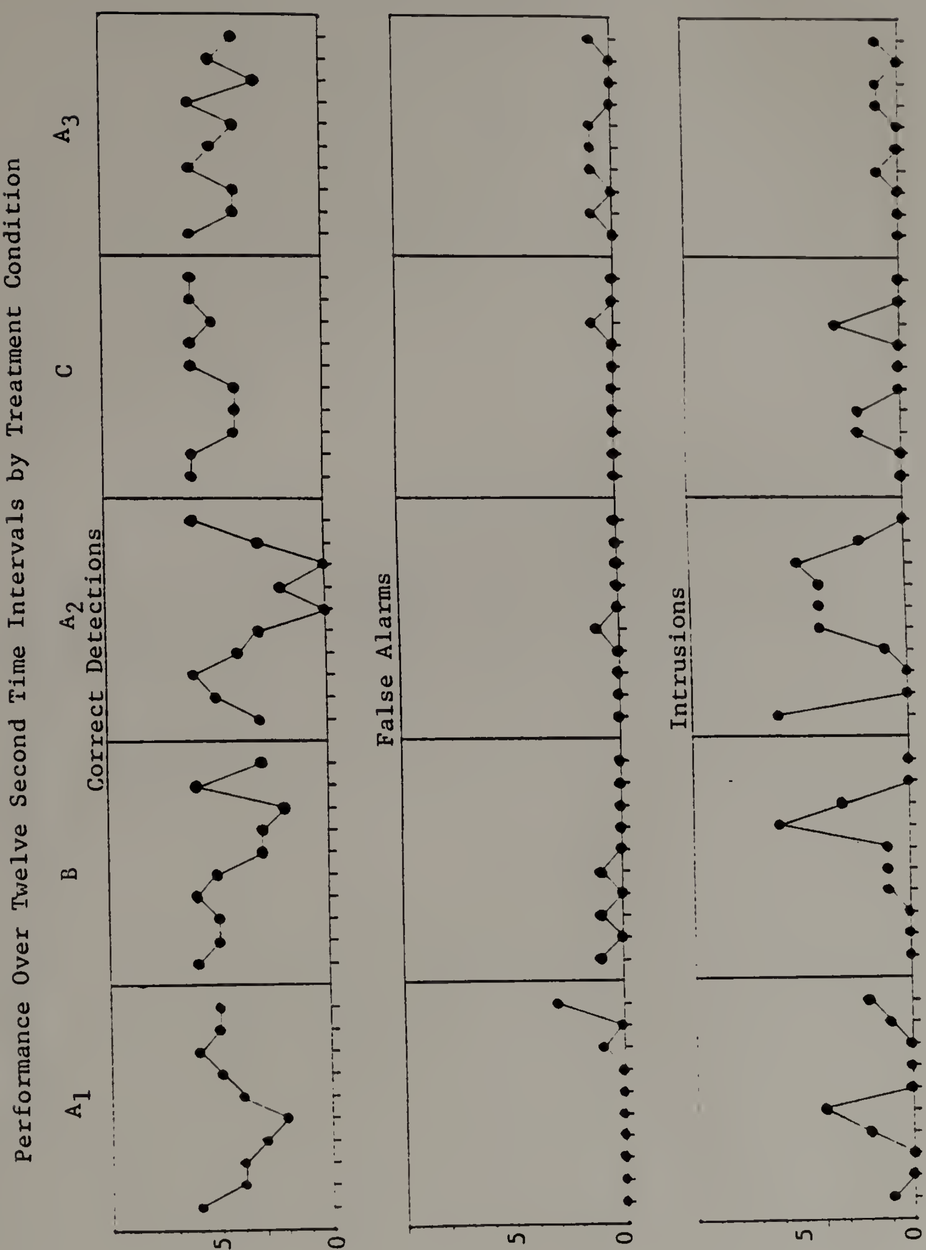


Performance Over Twelve Second Time Intervals by Treatment Condition



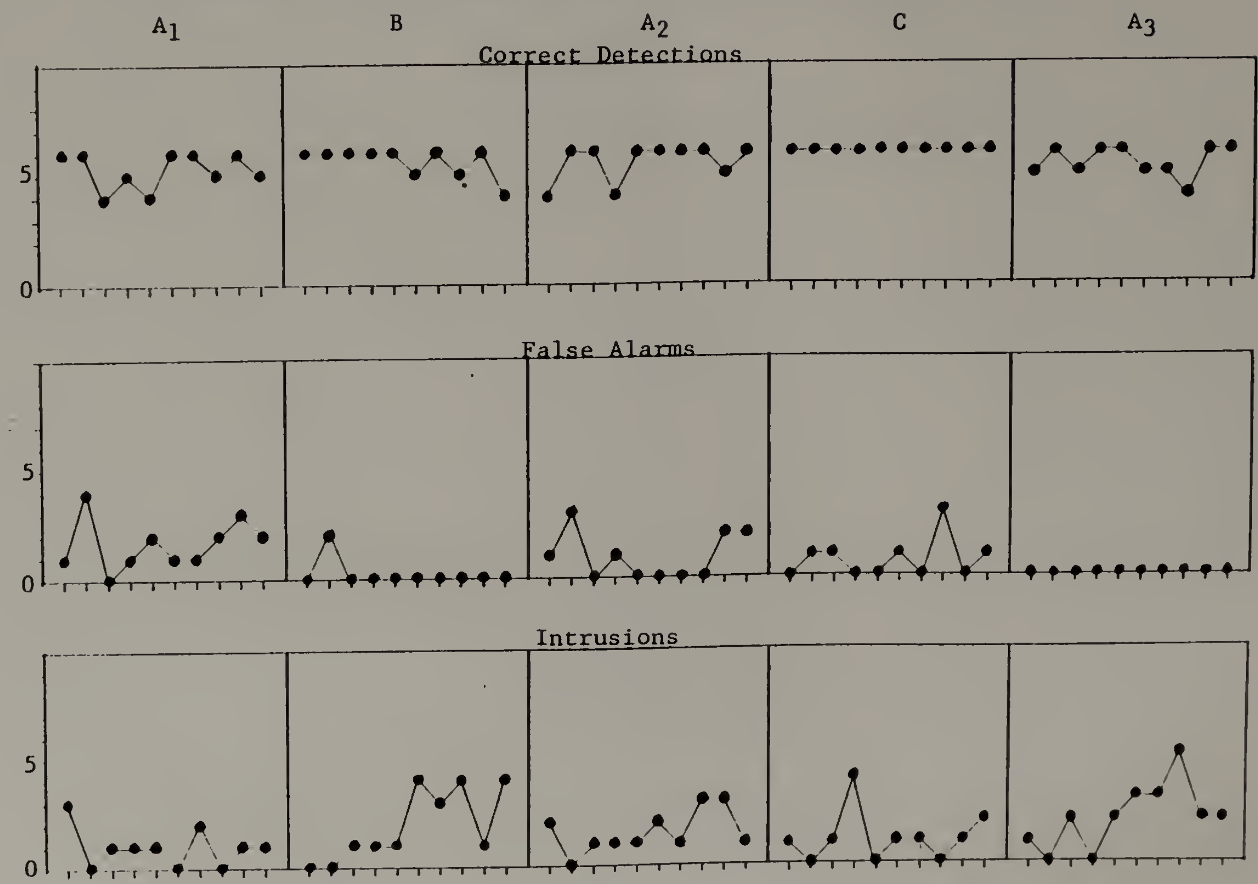
Dichotic Listening Task II: Subject 2

Dichotic Listening Task II: Subject 3

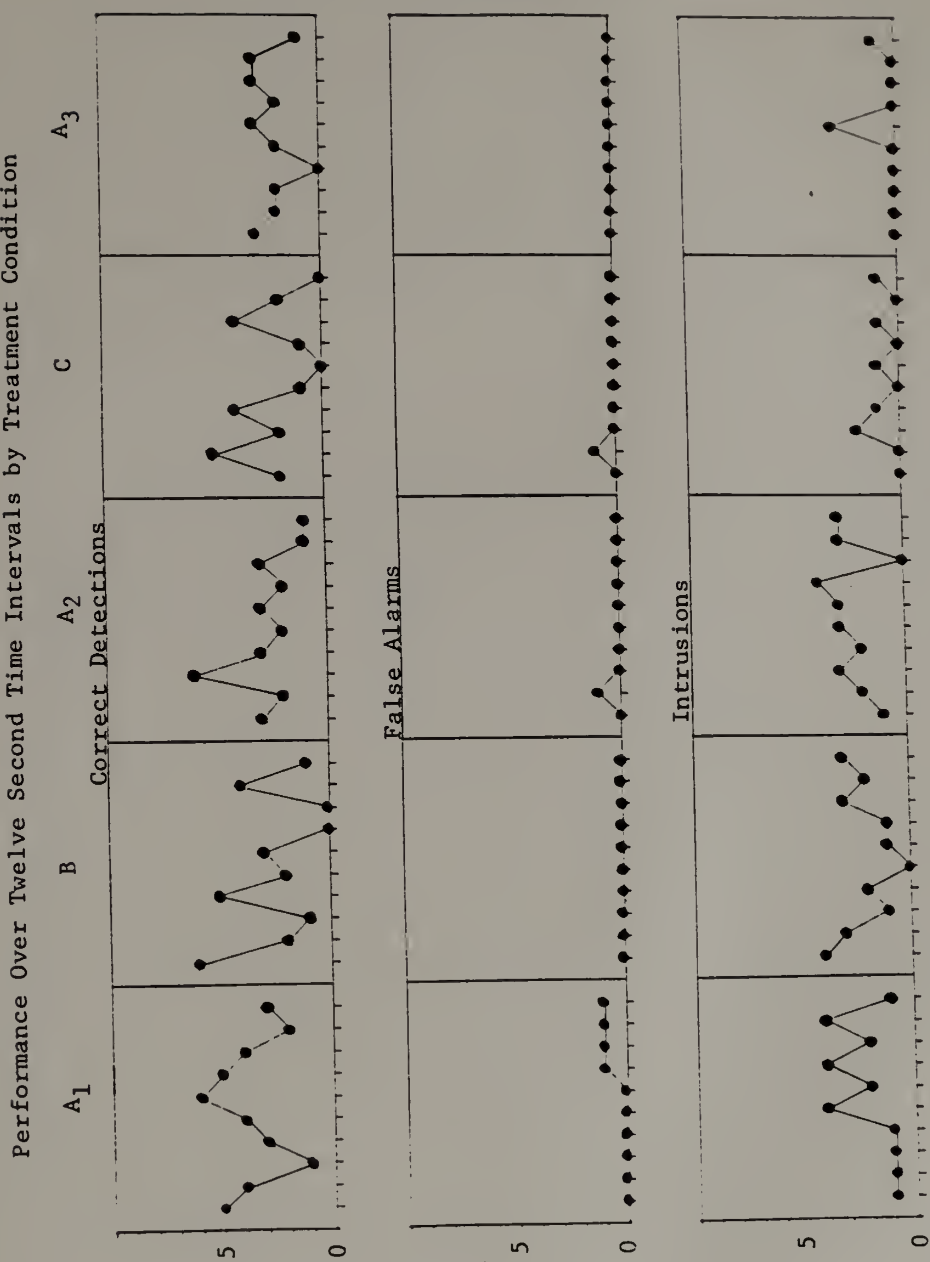


Dichotic Listening Task II: Subject 4

Performance Over Twelve Second Time Intervals by Treatment Condition



Dichotic Listening Task II: Subject 5

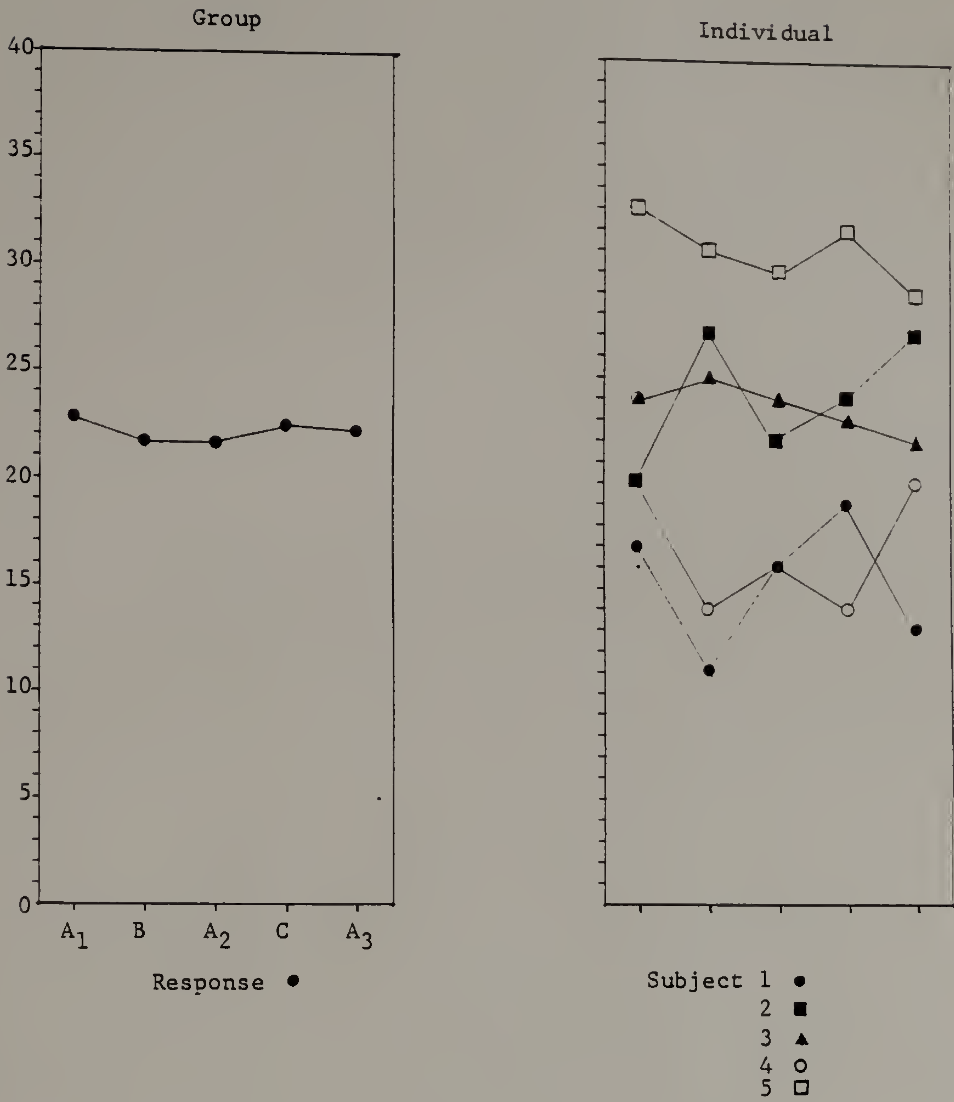


MEMORY TASK

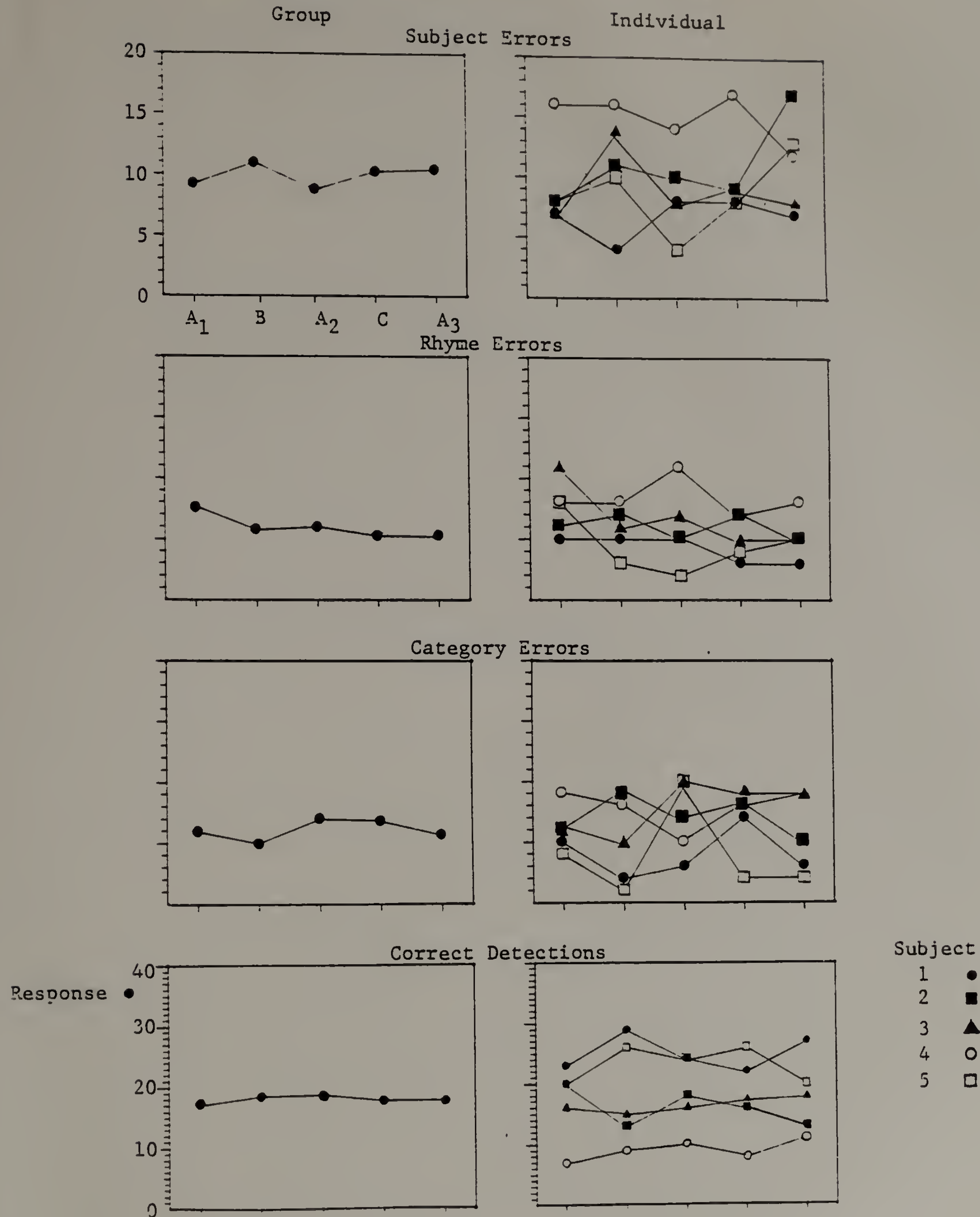
Response Type by Treatment Condition and Subject

Response Type	Subject	A[1]	B	A[2]	C	A[3]
		Treatment Condition				
Subject Associate	1	7	4	8	8	7
	2	8	11	10	9	17
	3	7	14	8	9	8
	4	8	10	4	8	13
	5	16	16	14	17	12
	Mean	9.2	11.0	8.8	10.2	11.4
Rhyme	1	5	5	5	3	3
	2	6	7	5	7	5
	3	11	6	7	5	5
	4	8	3	2	4	5
	5	8	8	11	7	8
	Mean	7.6	5.8	6.0	5.2	5.2
Category	1	5	2	3	7	3
	2	6	9	7	8	5
	3	6	5	9	9	9
	4	4	1	10	2	2
	5	9	7	5	8	9
	Mean	6.0	4.8	6.8	6.8	5.6
Target	1	23	29	24	22	27
	2	20	13	18	16	13
	3	16	15	16	17	18
	4	20	26	24	26	20
	5	7	9	10	8	11
	Mean	17.2	18.4	18.4	17.8	17.8

Average Total Recognition Memory Errors
by Group and Individual over
Treatment Phase



Memory Response Type by Group and Individual

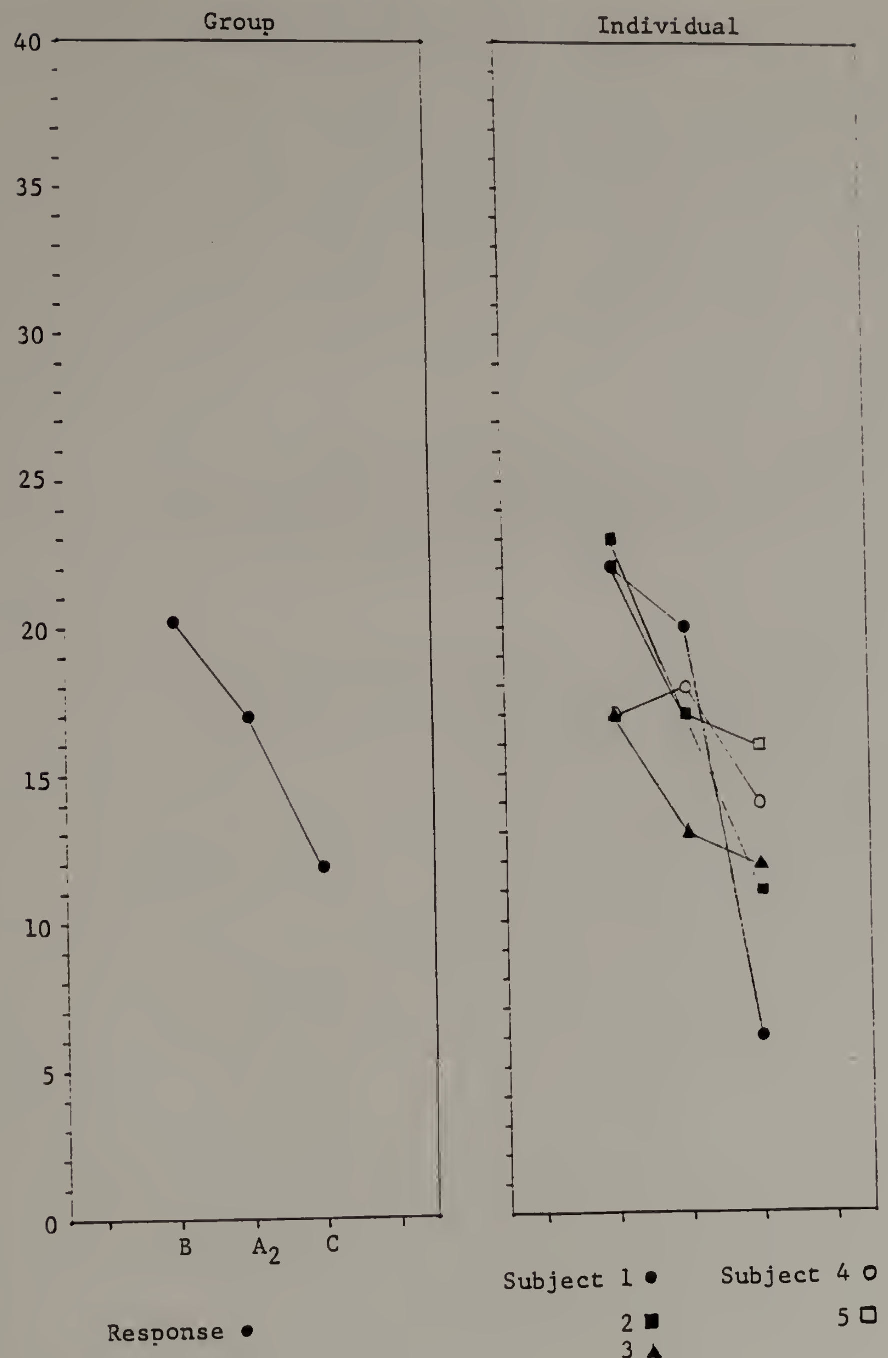


LOCUS OF CONTROL TASK

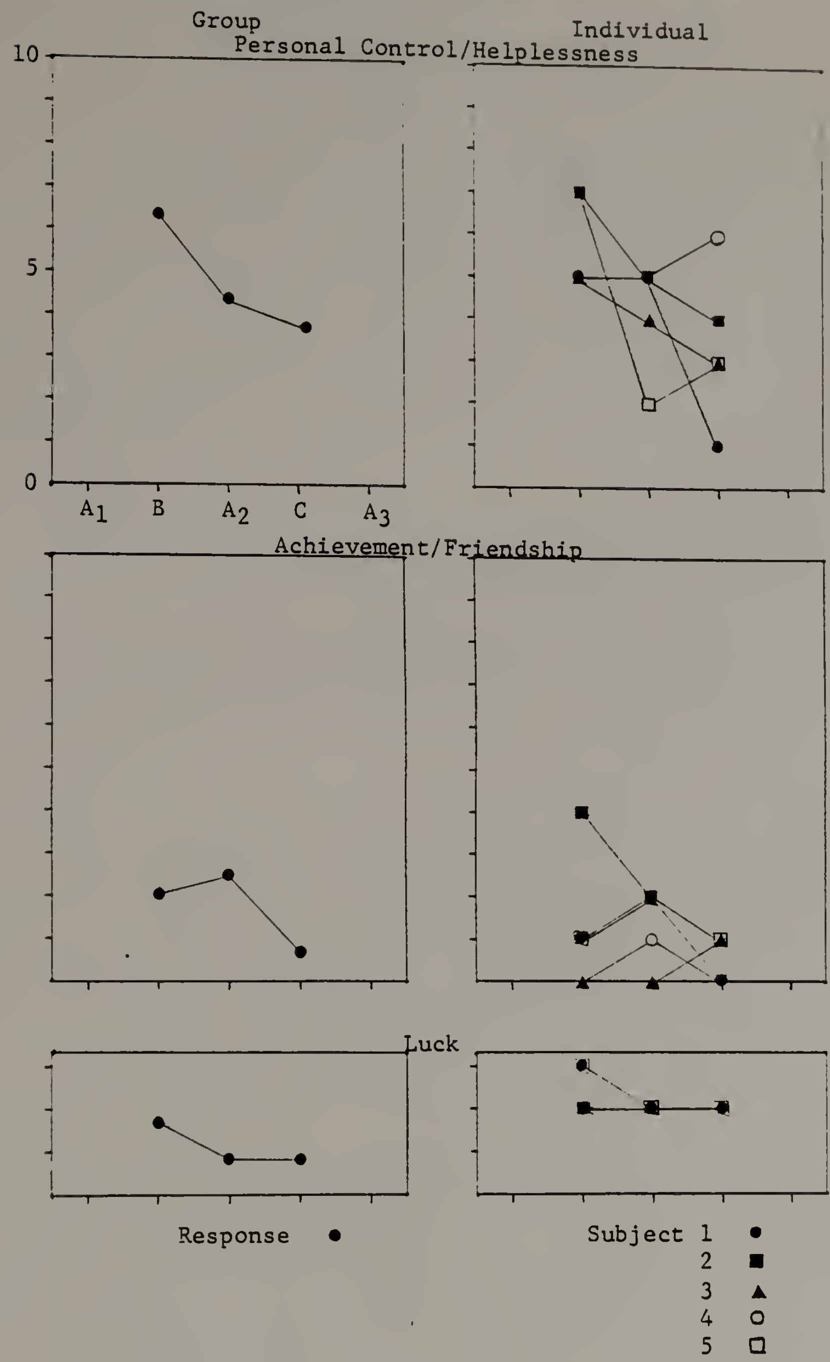
External Responses by Subject and Treatment Condition

Subject	B	A[2]	C
1	22	20	6
2	23	17	11
3	17	13	12
4	17	18	14
5	22	17	16
Mean	20.2	17.0	11.8

Locus of Control Averaged Group and Individual
External Responses by Treatment Phase



Locus of Control Task Performance by Factors



Correlated t-Test Results Average No Treatment with Treatment Results by Task Variable (N=5)

Variable	Con-dition	Mean	S.D.	S.E.	Differ-ence Mean	S.D.	S.E.	t-value	2-tail prob-ability
Continuous Performance Task I									
Hits	No	151.4	29.924	13.383					
	Drug	172.6	28.343	12.675	21.2	15.568	6.962	3.04	.038
	Bio	151.6	43.311	19.369	.2	13.706	6.13	.03	.976
False Alarms	No	31.4	12.597	5.634					
	Drug	19.0	17.219	7.701	-12.4	5.819	2.602	-4.77	.009
	Bio	10.4	4.879	2.182	-21.0	8.229	3.68	-5.71	.005
Continuous Performance Task II									
Hits	No	36.2667	25.444	11.379					
	Drug	40.2	26.715	11.947	3.933	14.436	6.456	.61	.575
	Bio	28.8	10.849	4.862	- 7.4667	20.145	9.009	-.83	.454
False Alarms	No	27.8	27.333	12.224					
	Drug	25.8	9.121	4.079	- 2.0	28.467	12.731	-.16	.883
	Bio	12.8	16.423	7.344	-15.0	11.557	5.168	-2.90	.044

Variable	Condition	Mean	S.D.	S.E.	Difference Mean	S.D.	S.E.	t-value	2-tail probability
Dichotic Task I									
Hits	No	42.0667	13.805	6.174					
	Drug	46.8	13.255	5.928	4.733	2.66	1.19	3.98	.016
	Bio	44.8	12.795	5.722	2.733	4.839	2.164	1.26	.275
False Alarms	No	6.0	2.867	1.282					
	Drug	3.2	1.643	.735	-2.8	1.804	.807	-3.47	.026
	Bio	2.0	1.871	.837	-4.0	1.434	.641	-6.24	.003
Intrusions	No	14.2	4.788	2.141					
	Drug	6.2	2.775	1.241	-8.0	5.072	2.268	-3.53	.024
	Bio	7.6	3.912	1.749	-6.6	2.976	1.331	-4.96	.008
Dichotic Task II									
Hits	No	42.33	11.884	5.315					
	Drug	42.8	12.911	5.774	.4667	3.150	1.409	.33	.757
	Bio	44.2	17.167	7.677	1.8667	7.456	3.334	.56	.605
False Alarms	No	5.7333	3.05	1.364					
	Drug	2.6	1.817	.812	-3.133	2.456	1.098	-2.85	.046
	Bio	2.4	2.793	1.249	-3.333	2.677	1.197	-2.78	.05
Intrusions	No	15.4667	3.776	1.689					
	Drug	16.2	3.849	1.774	.733	3.166	1.416	.52	.632
	Bio	8.6	4.393	1.965	-6.8667	2.292	1.025	-6.70	.003

Variable	Condition	Mean	S.D.	S.E.	Difference Mean	S.D.	S.E.	t-value	2-tail probability
Recognition Memory									
Subject Assoc.	No	9.8	2.912	1.302					
	Drug	11.0	4.583	2.049	1.2	3.579	1.601	.75	.495
	Bio	10.2	3.834	1.715	.4	2.10	.939	.43	.692
Rhyme	No	6.2667	1.978	.884					
	Drug	5.8	1.924	.860	- .4667	1.574	.704	-.66	.544
	Bio	5.2	1.789	.800	-1.0667	1.657	.741	-1.44	.223
Category	No	6.133	1.773	.793					
	Drug	4.8	3.347	1.497	-1.333	2.789	1.247	-1.07	.345
	Bio	6.8	2.775	1.241	.6667	2.506	1.121	.59	.584
Target	No	17.8	5.772	2.581					
	Drug	18.4	8.649	3.868	.6	3.796	1.698	.35	.742
	Bio	17.8	5.772	2.581	- .2	2.411	1.078	-.19	.862
Locus of Control									
	No	17.0	2.55	1.140					
	Drug	20.2	2.95	1.319	3.2	2.775	1.241	2.58	.061
	Bio	11.8	3.768	1.685	5.2	5.357	2.396	2.17	.096

Correlated t-Test Results Drug with Biofeedback
by Task Variable (N=5)

Variable	Condition	Mean	S.D.	S.E.	Difference Mean	S.D.	S.E.	t-value	2-tail probability
Continuous Performance Task I									
Hits	Drug	150.6	34.947	15.629					
	Bio	151.6	43.311	19.369	- 1.0	11.533	5.153	- .19	.856
False Alarms	Drug	19.0	17.219	7.701					
	Bio	10.4	4.879	2.182	8.6	13.409	5.997	1.43	.225
Continuous Performance Task II									
Hits	Drug	40.2	26.715	11.947					
	Bio	28.8	10.849	4.852	11.4	20.695	9.255	1.23	.286
False Alarms	Drug	25.8	9.121	4.079					
	Bio	12.8	16.423	7.344	13.0	19.812	8.86	1.47	.216
Dichotic Task I									
Hits	Drug	46.8	13.255	5.928					
	Bio	44.8	12.795	5.722	2.0	3.0	1.342	1.49	.210
False Alarms	Drug	3.2	1.643	.735					
	Bio	2.0	1.871	.837	1.2	.447	.2	6.0	.004
Intrusions	Drug	6.2	2.775	1.241					
	Bio	7.6	3.912	1.749	-1.4	4.099	1.833	- .76	.488

Variable	Condition	Mean	S.D.	S.E.	Difference Mean	S.D.	S.E.	t-value	2-tail probability
Dichotic Task II									
Hits	Drug	42.8	12.911	5.774	- 1.4	5.941	2.657	- .53	.626
	Bio	42.2	17.167	7.677					
False Alarms	Drug	2.6	18.17	.812	.2	3.271	1.463	.14	.898
	Bio	2.4	27.93	1.249					
Intrusions	Drug	16.2	3.899	1.744	7.6	4.159	1.86	4.09	.015
	Bio	8.6	4.393	1.965					
Recognition Memory									
Subject Assoc.	Drug	11.0	4.583	2.049	.8	3.421	1.53	.52	.629
	Bio	10.2	3.834	1.715					
Rhyme	Drug	5.8	1.924	.860	.6	1.14	.51	1.18	.305
	Bio	5.2	1.789	.8					
Category	Drug	4.8	3.347	1.497	- 2.0	2.449	1.095	-1.83	.142
	Bio	6.8	2.775	1.241					
Hits	Drug	18.4	8.649	3.868	.8	3.899	1.744	.46	.67
	Bio	17.6	6.504	2.909					

Median Regression Line and Test of
Correlated Proportions

<u>Subject 1</u>

Variable	Treatment Phase	Slope	Intercept	z-Score	2-tailed Probability
CPT I Correct Detections	A[1]	.0000	18.0000		
	B	-.2000	20.0000	1.00	p>.05
	A[2]	-.2222	17.2222	1.73	p>.05
	C	-.5714	21.1429	2.00	p<.05
	A[3]	-.7143	19.7143	2.70	p<.01
False Alarms	A[1]	.3333	-.3333		
	B	.3333	-.3333	0.00	p>.05
	A[2]	-.1111	4.1111	0.00	p>.05
	C	.1429	-.4286	2.70	p<.01
	A[3]	.5000	.5000	2.00	p<.05
CPT II Correct Detections	A[1]	.0000	8.0000		
	B	-.3333	9.6667	.60	p>.05
	A[2]	-.3333	10.3333	2.70	p<.01
	C	-.2500	5.5000	2.24	p<.05
	A[3]	.0000	8.0000	2.00	p<.05
False Alarms	A[1]	-.1429	2.2857		
	B	.1667	2.6667	2.00	p<.05
	A[2]	.3333	.6667	2.45	p<.05
	C	-.2000	1.8000	2.83	p<.01
	A[3]	.2000	.4000	2.00	p<.05
DLT I Correct Detections	A[1]	.0000	6.0000		
	B	-.1250	6.1250	1.73	p>.05
	A[2]	.0000	6.0000	1.42	p>.05
	C	.0000	5.0000	0.00	p>.05
	A[3]	.0000	5.0000	0.00	p>.05
False Alarms	A[1]	.0000	0.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	-.1250	1.1250	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	-.1667	1.5000	1.00	p>.05
Intrusions	A[1]	.0000	1.0000		
	B	.0000	1.0000	0.00	p>.05
	A[2]	-.1429	2.2857	1.00	p>.05
	C	.1250	-.2500	1.73	p>.05
	A[3]	.0000	1.0000	0.00	p>.05

DLT II Correct Detections	A[1]	.2000	4.2000		
	B	.2500	3.7500	2.64	p<.01
	A[2]	.0000	6.0000	0.00	p>.05
	C	.0000	6.0000	0.00	p>.05
	A[3]	.1250	4.8750	1.42	p>.05
False Alarms	A[1]	.0000	1.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	-.2500	2.5000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Intrusions	A[1]	.0000	1.0000		
	B	.0000	1.0000	0.00	p>.05
	A[2]	.2000	-.2000	0.00	p>.05
	C	.1250	-.2500	1.75	p>.05
	A[3]	.2000	-.2000	1.00	p>.05
Recognition Memory Subject Associate	A[1]	-.1111	1.1111		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	-.2000	1.8000	1.00	p>.05
Rhyme	A[1]	.0000	0.0000		
	B	.1111	-.1111	0.00	p>.05
	A[2]	.0000	0.0000	1.73	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Category	A[1]	.1250	-.1250		
	B	.0000	0.0000	1.42	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Target	A[1]	.0000	2.0000		
	B	.0000	3.0000	0.00	p>.05
	A[2]	-.2000	3.6000	1.00	p>.05
	C	-.2500	3.5000	2.00	p<.05
	A[3]	-.1667	3.6667	2.24	p<.05

Subject 2

CPT I Correct Detections	A[1]	-.6250	19.2500		
	B	-.6667	20.6667	2.00	p<.05
	A[2]	-1.1250	17.1250	1.23	p<.05
	C	-1.0000	17.0000	2.00	p<.05
	A[3]	-.8571	14.7143	2.23	p<.05
False Alarms	A[1]	.6000	3.0000		
	B	.0000	4.0000	2.00	p<.05
	A[2]	.2500	1.5000	1.73	p>.05
	C	-.1111	2.1111	2.00	p<.05
	A[3]	.0000	7.0000	2.83	p<.01
CPT II Correct Detections	A[1]	.3333	.6667		
	B	.0000	5.0000	0.00	p>.05
	A[2]	-.2222	4.2222	2.23	p<.05
	C	.0000	2.0000	0.00	p>.05
	A[3]	.1667	.6667	0.00	p>.05
False Alarms	A[1]	.0000	1.0000		
	B	-.5714	6.7143	1.73	p>.05
	A[2]	.0000	3.0000	1.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	1.0000	0.00	p>.05
DLT I Correct Detections	A[1]	-.2857	5.8571		
	B	-.2222	5.2222	2.24	p<.05
	A[2]	.0000	2.0000	0.00	p>.05
	C	-.2000	5.2000	1.73	p>.05
	A[3]	.2000	1.8000	0.00	p>.05
False Alarms	A[1]	.0000	1.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	1.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Intrusions	A[1]	.1429	1.7143		
	B	.0000	1.0000	1.42	p>.05
	A[2]	-.2857	3.8571	1.00	p>.05
	C	.1429	.5714	2.24	p<.05
	A[3]	.0000	1.0000	0.00	p>.05
DLT II Correct Detections	A[1]	.0000	5.0000		
	B	.2500	1.7500	1.00	p>.05
	A[2]	-.3333	5.3333	1.42	p>.05
	C	-.2000	4.0000	2.64	p<.01
	A[3]	-.3333	4.3333	2.45	p<.05

False Alarms	A[1]	.0000	1.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.1111	-.1111	0.00	p>.05
Intrusions	A[1]	-.4000	3.6000		
	B	-.1429	2.1429	2.00	p<.05
	A[2]	.2500	.5000	1.73	p>.05
	C	.0000	1.0000	1.73	p>.05
	A[3]	.2500	.5000	1.00	p>.05
Recognition Memory Subject Associate	A[1]	-.1111	1.1111		
	B	.0000	1.0000	1.42	p>.05
	A[2]	.1250	-.1250	0.00	p>.05
	C	.0000	0.0000	1.00	p>.05
	A[3]	.0000	2.0000	1.42	p>.05
Rhyme	A[1]	-.1429	1.2857		
	B	.0000	1.0000	2.00	p<.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.1250	-.1250	0.00	p>.05
Category	A[1]	.1429	-.2857		
	B	.0000	1.0000	0.00	p>.05
	A[2]	-.1429	1.4286	1.00	p>.05
	C	.0000	1.0000	2.00	p<.05
	A[3]	.0000	0.0000	0.00	p>.05
Target	A[1]	.0000	2.0000		
	B	-.1667	2.3333	0.00	p>.05
	A[2]	.0000	2.0000	2.00	p<.05
	C	.1667	.5000	0.00	p>.05
	A[3]	.0000	1.0000	1.73	p>.05

Subject 3

CPT I Correct Detections	A[1]	.1429	15.5714		
	B	.0000	20.0000	1.00	p>.05
	A[2]	-.2500	19.5000	1.42	p>.05
	C	.0000	18.0000	1.42	p>.05
	A[3]	-2.500	20.2500	1.00	p>.05
False Alarms	A[1]	.3333	.3333		
	B	.0000	0.0000	1.42	p>.05
	A[2]	.0000	2.0000	1.00	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.4000	-.2000	1.00	p>.05
CPT II Correct Detections	A[1]	-.5000	5.5000		
	B	.1667	1.5000	2.00	p<.05
	A[2]	.4000	1.2000	1.00	p>.05
	C	.0000	4.0000	1.00	p>.05
	A[3]	-.1250	1.2500	2.23	p>.05
False Alarms	A[1]	-.1429	2.2857		
	B	-.1667	2.6667	2.00	p<.05
	A[2]	.2500	.2500	1.42	p>.05
	C	.0000	0.0000	1.42	p>.05
	A[3]	-.2857	2.5714	0.00	p>.05
DLT I Correct Detections	A[1]	.1250	4.8750		
	B	.0000	6.0000	0.00	p>.05
	A[2]	-.1667	5.6667	1.00	p>.05
	C	.0000	5.0000	1.72	p>.05
	A[3]	.0000	4.0000	0.00	p>.05
False Alarms	A[1]	.0000	0.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.1429	1.1429	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Intrusions	A[1]	-.4286	3.8571		
	B	.1250	-.2500	2.00	p<.05
	A[2]	.0000	0.0000	1.73	p>.05
	C	.1429	-.2857	0.00	p>.05
	A[3]	.1111	-.1111	2.00	p<.05
DLT II Correct Detections	A[1]	.1250	3.7500		
	B	-.2857	5.8571	1.42	p>.05
	A[2]	.0000	3.0000	1.00	p>.05
	C	.0000	6.0000	2.00	p<.05
	A[3]	-.2000	6.0000	1.00	p>.05

False Alarms	A[1]	.0000	0.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	-.1429	1.2857	0.00	p>.05
Intrusions	A[1]	.1429	-.2857		
	B	.2000	-.2000	1.72	p>.05
	A[2]	-.5000	6.5000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.1250	-.2500	0.00	p>.05
Recognition Memory Subject Associate	A[1]	.1111	-.1111		
	B	.2000	.4000	0.00	p>.05
	A[2]	-.1250	1.1250	2.00	p<.05
	C	.1429	-.1429	2.00	p<.05
	A[3]	.1250	-.1250	1.72	p>.05
Rhyme	A[1]	.0000	1.0000		
	B	-.1667	1.5000	1.72	p>.05
	A[2]	-.1111	1.1111	2.24	p<.05
	C	.1250	-.1250	2.00	p<.05
	A[3]	.1250	-.1250	2.00	p<.05
Category	A[1]	.1250	-.2500		
	B	-.1250	1.2500	2.00	p<.05
	A[2]	.0000	1.0000	1.73	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.0000	1.0000	0.00	p>.05
Target	A[1]	.0000	2.0000		
	B	-.1667	2.3333	0.00	p>.05
	A[2]	.1250	.8750	1.73	p>.05
	C	.0000	1.0000	1.42	p>.05
	A[3]	.0000	1.0000	0.00	p>.05

Subject 4

CPT I Correct Detections	A[1]	.0000	19.0000		
	B	-.2222	20.2222	0.00	p>.05
	A[2]	.0000	19.0000	1.42	p>.05
	C	-.2000	20.2000	0.00	p>.05
	A[3]	.2500	15.5000	1.42	p>.05
False Alarms	A[1]	.0000	1.0000		
	B	.1250	-.2500	0.00	p>.05
	A[2]	-.1667	4.6667	1.42	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.3333	.3333	1.42	p>.05
CPT II Correct Detections	A[1]	.0000	5.0000		
	B	.0000	2.0000	1.42	p>.05
	A[2]	.2500	2.0000	1.00	p>.05
	C	.0000	2.0000	2.00	p<.05
	A[3]	-.3333	4.3333	0.00	p>.05
False Alarms	A[1]	.3750	5.2500		
	B	.0000	3.0000	1.73	p>.05
	A[2]	.3750	11.7500	1.73	p>.05
	C	.0000	4.0000	1.00	p>.05
	A[3]	.2222	4.7778	1.00	p>.05
DLT I Correct Detections	A[1]	.0000	6.0000		
	B	.0000	6.0000	0.00	p>.05
	A[2]	.0000	6.0000	0.00	p>.05
	C	.0000	6.0000	0.00	p>.05
	A[3]	.0000	6.0000	0.00	p>.05
False Alarms	A[1]	.1429	-.2857		
	B	-.1250	1.2500	2.44	p<.05
	A[2]	-.5000	4.5000	2.00	p<.05
	C	-.1250	1.1250	2.00	p<.05
	A[3]	.1429	-.2857	2.24	p<.05
Intrusions	A[1]	.0000	1.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.2500	1.0000	1.73	p>.05
	C	.2500	-.5000	2.00	p<.05
	A[3]	-.2500	3.2500	1.42	p>.05
DLT II Correct Detections	A[1]	-.1111	6.1111		
	B	.0000	6.0000	1.73	p>.05
	A[2]	.0000	6.0000	0.00	p>.05
	C	.0000	6.0000	0.00	p>.05
	A[3]	.1111	4.8889	1.00	p>.05

False Alarms	A[1]	.1111	.8889		
	B	.0000	0.0000	1.00	p>.05
	A[2]	-.1429	1.1429	0.00	p>.05
	C	.1111	-.1111	2.00	p<.05
	A[3]	.0000	0.0000	0.00	p>.05
Intrusions	A[1]	.0000	1.0000		
	B	.4444	-.4444	1.00	p>.05
	A[2]	.0000	1.0000	2.00	p<.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.2500	.7500	1.42	p>.05
Recognition Memory Subject Associate	A[1]	.1429	-.1429		
	B	.0000	1.0000	1.00	p>.05
	A[2]	.1250	-.2500	0.00	p>.05
	C	.1429	-.2857	1.72	p>.05
	A[3]	.2000	.2000	1.00	p>.05
Rhyme	A[1]	.1429	-.1429		
	B	.0000	0.0000	1.72	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	-.1111	1.1111	0.00	p>.05
Category	A[1]	.1429	-.4286		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	1.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Target	A[1]	-.3333	3.6667		
	B	.0000	3.0000	2.00	p<.05
	A[2]	-.1667	3.3333	1.42	p>.05
	C	-.1250	3.2500	1.72	p>.05
	A[3]	-.1667	2.6667	1.72	p>.05

Subject 5

CPT I Correct Detections	A[1]	.0000	12.0000		
	B	-.5000	15.0000	.58	p>.05
	A[2]	-.1000	17.0000	2.00	p<.05
	C	-.1667	11.6667	2.00	p<.05
	A[3]	-.1429	12.2857	1.42	p>.05
False Alarms	A[1]	.3333	.3333		
	B	.1667	.5000	1.00	p>.05
	A[2]	-.3333	4.6667	1.00	p>.05
	C	.1250	-.2500	.58	p>.05
	A[3]	-.3333	5.3333	0.00	p>.05
CPT II Correct Detections	A[1]	.2000	1.4000		
	B	-.4000	4.0000	1.00	p>.05
	A[2]	.0000	1.0000	2.24	p<.05
	C	.0000	2.0000	0.00	p>.05
	A[3]	.0000	1.0000	0.00	p>.05
False Alarms	A[1]	.2000	-.2000		
	B	.0000	1.0000	1.42	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	-.1111	1.1111	0.00	p>.05
	A[3]	.1667	-.1667	2.00	p<.05
DLT I Correct Detections	A[1]	.0000	3.0000		
	B	-.3750	4.3750	0.00	p>.05
	A[2]	-.2500	3.2500	2.00	p<.05
	C	-.1667	2.6667	2.00	p<.05
	A[3]	.0000	1.0000	0.00	p>.05
False Alarms	A[1]	.0000	0.0000		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	-.1250	1.1250	0.00	p>.05
Intrusions	A[1]	-.3333	3.3333		
	B	.0000	0.0000	0.00	p>.05
	A[2]	-.3750	3.3750	1.42	p>.05
	C	.0000	1.0000	1.42	p>.05
	A[3]	.0000	1.0000	0.00	p>.05
DLT II Correct Detections	A[1]	-.2000	5.0000		
	B	-.2000	3.0000	0.00	p>.05
	A[2]	-.1667	3.1667	2.00	p<.05
	C	-.2500	2.7500	1.73	p>.05
	A[3]	.0000	2.0000	1.43	p>.05

False Alarms	A[1]	.1250	-.2500		
	B	.0000	0.0000	0.00	p>.05
	A[2]	.0000	0.0000	0.00	p>.05
	C	.0000	0.0000	0.00	p>.05
	A[3]	.0000	0.0000	0.00	p>.05
Intrusions	A[1]	.2500	.5000		
	B	.0000	2.0000	1.73	p>.05
	A[2]	.1429	1.7143	1.42	p>.05
	C	.1111	-.1111	2.23	p<.05
	A[3]	.0000	0.0000	1.00	p>.05
Recognition Memory Subject Associate	A[1]	.0000	2.0000		
	B	.0000	1.0000	0.00	p>.05
	A[2]	-.1667	2.1667	0.00	p>.05
	C	.1111	.8889	2.00	p<.05
	A[3]	.0000	1.0000	1.00	p>.05
Rhyme	A[1]	.1250	-.1250		
	B	-.1429	1.2857	0.00	p>.05
	A[2]	-.1667	2.1667	2.00	p<.05
	C	-.1250	1.2500	1.73	p>.05
	A[3]	-.1111	1.1111	2.23	p<.05
Category	A[1]	.0000	1.0000		
	B	.1429	-.1429	0.00	p>.05
	A[2]	.1250	-.2500	2.00	p<.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	-.2500	2.5000	1.00	p>.05
Target	A[1]	.0000	1.0000		
	B	.0000	.0000	0.00	p>.05
	A[2]	.2000	-.2000	0.00	p>.05
	C	.0000	1.0000	0.00	p>.05
	A[3]	.2500	-.5000	0.00	p>.05

Percent Change for Subjects between Adjacent
O Slopes by Experimental Task

Variable	Subject	Treatment Phase A[1]-B	B-A[2]	A[2]-C	C-A[3]
Continuous Performance Task I					
False Alarms	3		+466	-47.1	
Continuous Performance Task II					
Correct	4		+ 73.4		
Dectections	5			+100	- 38.9
False	2			- 90.7	+233
Alarms	5		+ 25		
Dichotic Listening Task I					
Correct	1			- 5.7	- 4.0
Dectections	3				- 16.4
	4	+ 13.2	- 8.4	+ 5.5	- 1.8
False	1	- 25			
Alarms	2	- 66.6	+233	- 80	+150
	3	- 71.5			+100
	5	+200		-200	
Intrusions	1	- 88.8			
	4	- 69.3			
	5				+ 42.8
Dichotic Listening Task II					
Correct	1			- 1.8	
Dectections	3			+ 65.6	
	4		- 1.8	+ 9.0	
False	1	- 77.0			+100
Alarms	2	- 64.3	- 40.0	0.0	
	3	- 25.0	- 66.6	0.0	
	5		+100.0	0.0	0.0
Intrusions	1	- 21.2			
	4				+ 81.8