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A Study of the Effectiveness of a Commercially Available Feedback Training Program in Increasing the Classroom Attending Skills of Students with Attention Deficit Disorder

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A STUDY OF THE EFFECTIVENESS OF A COMMERCIALLY AVAILABLE FEEDBACK TRAINING PROGRAM IN INCREASING THE CLASSROOM ATTENDING SKILLS OF STUDENTS WITH ATTENTION DEFICIT DISORDER

by

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The incidence of attention deficit disorder among elementary aged children has increased dramatically along with reliance on psychostimulant medication. Many parents and professionals seek alternative or supplemental treatments. Neurofeedback training is an alternative intervention that has been researched over the past twenty years with many positive results. The advent of commercially available systems makes neurofeedback training a more realistic and cost-effective option. Such systems must be shown to be effective and practical within a school setting.

This multiple baseline single system experimental study of three male subjects with ADD/HD confirmed that the Play Attention feedback training program by Unique Logic, Inc. can be implemented in a school setting. All three subjects improved in their ability to attend to the training tasks. Two of the three subjects also improved in measurements of time on task in the classroom and in scores on the Conners' Teacher Rating Scale(short)-Revised.

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CHAPTER I

INTRODUCTION

The Need for Alternative Treatment Strategies for Attention Deficit Disorder

The incidence of school-age children diagnosed with attention deficit disorder with or without hyperactivity (ADHD or ADD) is reported to be anywhere from 3% to 12% of all school-age children (American Psychiatric Association, 1994; Lubar, 1995; Thompson, 1998). As defined in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, (1994, p. 78) children with attention deficit disorder manifest symptoms of inattention and/or hyperactivity "before age seven years...in two or more settings...[with] clear evidence of clinically significant impairment in social, academic, or occupational functioning." Adolescents exhibiting symptoms of ADHD before age seven are found to have higher levels of grade retention, suspension and expulsion. Approximately one third of children diagnosed with ADD or ADHD receive special education services. Attention deficit disorder has a significant impact on educational resources and on educational outcomes for students (Chesapeake Institute, 1992).

Of children diagnosed with attention deficit disorder, 60% to 90% are treated with psychostimulant medication, especially Ritalin, for long periods of time. Controversies persist regarding stimulant medications despite their widespread usage.

research, while the long-term effects remain unknown. There are known adverse sideeffects, while no effects on learning and complex thinking skills have been concretely demonstrated (Chesapeake Institute, 1992). Many authors recommend a bimodal treatment approach of psychostimulant medication along with one or more of several training aims to increase a calm, alert, relaxed and focused mental state during cognitive tasks (Thompson & Thompson, 1998).

Neurofeedback training for children with ADD has been studied for the past 20 years, with many positive results (Chesapeake Institute, 1992; Lubar, 1991; Lubar & Lubar, 1984; Lubar, Swartwood, Swartwood, & O'Donnell, 1995).

In neurofeedback training, the subject learns to increase use of brainwaves that are active in focused cognitive activity and to decrease brainwave activity that is indicative of inattention or distractedness (Pope, 1996). However, when examining non-pharmacological interventions for ADD, the Research Triangle Institute's report (Fiore, Becker, & Nero, 1992, p. 49) stated, "...some preliminary results indicated that these procedures had broad positive effects. Most results, however, were based on extended treatments in clinical or laboratory settings...these treatments have not been adequately tested in school settings." Rossiter (2000) suggests that neurofeedback training must be made more readily available and less costly if it is to be considered a viable treatment alternative on a significant scale.

Need for Research on the Efficacy and Practicality of Commercially Available Computerized Feedback Training Systems for ADD

Blanton and Johnson (1991) reported successful clinical implementation of computer assisted biofeedback training of three children and suggested that with the availability of computers, such a program might be feasible in a school setting. Neurofeedback training in the school setting may be more feasible since the advent of commercially available computer video game software that utilizes brainwave feedback to require the participant to maintain adequate focus to succeed (Play Attention, 1999; Pope, 1996).

Neurofeedback is a time-intensive training protocol, which has taken place primarily in the clinical setting (Fiore et al., 1992). The advent of commercially available computer training systems makes neurofeedback training more readily available and less costly. The efficacy of these systems in training students to increase attending skills, with carry-over into the classroom, must be evaluated. Also, it must be demonstrated that training using these systems can be practically carried out in a school setting (Boyd & Campbell, 2000). To obtain such results, a study must be carried out with students in their natural school setting.

Therefore, this study attempted to determine the treatment effect of the Play Attention feedback training system for three males subjects, age eleven, with a medical diagnosis of attention deficit disorder. The study took place in a rural school system where students did not have easy access to treatment alternatives or supplements to psychostimulants outside of the school setting. A series of three N=1, single case experiments with an ABA design was done.

CHAPTER II

LITERATURE REVIEW

Attention Deficit Disorder and Reading Performance

Lam and Beale (1991) measured close to 200 students using a Continuous Performance Test of sustained attention, a Delay Task to test impulsivity, the Progressive Achievement Test in reading, and the Conners' Teacher Rating Scale. They found that inattention rather than hyperactivity caused decreased achievement in reading. They hypothesized that the decreased reading ability led to hyperactive behavior in the classroom. Lam and Beale also found that the Conner's Teacher Rating Scale, a measure of behavioral inattention, correlated with academic achievement. They offered the following for consideration in future research:

> ...improvement in sustained attention has the propensity to generalize to academic performance. Training of sustained attention could be done on tasks that measure sustained attention, such as the CPT [Continuous Performance Test]. If such training proves effective and could easily be automated, then it could be a very efficient form of remediation. However, more research is needed in this area before its efficacy can be determined (p. 46).

Attention Deficit Disorder and Neurofeedback Training

The three primary features of ADD/HD are inattention, impulsivity, and hyperactivity (Kaiser & Othmer, 1997; Lubar, Swartwood, & O'Donnell, 1995). It has been demonstrated that attention deficit disorder has a neurological, as well as a metabolic, basis. On EEG studies, children with attention deficit disorder exhibit

excessive slow or theta brainwave activity (4-8 Hz) in relation to faster beta brainwave activity (12-20 Hz) (Alhambra & Alhambra, 1995; Jansen, Graap, Stephanson, Marshall & Fitzsimmons, 1995; Lubar et al., 1992). A specific EEG profile that distinctly differentiates ADHD from non-ADHD boys between the ages of eight and twelve during transition between easy cognitive tasks has also been reported (Cox, Kovatchev, Morris, Phillips, Hill, & Merkel, 1998).

In neurofeedback training, trainees are given moment-by-moment auditory and/or visual feedback regarding brainwave activity. They learn "to move brain activity in the desired direction (A Chance to Grow, 2000)." In this way they increase brain activity needed to focus on a cognitive task (Beta) and decrease brain activity indicative of inattention or daydreaming (Theta) (Alhambra, 1995; Lubar et al., 1992). The individual can learn to effect cortical activation and arousal (Othmer, Othmer, & Marks, 1991).

Research on the use of neurofeedback training with individuals with ADD/HD began in the 1970's when Lubar and Shouse (1976) reported a case study of an eleven-year-old hyperactive child who was able to reduce undirected motor activity in the classroom following intensive neurofeedback training. Since then, many clinic-based studies have been reported with positive results (Kaiser & Othmer, 1997; Linden, Habib, & Radojevic, 1996; Lubar & Lubar, 1984; Lubar, Swartwood, Swartwood, & O'Donnell, 1995; Othmer, Othmer, & Marks, 1991; Rossiter & ; LaVaque, 1995; Siniatkin, Kropp, & Gerber, 2000; Tansey, 1991; Tansey, 1994).

Many of these studies measured improvement with the Test of Variables of

Attention (T.O.V.A.), a computerized continuous performance test (Kaiser & Othmer, 1997; Lubar, Swartwood, Swartwood, & O'Donnell, 1995; Rossiter & La Vaque, 1995). The T.O.V.A. measures attention, impulsivity, response time and response variability. Response variability is the most significant correlate, reflecting inconsistency and unpredictability of performance, which is typical of children with ADD (A Chance to Grow, 2000). Other studies examined scores on the Wechsler Scale (WISC-R) and/or Wide Range Achievement Teest-3 (WRAT-3) before and following neurofeedback training (Linden, Habib, & Radojevic, 1996; Othmer, Othmer, & Marks, 1991; Tansey, 1991). Few studies looked at behavior and performance outside the clinic setting following training (Rossiter & LaVaque, 1995). All of the studies correlated changes in the subjects' brainwave activity, as indicated by electroencephalogram (EEG), with psychometric test score improvements, demonstrating that the subjects who were able to successfully learn to control their brainwave activity were the same subjects who improved on other dependent measures (Kaiser & Othmer, 1997; Lubar et al., 1995; Rossiter & LaVaque, 1995).

Kaiser and Othmer (1997) carried out a study with a large sample of 408 children six to sixteen years old and 122 adults seventeen to sixty-seven years old. They reported significant improvements in T.O.V.A. scores, especially for inattention and impulsivity, but also for response time and response variability, for 75% of the subjects following twenty forty-five minute neurofeedback training sessions.

Rossiter and LaVaque (1995) also reported improvements in both T.O.V.A. scores and parent ratings on the Behavior Assessment System for Children (BASC) for

23- 8 to 21 year old subjects with attention deficit disorder following 20 neurofeedback training sessions over a 4 to 7 week period. This study had a control group of twenty-three matched subjects on psychostimulant medications that made equivalent gains in the T.O.V.A. and BASC. There was no non-treatment control group (Rossiter & LaVaque, 1995). Alhambra and Alhambra (1995) evaluated the effects of 30 sessions of neurofeedback training on 32 males and 11 females, ages seven to seventeen, with a diagnosis of ADD/HD. The researchers examined responses to parent questionnaires, T.O.V.A. scores before and after 20 training sessions, and EEG changes after 30 sessions. They found "a good correlation of observed clinical improvement to T.O.V.A. score improvement...and changes in QEEG parameters..." These two studies confirmed the effectiveness of a neurofeedback protocol set up to decrease the theta/beta ratio in subjects. They also demonstrated significant improvements following only 20 training sessions, as opposed to the 40 to 60 previously recommended. Permanence of changes following only 20 or 30 sessions still needs to be studied (Rossiter & LaVaque, 1995).

Linden, Habib, and Radojevic (1996) did a study with a non-training control group. This small study of nine subjects in each group demonstrated that following forty sessions of neurofeedback training, the training group improved significantly more in IQ scores and parent ratings of inattentive behaviors than the non-training group. This study surpassed previous ones in using a carefully matched, non-training control group. However, carryover of improved attending skills into the classroom was not addressed.

In the 1990's, some researchers began to look at the effect of ability to control brainwave activity on behaviors and performance in the classroom (A Chance to Grow, 2000a, 2000b; Blanton & Johnson, 1991; Boyd & Campbell, 2000; Thompson, 1998). A Chance to Grow, Inc. was formed to provide neurofeedback training in Minnesota schools and ended up opening a charter public school, New Visions, for first through eighth graders, in 1992. New Visions claims to be the first public school in the nation to include neurofeedback training as part of its public school program. Each year, a few more students are added to the neurofeedback training program. Sixty-five students participated in neurofeedback training in 1996-97 and 75 participated in 1997-98. Training usually consisted of two half hour sessions per week, but varied according to individual student needs. Pre- and post-test measurement instruments were the T.O.V.A. or another similar test of attention, the Conners-Continuous Performance Test. For both school years, approximately 75% of subjects improved one standard deviation or more in one or more variability scale for the T.O.V.A. or Conners-CPT. In the Conners-CPT, as in the T.O.V.A., response variability is considered the most significant correlate to ADD (A Chance to Grow, 2000a, 2000b). There was no measure of classroom behavior or performance reported. The report did discuss significant concerns for school-based neurofeedback training. These included availability of sufficient staff, equipment, and space for training (A Chance to Grow, 2000a). The New Vision annual reports make no mention of control groups for comparison of results. Neither do they describe other behavioral or cognitive strategy interventions, which may have been going on in the classroom and

affected post-test scores. The 1997-98 New Visions report announced that a research project with 40 students in regular Minnesota public schools receiving neurofeedback training was planned for the 1998-99 school year (A Chance to Grow, 2000b).

Carmody (1998) reported on a study of eight elementary school children who underwent 37-55 neurofeedback training sessions. This study had a control group of eight same-aged students who were on a waiting list for training. Each of the groups had four subjects diagnosed with ADD/HD and four who had no diagnosis. The training group demonstrated improved performance on the T.O.V.A. Some of the training group had positive changes in ratings for impulsivity and hyperactivity on the Conners' Teacher Rating Scale. None of the control group subjects had changes in the Conners' Rating Scale. Carmody recommended that neurofeedback be included in "a multimodal treatment program in a school setting for children with ADHD."

Boyd and Campbell (2000) also reported on a neurofeedback training program for students with ADD/HD that was carried out within the school day, in a public school setting. The subject sample consisted of only 6 middle school students who underwent 20 sessions of EEG biofeedback training. Although 5 of 6 subjects completed the training and demonstrated improved scores on the T.O.V.A., the authors pointed out that the small sample severely limits generalizability of these results. They were more concerned with the demonstration that neurofeedback training can be carried out in a public school setting. Boyd and Campbell list the following considerations for setting up a similar training program: equipment must be readily available and in good working order; scheduling within the school day is challenging;

motivation can be a limiting factor for students; personnel to carry out the relatively long training protocol must be available.

Blanton and Johnson (1991) carried out a clinic-based study of 2 sixth and 1 fourth grade students with ADHD. They did pre-and post-test observations of one of the subjects in the classroom and found that on-task behavior increased along with ability to control brainwave activity. The study was not an experimental design that demonstrated conclusively that the neurofeedback training produced the increase in on-task behavior.

Thompson and Thompson (1998) studied the effectiveness of neurofeedback training along with coaching in metacognitive strategies. They report significantly improved T.O.V.A. scores for inattention and impulsivity. They also report positive changes in school performance, such as improvement in one student's reading grade level, and a change in placement out of a special education classroom for another student. These authors did not use any formal measure of classroom behavior or performance.

Siniatckin (2000)studied nine healthy children during five sessions of neurofeedback training to evaluate the effect of reversing the contingency conditions after two sessions. He observed that, after an initial deterioration, the subjects were able to regain their ability for self-regulation following reversal of the feedback conditions. The subjects verbalized that they did this by reflecting on the feedback responses, but without altering the strategies they had developed during the initial two training sessions. Siniatckin concluded that positive encouragement, rewards, and

demonstration of positive results were more important to successful feedback training of self-regulation than discussing with the subject his or her strategies or experiences during the training.

Rossiter (2000) examined how neurofeedback training can be made less expensive and more accessible by exploring the implementation of patient-directed neurofeedback. He provided treatment options in which clients rented a computer and feedback equipment to carry out training with initial training and periodic supervision from the therapist. Prices of his treatment options were $1250, $1550, and $1850 as opposed to approximately $4000 for a traditional, in-office, therapist-directed neurofeedback training program. Rossiter's (2000) pilot program had only six subjects who underwent patient- (or parent-) directed neurofeedback training for thirty to fifty sessions and demonstrated improvements in fifteen out of twenty-four T.O.V.A. scores, with none worsening and the most significant improvement in the areas of greatest pre-training deficit. Rossiter (2000, p. 13) concluded, "If neurofeedback is to become the accepted treatment of choice for AD/HD, clinicians must not only demonstrate that it is effective, but must also find more cost effective methods of delivering their services. An effective treatment that is prohibitively expensive is of little value to most patients."

In general, research has demonstrated that neurofeedback training can have a positive and global effect on ability to attend to cognitive tasks for students with attention deficit disorder. The need for training protocols, which are not cost prohibitive and are readily available to students in need has been shown There has been

a lack of study of the effect of an increased ability to control brainwave activity for attending during training on behavior and performance within the classroom setting. Most studies have been clinic-based and rely on psychometric test measures. Those studies that have taken place in a school setting lacked adequate control to clearly demonstrate a treatment effect and did not study the carry-over effect on classroom behavior and performance.

Play Attention: A Commercially Available Feedback Training System

Play Attention is a commercially available, computer-assisted biofeedback system produced by Unique Logic & Technology, Inc. It is recommended for any individual age seven years and up who wants to improve attending skills. The user wears a helmet with brainwave sensors in it, which allow control of characters on the computer monitor through attention alone. Auditory and visual feedback are provided in five different training games. For example, one game requires attention in order to build a tower of blocks. The graphics are very simple. Threshold levels can be adjusted to maintain optimum motivation. Twice weekly, 30 to 40 minute training sessions are recommended, with long-term retention of skills to be expected after about 40 sessions (www.playattention.com).

After each training session, data is produced that includes time spent playing each game and percentage of time on task. The games are actually training the user to decrease theta brainwave activity and increase the relative strength of beta brainwave activity. However, the user interface puts this in terms more understandable to a teacher or therapist who is not specifically trained in neurofeedback. Training of the coach is done via the Play Attention manual and a training video and should take about

three hours. This system clearly intends to make feedback technology available through a wider variety of professionals than just those certified in biofeedback (Play Attention, 1999).

The Play Attention manual and training video recommend coaching to assist the student in reflecting on his/her success or failure and to develop an awareness of what it feels like when optimal attending is occurring. Development of vocabulary, which can be carried over into the classroom, is recommended. The manual provides pre- and post-test measures in the form of parent and teacher behavior rating scales, as well as a rating scale for each individual session. Changes in percentage of time on task and number of correct responses during training are other measures of improvement suggested in the program (Play Attention, 1999).

There are a few important differences between the feedback training provided by the Play Attention system and neurofeedback training protocols described in previously published studies. First, in all studies reviewed, trainers have been individuals, usually psychologists, who are certified or training to be certified in neurofeedback (Blanton & Johnson, 1991; Kaiser & Othmer, 1997; Linden et al., 1996; Lubar & Lubar, 1984; Lubar et al., 1995; Othmer & Othmer, 1989; Rossiter & LaVaque, 1995). Training with Play Attention is meant to be carried out by any person who reviews the manual, views the training video, and is able to use the system him or herself (Play Attention, 1999). The Play Attention web site describes coaches as, "special education teachers, regular classroom teachers, teacher assistants, guidance counselors, school psychologists, parent volunteers, etc. (www.playattention.com)." Therefore, the training protocol is not as individualized as in most previous studies where electrode placement and brainwave frequency were individually set (Blanton & Johnson, 1991; Kaiser & Othmer, 1997; Linden et al., 1996; Lubar & Lubar 1984;

Lubar et al., 1995; Othmer & Othmer, 1989; Rossiter & LaVaque, 1995). There is no pre-training diagnostic EEG mapping, which is strongly recommended by several authors in order both to determine the appropriate electrode placement and contingency program and to evaluate a change in ability to control brainwave activity (Alhambra & Alhambra, 1995; Barabasz & Barabasz, 2000; Sterman, 2000).

Individual adjustments that can be made with Play Attention are adjustments to the helmet straps to get the helmet, and therefore the sensors, fitting right, and changes to the threshold level to adjust level of difficulty and maintain optimum motivation. A baseline setting is established for each student at the beginning of training to set the threshold. However, this can be adjusted manually by the coach based on judgment that the games are either too difficult and therefore frustrating, or too easy and therefore boring (Play Attention, 1999). Another important difference in the Play Attention system if training occurs during the school day might be motivation for a service, which has not been carefully sought out. Most studies have been carried out in private clinic settings where subjects had to at least get transportation to, if not provide payment for, the two to several times a week training sessions (Rossiter, 2000).

Research to Date on the Effectiveness of Play Attention

Upon request, Unique Logic & Technology provided copies of unpublished summaries of two research studies of the effectiveness of the Play Attention system. Both summaries had the Unique Logic & Technology logo printed on them. One study took place at the Isaac Dickson Elementary School in North Carolina (Unique Logic & Technology, Play Attention Summative Evaluation). Seven subjects trained on the Play Attention system twice weekly for a total training time of at least 15 hours. Pre-

and post-training measures were the Conners' Continuous Performance Test (CPT), the WRAT (tan and blue versions), and the Conners' Behavioral Rating Scales (parent and teacher). A parental questionnaire was also given post-training.

The summary report treated the group results on the CPT as a whole. For the group, there was a decline in responses categorized as markedly atypical from 46 to 14 occurrences. There was also an increase in responses categorized as average from 21 to 56. A sample of pre- and post-training scores on the CPT was made available for 1 male subject who had a diagnosis of attention deficit disorder and was on Ritalin. In four of the test components this subject improved from markedly atypical to good performance. In three test components he improved from markedly atypical to average performance. In two areas he improved from markedly atypical to mildly atypical and in the three remaining areas he did not change from the average range. This subject certainly demonstrated improved performance on the CPT, but the report provides no information to acknowledge or refute other possible explanations for this improvement over a four-month training period (Unique Logic & Technology, (1996). There was no evidence of an experimental design that clearly demonstrated a treatment effect. The improvements in CPT scores for the group as a whole are difficult to interpret because no other individual scores were provided. It is impossible to tell how the score ratings were distributed across subjects.

Although there was some improvement in the post-training WRAT scores, it was not statistically significant. No data was provided for the Conners' Teacher/Parent Rating Scales. The report did state that for two of the subjects, the Teacher Rating Scale indicated a significant decrease in hyperactivity. The parent questionnaires indicated that virtually all parents perceived a positive result in their child after training (Unique Logic & Technology, Play Attention Summative Evaluation).

The second summary report was of 2 case studies carried out by Jerry Coffey, Ph.D., of Sylva Clinical Associates, P.A., in psychology, psychiatry, and education. This study demonstrated significant improvements in both subjects on the Intermediate Visual and Auditory Continuous Performance Test (I.V.A.) pre- and post-training with Play Attention. Scores for the Response Control Quotient and the Attention Quotient were provided. These are two out of six primary scales comprising the I.V.A. No other measures were reported in this report of the case studies (Unique Logic & Technology, Case Studies). Again, this study design does not adequately control for extraneous factors in order to demonstrate a clear treatment effect.

Single Case Experimental Research Design

Rationale for Use of Single Case Experimental Research Design in a Public School Setting

The single system or case study experimental design is accepted research methodology in the area of learning disabilities. Single case experimental design is used to study instructional practices, techniques and programs for academics and social skills, as well as interventions to improve cognitive processes such as attention and problem-solving (Lloyd, Tankersley, & Talbott, 1994). Ottenbacher (1986) strongly recommends the single case or system experimental design to occupational therapists as a practical way to bridge the gap between academic research and practice. Ottenbacher (1986, p. 56) quoted Kazdin who stated that single system design " represents a scientific methodology that can evaluate alternative treatments and rule out the impact of extraneous factors as rival explanations of the results. More importantly, the methodology provides a flexible approach that is consistent with many

of the priorities, professional responsibilities and practical exigencies of clinical practice."

Ottenbacher (1986) explains that large, group comparison studies are widely accepted as the most valid for establishing a causal relationship while controlling the effects of external factors. However, he asserts that the results of such studies are better used to support theory development rather than treatment planning decisions for a single individual from a very heterogeneous population. Students in special education are from a very heterogeneous population (Lloyd, Tankersley, & Talbott, 1994).

There are several reasons that the large, group comparison study design is not applicable to research in the applied, special education setting. Results of such a study are based upon a group statistical average and cannot be applied to most individuals with very unique characteristics typical of the special education population (Lloyd, Tankersley, & Talbott, 1994). It is impractical to attempt to achieve external and internal validity in the classroom setting. Usually, there is not sufficient number of subjects to achieve statistical significance. It is very difficult to get a homogenous, random sample required for internal validity. It is impossible to control external variables in the natural setting. The requirement for a control group may present an ethical concern if treatment must be withheld or a less promising treatment provided to one group of students (Ottenbacher, 1986). Finally, in a control group study, the researcher looks for statistically significant results, while what is important to a service provider is a clinically significant result. The practitioner looks for information about individual client characteristics associated with success or failure of a specific treatment, rather than statistical generalities (Lloyd et al., 1994; Ottenbacher, 1986).

In single system studies, there is no need for a large subject group. There is no ethical conflict with a non-treatment control group, since the individual subject serves

subject serves as its own control. Randomization is not an issue. The design is meant to be flexible and appropriate for the individual subject and setting. The single case study experimental design is less demanding of time, money and personnel resources than a group comparison study. The questions studied, measurements used and variables identified are usually more relevant to the subject and practitioner because they occur in the natural setting. Finally, there is no disruption in the routine of the subject as the study occurs within the natural setting. These characteristics make this research methodology ideal for the special education practitioner who wants to study empirically the effectiveness of specific interventions or measure change in individual students (Lloyd et al., 1994; Ottenbacher, 1986).

The single case study research methodology includes the ability to look at process as well as outcome. Variability of response, rather than negating results, can provide useful information when analyzed. A group of single case study experiments may provide the initial information needed to justify and design a large, group comparison study (Ottenbacher, 1986).

Single Case Experimental Methodology

The major distinguishing components of a single system design are the sequential application and withdrawal or variation of an intervention, and frequent and repeated outcome measures (Ottenbacher, 1986).

Internal validity is achieved by the multiple applications and withdrawals or variations of the intervention, as well as by repeated measures. External validity is attempted through the absence of a sample bias, and through direct observation of any extraneous factors or threats (Ottenbacher. 1986). The significance of results in single case studies is dependent upon multiple replications in different settings, with different

subjects and by different researchers. (Lloyd, Tankersley, & Talbott, 1994; Ottenbacher, 1986).

There are several basic experimental designs that are used in single case studies. The most basic is the ABA design, in which a baseline measure is taken (A) followed by an intervention, during which the measure is taken again (B). To attempt to achieve validity, the intervention is withdrawn and the measure is taken yet again. If a change from the baseline measure is observed along with the intervention, and a return to the baseline measure is observed with withdrawal of the intervention, a clinical change related to the intervention for this specific subject has been demonstrated. Extending this design to an ABAB design increases the validity of the results. Variations of this design include ABACABAC, in which C is a variation of the intervention or an alternate intervention. This design variation is used to compare the effectiveness of two interventions or variations of an intervention (Lloyd, Tankersley, & Talbott, 1994).

It is not always possible to withdraw the effects of an intervention. Or a practitioner may not ethically want to stop an intervention that is producing a positive effect. In these cases, the multiple baseline design for a single case study introduces an intervention over staggered points in time, across separate baselines. The baseline that has not yet received intervention serves as the control for the subject that has already received intervention. The hoped for outcome is that each of the baselines will remain stable until the point when the intervention is introduced. The dependent variable in this design can be one target behavior across multiple subjects, multiple target behaviors across one subject, or one behavior in one subject across multiple settings. (Lloyd, Tankersley, & Talbott, 1994).

A variation of the multiple baseline design is multiple probes. Intermittent

probes are used to measure an intervention effect at different times during the intervention as opposed to continuous measurement. At least three probes are needed prior to intervention. This design variation eliminates the need for extensive recording of continuous baseline data (Ottenbacher, 1986).

To summarize the general procedures for a single case study experiment, first define a discrete, observable target behavior. Establish reliable measures of the behavior. Record data through the discrete phases of the experimental design chosen. Next, analyze the data visually and, if appropriate, statistically. Finally, interpret the data, looking for treatment effect in the individual, causal relationships, and/or individual characteristics related to changes in performance over time (Ottenbacher, 1986).

There are disadvantages to single system experimental design that must be considered. Frequent and repeated measures have a high probability of testing reactivity, usually resulting in at least some decrease in internal validity. The subject may feel manipulated by a change in the intervention or not want to have a successful intervention withdrawn. One must be very conservative in drawing any causal conclusions from a single case study experiment. Such conclusions are very dependent upon multiple replications of the study. Although it may allow for greater generalizability, the multiple baseline design requires the most resources of time and personnel to accomplish (Ottenbacher, 1986).

Analysis and Interpretation of Data

Visual analysis, in the form of graphs and charts, is accepted as the primary means of analyzing single system research data . There is a wide range of types of graphs and charts to fit most any type of data. Visual analysis is an accepted empirical

method to judge the presence or absence of a treatment effect by demonstrating a change in level of a behavior or a change in trend of a behavior (Busk & Marascuilo, 1992). A weak treatment effect will generally not show up on a graph. Because there is little transformation of data in graphing, the data is readily accessible for direct interpretation by the viewer (Ottenbacher, 1986).

Interpretation of visual analysis by the viewer is problematic because there are no framework or rules for interpretation. Visual inspection of graphs and charts has been shown to be subjective and inconsistent between viewers (Busk & Marascuilo, 1992). Busk and Marascuilo recommend nonparametric and randomization tests to supplement visual analysis of data in single case experimental studies where observations are less than 35 per experimental phase. They recommend time-series analyses in studies with large numbers of observations per phase.

Generalizability of Results in Single Case Study Experimental Design

For the subject and setting being studied, there is immediate applicability of results. Results can be applied outside the study only to individuals and settings with characteristics very similar to the subject of the study. Barlow & Hersen (Ottenbacher, 1986, p.55) outlined three phases of establishing generalizability of single case experimental studies:

1. accumulation of replications of treatment effect on one well-defined dependent measure within one clinical setting;

2. systematic replication of program or treatment effect across subjects, settings, therapists, or a combination of these;

3. clinical replication of a treatment package consisting of two or more procedures.

Measuring Attention in the Classroom

Raeissi and Baer (1984) surveyed preschool teachers regarding their definition of attention and found the most consistent theme to be "being on task." Several studies of psychostimulant dosages for students with attention deficit disorder, measured "time-on-task" (Fischer & Newby, 1998; Hale, Hoeppner, DeWitt, Coury, Ritacco, & Trommer, 1998).

Platzman et al.(1992) did a review of studies to determine what measurements best distinguish between medicated and non-medicated students with attention deficit disorder and hyperactivity. They found that 79% of the studies reviewed purported to measure attention, but only a very small number of them used direct observation. Platzman et al. hypothesized the reason to be the extra expense, time and expertise required for direct observation. Of the studies measuring attention the measurement take place in the classroom setting in only 33%. Platzman et al. found that more significant differences were found between the two groups of students when measurement took place in the natural, classroom setting, rather than in the lab. Based on their review of the results of these studies, they concluded that classroom observation and teacher reports, such as the Conners' Teacher Rating Scale, were valid measurements in distinguishing students with attention deficit/hyperactivity disorder who were on medication. Platzman et al. recommended that more research in the area of attention deficit disorder take place in the classroom setting and that the behavior characteristics of attention deficit disorder, i.e. hyperactivity, negative vocalizations, and being off-task, should be measured. They further suggested that these behaviors should be operationalized to facilitate replication.

Fischer and Newby (1998) demonstrated effective use of a Restricted Academic Task (RAT) in a clinical setting to evaluate students' responses to stimulant

medication. A Restricted Academic Task is a simulated task, accomplished without adult supervision. They used ability-appropriate math problems. Individual students worked for ten minutes while being observed through a one-way mirror. At 30-second intervals (signaled by a tape player), behavior was coded as follows: off-task, vocalizing, playing with objects, out of seat. Each student was scored for percent of each behavior occurrence related to total possible occurrences, percent of all behaviors recorded in relation to total possible occurrences, and percent of correct math problems out of those attempted.

Fischer and Newby (1998) found that the RAT distinguished between students with attention deficit/hyperactivity disorder, students without attention deficit/hyperactivity disorder, and students without attention deficit/hyperactivity disorder but with behavior problems. They also found teacher ratings of hyperactivity and behavior problems to correlate significantly with the RAT. These researchers suggested that the RAT could be used in the classroom setting in single case experimental design. They also hypothesized that there would be less subject reactivity to the observation in a natural, classroom setting than in a clinic setting.

The RAT was among the techniques studied by Hale, et al. (1998) in an effort to determine effective measures in evaluating children's responses to varying medication dosages. These researchers compared the following measures: RAT; direct cognitive assessment; weekly parent and teacher behavioral questionnaires. They used a single subject methodology in which they rank ordered performance on each of the measures for each of the dosage conditions. They concluded that because of the diversity of symptoms associated with attention deficit/hyperactivity disorder, it is best to measure the occurrence of behavioral obstacles to learning rather than to directly measure cognitive deficits.

What is the best way to measure the attending, or on-task/off-task, behavior of students with attention deficit order? Moore (1983) reported on a project undertaken by the Detroit Public Schools for the National Institute of Education to research the subject of academic learning time. The first task was to develop a measure of on-task/off-task status during reading and math class. The measure developed was one of direct observation, in which the observer swept the classroom every two minutes, recording on-task/off-task status for each student in the class. On-task (recorded as +) was defined as "the student participating in the intended lesson which was related to either reading or mathematics" (Moore, p. 3, 1983). Examples given were participating in a guided lesson, responding orally, engaging in written assignment, engaging in discussion relative to a lesson, taking a test or quiz. Off-task (recorded as –) was defined as "behaviors not related to the lesson or lack of involvement on the part of students." Examples given were socializing, disruptive behavior, waiting for help, being disciplined, day dreaming, out of seat, sharpening pencils. A zero was recorded only if the observer was unable to observe the student. Training for this "sweep observation" method took two days during which observers learned the definitions, practiced with videotapes, and practiced with peer coders.

In a study of 108 students in 18 classes, Karweit, and Slaven, (1980) used an observation measure similar to the "sweep method" described by Moore (1983). Definitions of on-task, off-task, and other behavior were similar as well. Karweit and Slaven identified some issues to consider when observing on-task/off-task behavior. Including or not including momentary inattention as off-task made a significant difference in the data and results. Karweit and Slaven identified an ambiguous state, for example, when a student completed the assignment, which he called "no-task opptunity." There must be enough assigned work to fill the observation period. The

length of observation periods must be carefully considered, with a shorter time period requiring more careful selection of the time of day and activity observed. Karweit and Slaven suggested an entire instructional period be observed. They also examined the impact of which days were selected for observation and found it not to be significant.

Wilson (1987) recommended direct observation for the measurement of academic learning time, citing several advantages. The behavior being measured is objective since it is openly observed, relevant since the student is performing tasks important to the teacher, and immediate, as opposed to a test which measures learning or achievement at a later time. The difficulties presented by direct observation are that an independent observer is required, and that students' inner processes cannot be observed. Is a student daydreaming or pondering the lesson? In Wilson's report, academic learning time is the "amount of time students spend successfully performing relevant academic tasks" and has three components: time on-task, amount of instructional time, and student success rate or percent of correct responses. Wilson defined on-task behavior as "time the student spends looking at some appropriate instructional object or person." He defined off-task behavior as eyes closed or looking out the window, door, floor, or a non-participating classmate.

Wilson (1987) recommended a Momentary Sampling Procedure in which the observer rates on-task/off-task status (recorded as + or –) every ten seconds for six observations every minute. He provides a form to record up to 15 minutes worth of observations. For scoring, pluses and minuses are totaled. The total number of pluses is divided by the sum of the pluses and minuses. The result is multiplied by 100 to give percentage of time on-task.

Observing students during their most important instructional time period is suggested. The observer should be familiar with a student's typical on-task behavior

and record any atypical behavior (Wilson, 1987).

In his report, Wilson (1987) sites research regarding average on-task behavior. Regular elementary students are on task 70% of the time during seatwork and 85% of the time during teacher directed activities. Mildly handicapped special education students are on-task 60% of the time during seatwork and 90% of the time during teacher directed activities. Wilson contends that ten percent variations from these numbers can still be considered average.

Other research studies of students with attention deficit disorder have utilized direct observation. In a comparison study of the effects of massage and relaxation therapy on students with attention deficit disorder, Field, Quintino, Hernandez-Reif, and Koslovsky (1998) measured with direct observation of time on-task, self-report, and the Conners Teacher Rating Scale. In two case studies of the effectiveness of self-management strategies to improve the classroom behavior of students with attention deficit/hyperactivity disorder, Shapiro, DuPaul, and Bradley-Kug (1998) used both the Conners Teacher's Rating Scale-Revised and direct observation of on-task behavior. They defined on-task as eyes and head focused on work, teacher, or another student as appropriate to the academic assignment. In a study of the effects of seat arrangement on on-task/off-task behavior (Roy, 1998), off-task behaviors were directly observed and recorded. Off-task was defined as inappropriate talking, fidgeting with materials, not following oral directions, or not beginning the task promptly.

Videotaping for Research in the Classroom Setting

Videotaping can greatly enhance the advantages of direct observation by creating a permanent record that can be reviewed by multiple observers. This reduces reliance on spur of the moment perceptions, faulty recording, and limited memory.

Videotaping allows the observer to take ample time in observing and coding data. All of these advantages enhance the reliability of the coding of observational data (Niebuhr, Manz & Davis, 1981).

In deciding whether or not to use videotaping to record data, certain disadvantages must also be considered. Observation cannot be in secret when videotape equipment is set up. The cameraperson comes to the task with personal biases and perceptions, just as an observer does. There may be additional subject reactivity to the taping equipment, requiring that an adaptation period be included in the study design (Niebuhr et al., 1981). However, in a study comparing methods of data collection, Gardner, Clements, and Rodriquez (1982) did not find significant reactivity in students' behavior during videotaping in the classroom.

There are technical advantages and disadvantages to videotaping. It allows replaying of tape portions, closed circuit for simultaneous viewing by several observers in different locations, and conversion of images into digital signals for input into a computer for analysis. A split screen enables recording of more than one behavior. Taped data can be used at a later date for a different research goal. Technical limitations of videotaping include the time consuming nature of coding videotape, the deterioration of tape over time, and the obtrusiveness of videotape equipment in a natural setting (Niebuhr et al., 1981).

There are some basic guidelines to follow when videotaping in classrooms. It is crucial that the goals of the data collection be clearly defined before taping begins. In order to anticipate and minimize technical and logistical problems, always have a dry run before actually taping (Wilkinson & Brady, 1982).

Permissions from administration to enter the school, the teacher to enter the classroom, and the parent to videotape a child all must be obtained. Camera crew

should be extremely prompt and reliable in maintaining the schedule agreed upon with the teacher. Courtesy extends to placement of equipment so that it does not interfere with teaching and learning. The crew and equipment should be in place in advance of the taping so as to minimize disruption of the classroom and to minimize possible reactivity. In fact, there should be no on/off light on the camera, which would cue students as to when taping is occurring (Gardner, Miller, & Clements, 1980). Despite the technical and logistical requirements, videotape can be a valuable tool to improve the reliability of recording and coding behavioral data (Gardner et al., 1982; Niebuhr et al., 1981; Wilkinson & Brady, 1982).

Conners' Teacher Rating Scales

The Conners' Rating Scales-Revised, developed by Keith Conners, is made up of a teacher and a parent scale. The purpose of the scales is to obtain reports from teachers and parents that can be used along with other information in the diagnosis of behavioral problems, such as attention deficit/hyperactivity in children ages 3-17. The scales can be given together or independently. There are long and short forms. Normative, reliability and validity data are included with the scales (ERIC Clearinghouse on Assessment and Evaluation).

The Conners' Rating Scales have been used extensively in research of attention deficit/hyperactivity (Martens, 1992). There is some difficulty interpreting the research since which scales were used (long or short, parent or teacher) was often not specified (Martens,1992). In The Eleventh Mental Measurements Yearbook, Oehler-Stinnett (1992) cautions researchers against using the Conners' scales simply because they will allow comparison to previous research. She states, "There is a state of confusion (including incomplete and inaccurate citations) in the research literature,

previous review, and also the new manual, regarding which version of which scale was actually used from one research study to the next" (Oehler-Stinnett, 1992, p. 234).

In their reviews of the Conners' Scales, both Brian Martens and Judy Oehler-Stinnett agree that the standardization was done on an inadequately diversified sample (Martens,1992; Oehler-Stinnett, 1992). Martens concludes that reliability, including inter-rater reliability, and validity data supporting the Scales are extensive. Oehler-Stinnett reports significant regression to the mean on retest, requiring two pretests when measuring for treatment effects. She concludes that there is, "lack of comprehensive coverage of the scales in the manual, the retention of all versions of the scales, use of outdated norms, inappropriate interpretive advice, and a general lack of caution to readers regarding shortcomings of the scales" (Oehler-Stinnet, 1992, p. 240). She further advises that, "For the measurement of hyperactivity, inattention, and impulsivity, scales such as the ADD-H Comprehensive Teacher's Rating Scale (7), the Yale Children's Inventory, and the Attention Checklist may prove to be more useful instruments."

CHAPTER III

STUDY DESIGN

Research Question and Hypotheses

This series of three single case experimental studies attempted to answer the question: Can the Play Attention feedback training program have a positive treatment effect on classroom behavior and/or performance? To answer this question, the following hypotheses were put forth.

Hypothesis 1: The subjects will demonstrate an improved ability to attend during the training sessions by increasing the percent of time on task during the Play Attention games.

Hypothesis 2: The subjects will demonstrate improved time on task in the classroom along with improvement in percent of time on task during Play Attention training.

Hypothesis 3: The subjects will demonstrate improved behavior and/or performance in the classroom as reflected in decreased scores in the Conners' Teacher Rating Scale-Revised(Short) and improved report card grades following ten weeks of Play Attention training.

Experimental Design and Procedures

Single-case Experimental Design

In order to answer the question of the effect of Play Attention training on performance within the classroom setting, this study was carried out in a rural,

Midwestern elementary school. Single-case experimental design was ideally suited to studying treatment effect in a natural setting with individuals from the heterogeneous population of students with attention deficit disorder (Lloy, Tankersley, & Talbott, 1994). Because the effect of the Play Attention training could not be withdrawn, except by fading away over time, a multiple baseline design was planned. By staggering the timing of the Play Attention trainin g, the subjects(s) who did not yet begin training were to serve as a control for the subject(s) already training.

Subjects

Three students from the fifth grade were selected to train with Play Attention. A teacher of at risk students assisted in identifying three students with the following characteristics: medical diagnosis of attention deficit disorder with or without hyperactivity; no other educational or medical diagnosis; not in the special education program; no known prospective change in medication or other treatment or programming during the study time period; no history of excessive absences; no history of head lice (the protocol involves wearing a helmet); having parents who give written permission for the student to participate in the training and in the study (see appendix A for Permission Form); having a classroom teacher willing to allow videotaping or observation in the classroom and willing to allow the student to participate in the training twice weekly (see Appendix B for subject recruitment form).

The subjects' parents were given complete information on the nature of the Play Attention training program and the experimental procedure. Each subject's parent gave written consent for the subject's participation, according to the policies and procedures of the Human Subjects Institutional Review Board of Western Michigan University (see Appendix A for consent forms). The subjects' teachers were provided

with details regarding their responsibilities in filling out the Conners' Teacher Rating Scale and allowing the students to be observed and/or videotaped in the classroom. Prior to initiating any aspect of the study, a proposal for this study was approved by the Human Subjects Institutional Review Board of Western Michigan University.

By necessity, the subjects were assigned to a training schedule according to the days and times they were able to attend. Each subject was, again by necessity, matched with the coach who was able to meet the subject's scheduling needs. Each coach, because of personal commitments, had to complete their involvement in the study by a certain date. This then determined the order in which subjects began training.

Intervention Protocol

The protocol for Play Attention training was to be carried out as specified in the Play Attention manual and training video. Subjects received two training sessions weekly for 30-40 minutes for ten weeks for a total of 20 sessions for subjects one and three and 19 sessions for subject two. Training took place in a one-to-one situation in a small classroom during the school day or immediately after school.

Each session began with the coach stating the rules and objective for the session. The objective was to increase percentage of time-on-task as reported by the Play Attention data.

The Play Attention User's Manual (Unique Logic & Technology, 1999) lists these primary functions of the coach:

1. To scan the student's eyes and insure that the eyes do not stray from the screen characters.

2. To establish educational and behavioral objectives for the student.

3. To maintain and collect data associated with the educational and behavioral objectives for purposes of review and efficacy of the

intervention.

> 4. To assist the student in learning the associations between attention and behaviors and to assist the student in transference of the newly learned positive behaviors into different environments. (p. 2)

All three coaches attended a three hour training session consisting of the review of the written Play Attention training protocol, viewing of a Play Attention Coach's Training video, review of Unique Logic's web site for Play Attention, and instruction for filling out the anecdotal record form and subject's sign-in sheet.

Following the statement of the rules and objectives, the subject played one Play Attention game from each of five levels. Each of the five sequential games is designed to shut down automatically after five minutes of play. During the game play, the coaches monitored the subjects' eyes and provided minimal verbal reinforcement to redirect or praise the student. After four to five weeks of training, the coach was to add an extra game of Glider or Diver, during which the coach was to read to the subject from an Accelerated Reader selection at an appropriate level as specified by the subject's teacher. After the game, the coach was to ask two or three comprehension questions regarding the reading (Unique Logic & Technology, 1999).

The coach for Subject #3 carried out the training protocol as specified above, including the additional game with reading. The coaches for Subjects #1 and #2 incorrectly added the reading during the play of the third, fourth, or fifth game during initial play. Choice of which game included reading changed from session to session. Although the coaches recorded the session numbers during which reading took place, they did not record the specific games during which the reading occurred.

At the end of each session, the coach and subject reviewed the data generated by the software for each game played. The coach guided the subject in reflecting on the session and how positive, attending behaviors can be carried over into the classroom. To end the session, the coach gave the subject a token reinforcement such as a food item.

Measures

Time-on-task in the Classroom

Data for time on-task was collected during the baseline phase and during intermittent probes for each subject. Time on task was measured using Wilson's method (1987) of Momentary Sampling (see Appendix C for observation record form). The subjects were videotaped for ten-minute sessions during a regularly scheduled time for independent seatwork (See Appendix D for Permission to Videotape Form). Independent tape reviewers coded + for "on-task" and – for "off-task" every ten seconds for ten minutes. On-task behavior was initially defined as "time the student spends looking at some appropriate instructional object or person." Off-task behavior was initially defined as eyes closed or looking out the window, door, floor, or a non-participating classmate (Wilson, 1987). These definitions were eventually refined to improve inter rater reliability, as will be described. For each session, percentage of time on-task will be calculated as:

$$\frac{\text{+'s}}{\text{+'s (+) −'s}} \times 100$$

(Wilson, 1987).

To reduce the subjects' potential reactivity to having a video camera in the classroom, the first two videotape sessions were not used for data. Subject #1 was videotaped seven times over three to four weeks prior to beginning training. Subject #2 was videotaped five times over two to three weeks. Subject #3 will be videotaped three times over one to two weeks.

Independent observers reviewed the videotapes to record time-on-task data for each session. These observers were aware of the nature of the study and the training protocol. However, they did not know what the order or phase of the study was for each videotape. The observers were trained as follows: 1) learned definition of on-task and off-task behavior, 2) became familiar with the recording form and use of +'s and –'s, 3) practiced recording data for one sample videotape along with discussion, 4) independently recorded data for a second videotape followed by a calculation of non-occurance inter rater reliability. The initial two videotapes per subject that were not used as data were used for this training.

After five data videotapes were coded, inter rater reliability for five of the tapes was found to be unacceptable (less than 75%). The definitions for on-task and off-task behavior were then refined as follows. To code a "+" for on-task behavior, the coder must answer yes to the following questions. Are the subject's eyes are on the instructional material, teacher, or another student who is asking a question or making a comment pertinent to the instructional material? If eyes are not directly visible, is the subject's head directed toward the instructional material, the teacher, or another student who is asking a question or making a comment pertinent to the instructional material? If the answer to these questions is no, the coders were to code a "-" (for off-task behavior). If the coder was in doubt, she was to code a "-". If the subject was

obstructed from view, the code was "0". After clarifying the code definitions, the five videotapes were recoded with acceptable inter rater reliability (greater than 75%).

Teacher Rating Scale

Pre- and post-training, the Conners' Teacher Rating Scale-Revised(Short) was filled out by the subjects' teachers to further examine behavior in the classroom. As recommended by Oehler-Stinnett (1992) the teacher rating scale was given twice pre-training in order to reduce regression to the mean. The second set of scores was used for comparison with the post-training response.

Report Card Grades

Pre-training and post-training report card grades were compared. There were two report cards issued prior to training. Those grades served as the baseline. Letter grades for each subject were equated to numerical equivalents as shown in Table 1.

Training Session Records

The coaches maintained records of attendance consisting of a sign-in sheet for the subject. They filled out an anecdotal record of unusual behaviors by the subjects or reports from parents or teachers of unusual events in the subjects' lives, or problems with the equipment for each session (see Appendix J for Session Record Form). For example, if a student had to end the session early because of a doctor's appointment, this was recorded. If a student gave the coach any unsolicited feedback about the training experience, this was also recorded. All of the coaches' records of their own

Table 1

Numerical Equivalents for Letter Grades on Report Cards

Letter Grade	Numerical Equivalent	Letter Grade	Numerical Equivalent
A	4.0	C-	1.75
A-	3.75	D+	1.25
B+	3.25	D	1.0
B	3.0	D-	.75
B-	2.75	E+	.25
C+	2.25	E	.0
C	2.0		

observations and the subjects' unsolicited comments are reported as data under "Additional Findings."

Analysis of Data

To demonstrate that the Play Attention training had a significant positive effect on the subjects' ability to attend in the classroom and/or on the subjects' performance in the classroom, it must first be demonstrated that the subjects were successful in the training. This was determined by graphing the percentage of time-on-task during training for each session and comparing the data from the first five weeks of training with the second five weeks of training. The data from the first half of the training period was used as the baseline because there could be no measure of percent of time on task during the games until the training began. If the subject improved in ability to attend during the training, then the mean percent of time on task for the second half of training would be higher than for the first half. Also, a decrease in the standard deviation for the second half of the training would indicate less variable or more consistent performance.

Next it must be shown that time-on-task during classroom improved after Play Attention training. Again, the mean and standard deviation for the baseline measurements were compared to those for post-training measurements.

The results of the Conners' Teacher Rating Scales (CTRS) were used only as supplemental information. In an attempt to minimize regression to the mean, the two pre-test scores were averaged. The result were compared with the post-test score. An improvement was interpreted simply as a positive change in the teacher's perception of the student and added weight to any other evidence of improved attention and/or performance in the classroom.

The coaches' attendance and anecdotal records were examined for possible extraneous factors having an effect, outside the training effect, on attention and performance in the classroom. Every effort was made to identify and analyze factors, other than the training, which may have impacted the subjects' attending skills during measurement.

CHAPTER IV

RESULTS

Three subjects participated in ten weeks of Play Attention feedback training, two times weekly, to learn to increase their ratio of beta to theta brainwaves for the purpose of improving ability to attend. It was predicted that the subjects would improve in percent of time on task during training. It was also predicted that as the subjects improved in time on task during the training, they would also begin to improve in time on task in the classroom. Finally, it was predicted that the subjective reports of the subjects' teachers, via the Conners' Teacher Rating Scale–Revised (Short) and report card grades, would provide supporting evidence of improved behavior and/or performance in the classroom following training with the Play Attention system. The single case experimental design was developed to take place in the natural, school setting, allowing effects beyond the clinic or laboratory to be measured.

Subject #1

Hypothesis #1: Time on Task During Training

Figures 1 through 5 are graphs of percent of time on task during training in games one through five. The scores for the first five weeks of training are used as the

baseline measurements because there is no way to measure performance in the games until training is begun.

Subject #1 increased in mean percent of time on task from 82.7% to 92.8% in the first game and from 74.5% to 87% in the second game. Variability of performance decreased, with the standard deviation decreasing from 16.75 to 6.67 in the first game and from 24.03 to 14.97 in the second game. In the third and fourth games, Subject #1 decreased in mean percent of time on task and increased in variability of performance. In the fifth game, Subject #1's mean percent of time on task remained almost unchanged, but consistency of performance improved. Table 1 lists the means and standard deviations for percent of time on task for both the first and second five weeks of training for all five games.

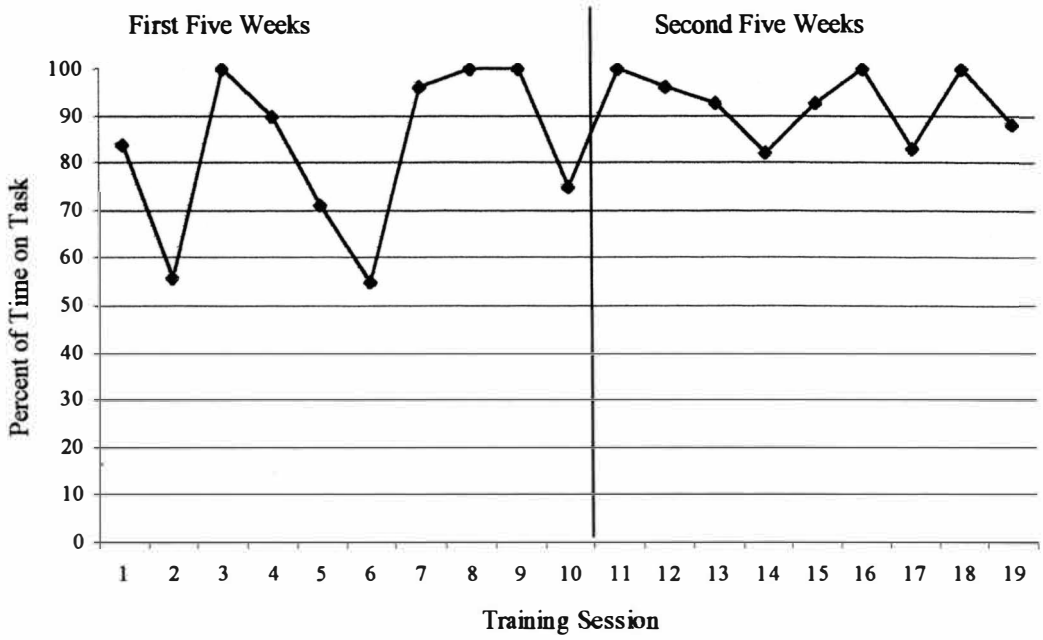


Figure 1. Subject #1: Game 1 Performance

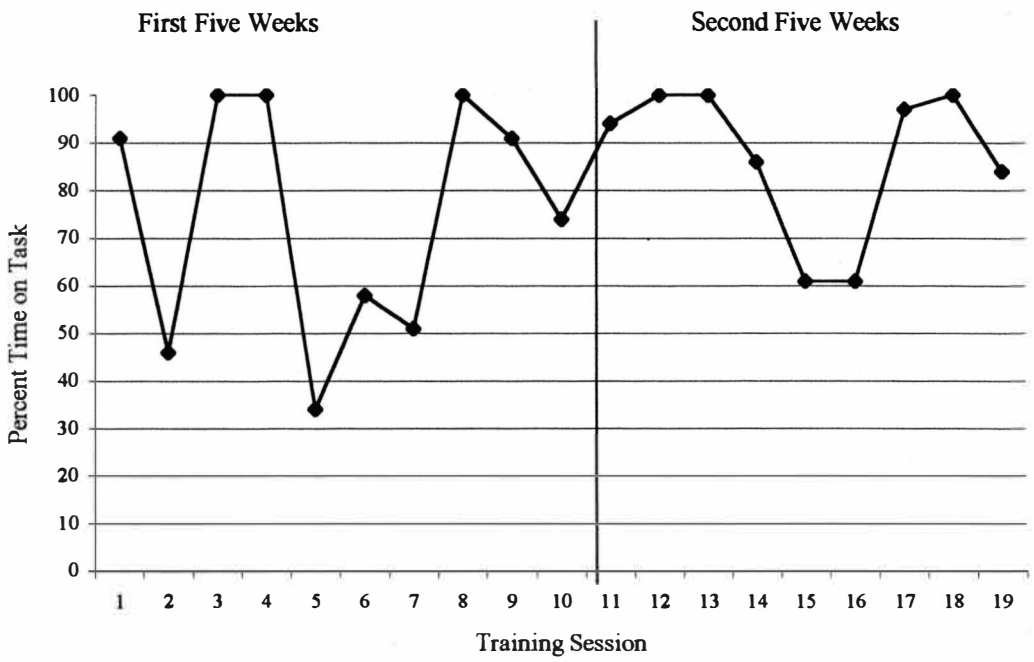


Figure 2. Subject #1: Game 2 Performance

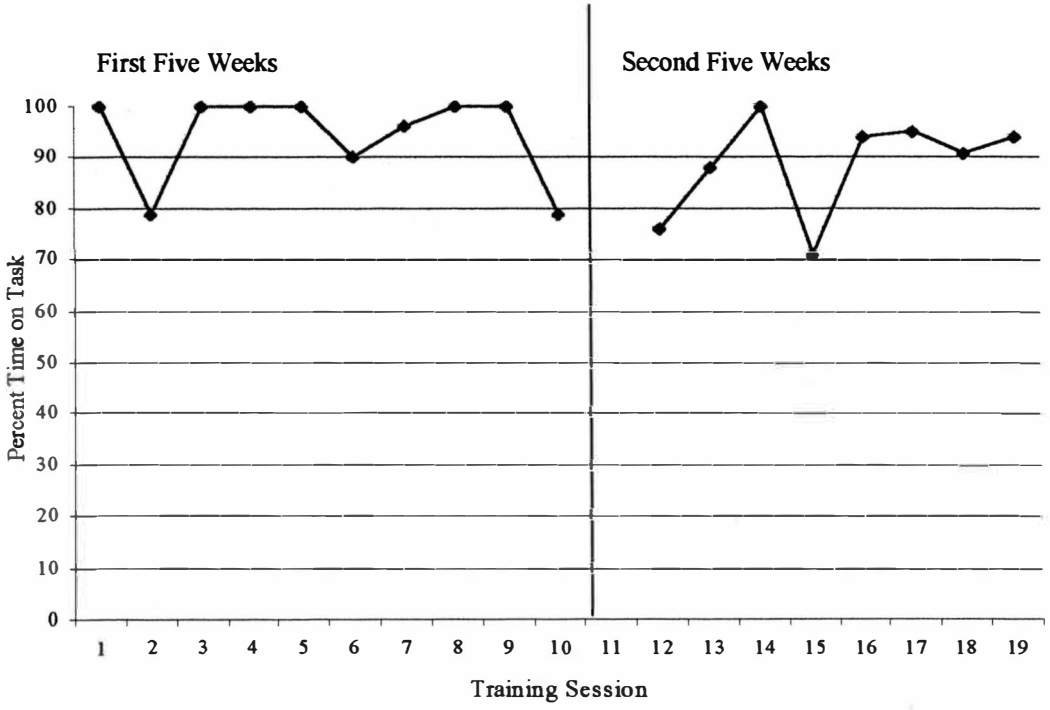


Figure 3. Subject #1: Game 3 Performance

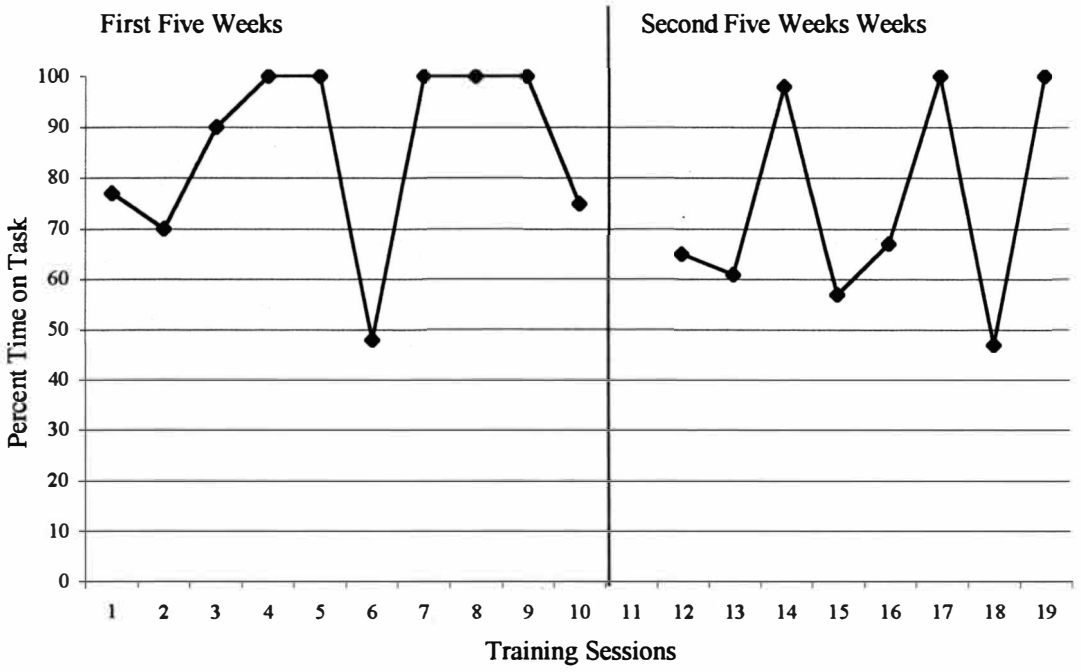


Figure 4. Subject #1: Game 4 Performance

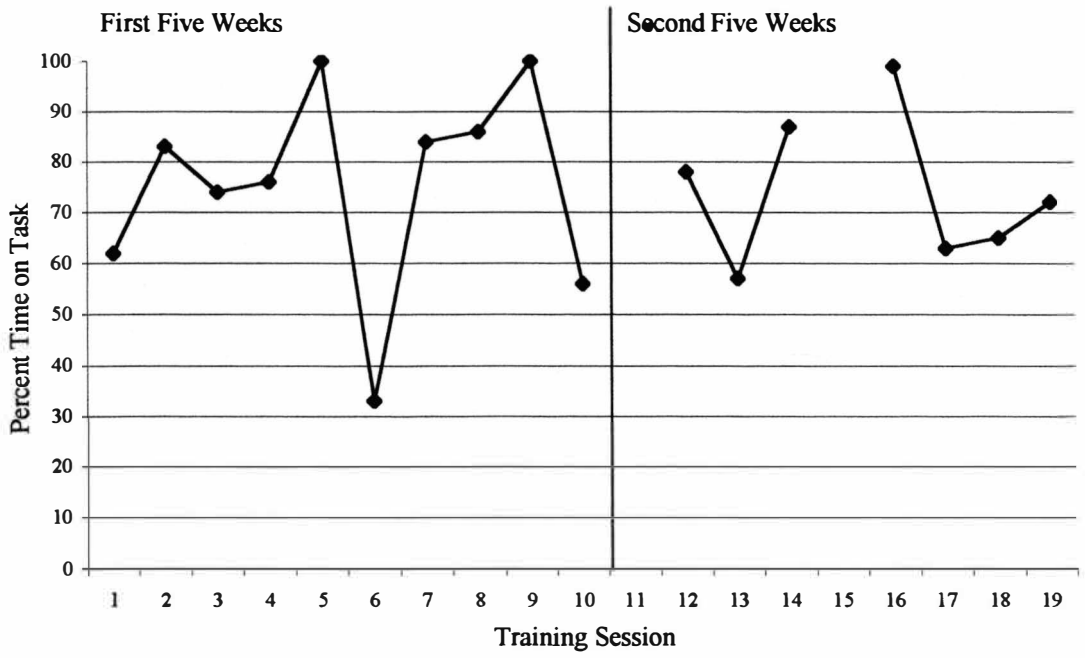


Figure 5. Subject #1: Game 5 Performance

Table 2

Subject #1: Comparison of Mean Percent of Time on Task and Variance in Scores Between First and Second Five Weeks of Training

	Mean		Standard Deviation	
	1st Five Weeks	2nd Five Weeks	1st Five Weeks	2nd Five Weeks
Game 1	82.7%	92.8%	16.75	6.68
Game 2	74.5%	87%	24.03	14.97
Game 3	94.4%	88.63%	8.27	9.38
Game 4	86%	74.38%	17.02	20.14
Game 5	75.4%	74.43%	19.52	13.65

Hypothesis #2: Time on Task in the Classroom

Figure 6 is a graph of baseline and post-training measurements of percent of time on task in the classroom, based on momentary sampling of classroom videotapes. The baseline measurements of percent of time on task in the classroom had a mean of 47.13% with a standard deviation of 14.19. One measurement of 58.3% time on task was taken midway through the training period. Between the sixteenth training session and one week post training, four more measurements were taken, with a mean percent of time on task in the classroom of 87.7% and a standard deviation of 8.41.

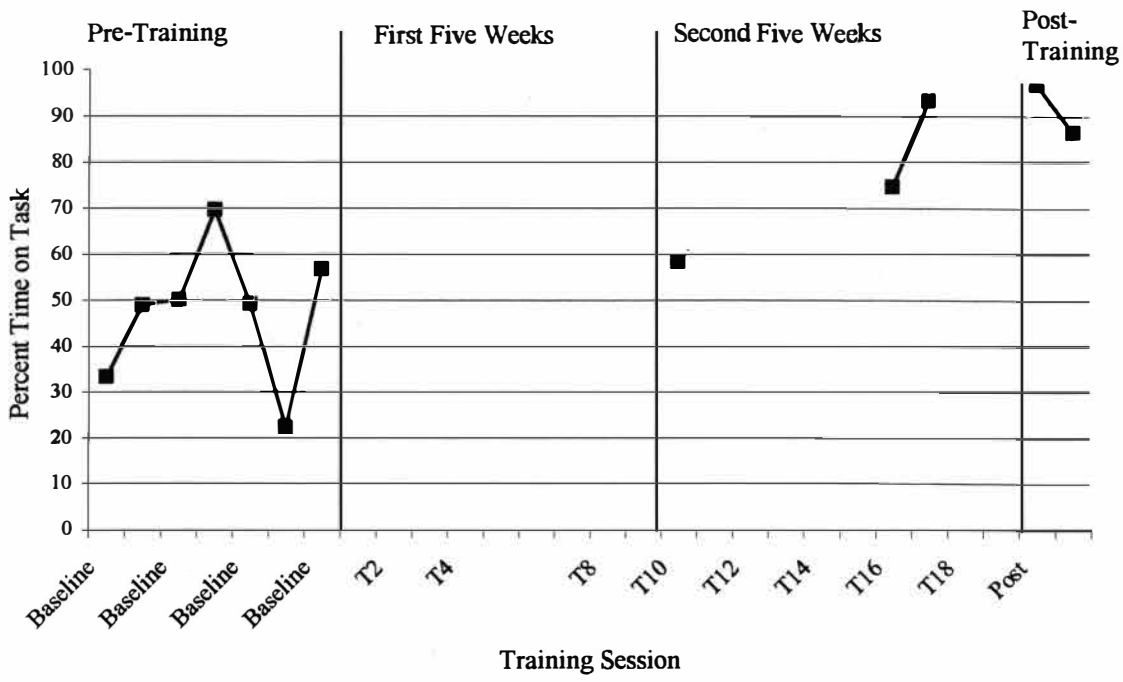


Figure 6. Subject #1: Percent of Time on Task in the Classroom Based on Momentary Sampling of Classroom Videotapes

Hypothesis #3: Conners' Rating Scale and Report Card Grades

Subject #1's classroom teacher provided subjective data in the form of the Conners' Teacher Rating Scale(Revised)-Short. In Figure 7, it is apparent that Subject #1's indicator scores on the Conners' Teacher Rating Scale-Revised(Short) decreased in three areas from baseline measurement to post-training measurement. The ADHD Index went from a score of 27 to a score of 19. The indicator for cognitive problems/inattention fell from eleven to six. The indicator for hyperactivity went from eight to six. The indicator for oppositional behavior remained at zero.

Figure 8 shows Subject #1's report card grades pre- and post-training. There are two baseline measurements because there were two report cards issued prior to training. Subject #1's report card grades for math and spelling improved by more than one point. Language arts and science grades appeared to stay consistent with pre-training grades. Report card grades for reading and social studies actually fell following training.

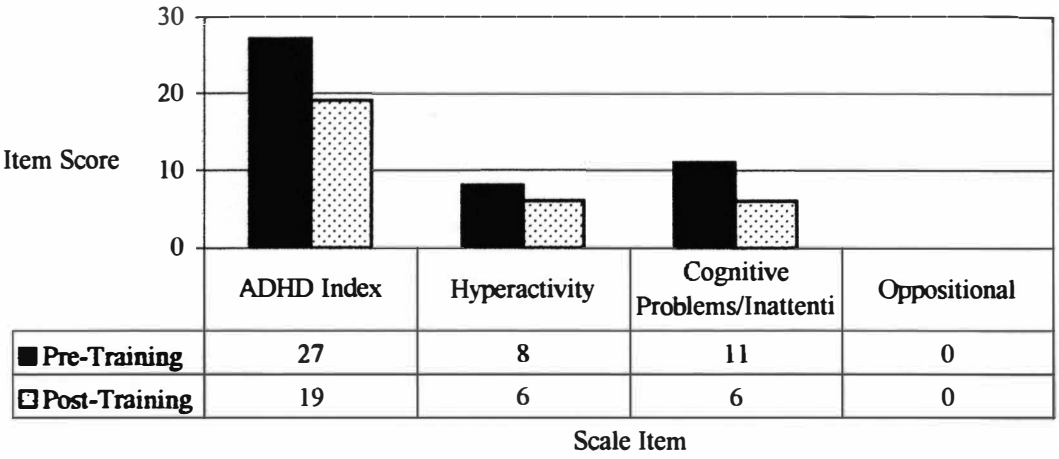


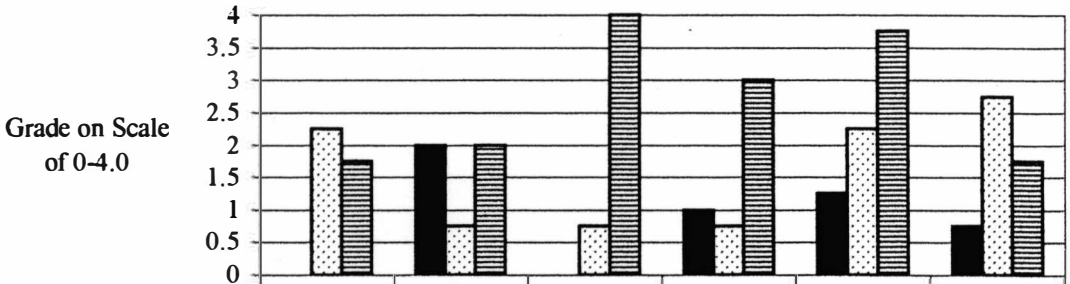
Figure 7. Subject #1: Comparison of Scores on Conners' Teacher Rating Scale Pre- and Post-Training

Additional Findings

The Play Attention coach for Subject #1 recorded the following observations and unsolicited comments on the Anecdotal Session Records:

[...] enjoys doing this "attention thing."
[...] is asking a lot of questions about his scores, which is good.

[...] was quite impressed with his 100% on Tower Builder.
[...] was very impressed @ how well he was doing.
[Subject stated,] "Now I'm getting A's and B's because I pay attention better."



	Reading	LA	Spelling	Math	Science	Social Studies
■ Baseline	0	2	0	1	1.25	0.75
⊡ Baseline	2.25	0.75	0.75	0.75	2.25	2.75
⊟ After 14 Sessions	1.75	2	4	3	3.75	1.75

Subject

Figure 8. Subject #1: Comparison of Report Card Grades Pre- and Post-Training

Subject #2

Hypothesis #1: Time on Task During Training

Subject #2 increased in mean percent of time on task during training for the first, second, and fifth games. Subject #2's performance also became more consistent in the first, second, and third games during the second half of training as seen in decreased standard deviation scores. The first five weeks of training were used as the baseline for the second five weeks because could not be any measurement until training began.

Figures 9-13 are graphs of percent of time on task during training for the first through fifth games. Table 2 lists the means and standard deviations for percent of time on task for both the first and second five weeks of training for all five games.

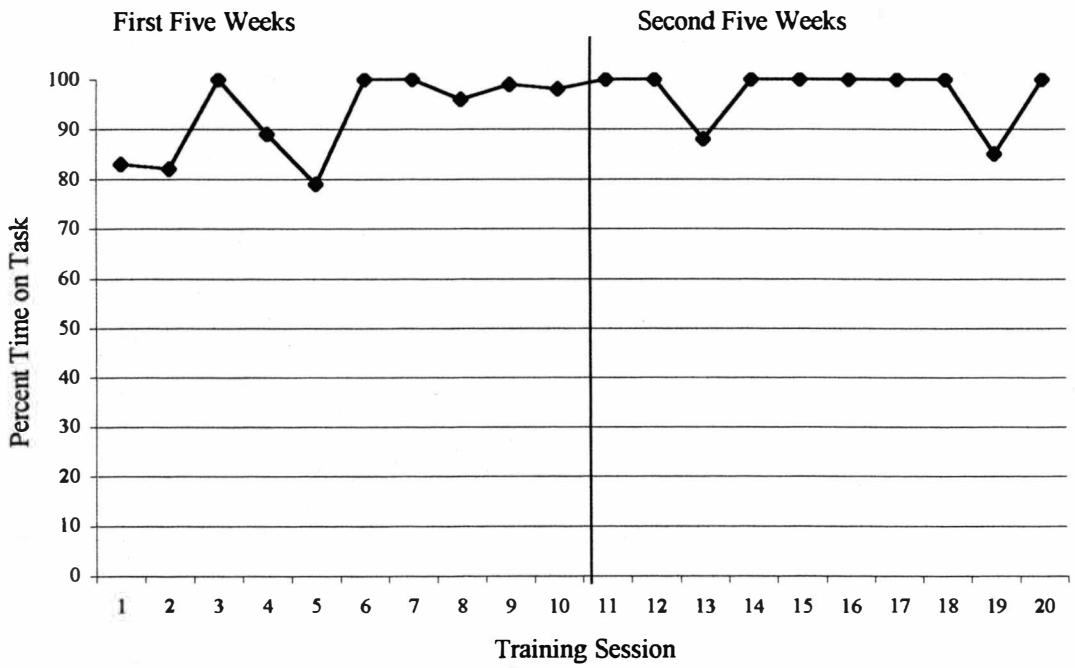


Figure 9. Subject #2: Game 1 Performance

Hypothesis #2: Time on Task in the Classroom

Figure 14 is a graph of baseline and post-training measurements of percent of time on task in the classroom for Subject #1. The mean percent of time on task in the classroom during baseline measurement was 85.86% with a standard deviation of 7.29. The mean percent of time on task in the classroom post-training was 85.44% with a standard deviation of 7.09.

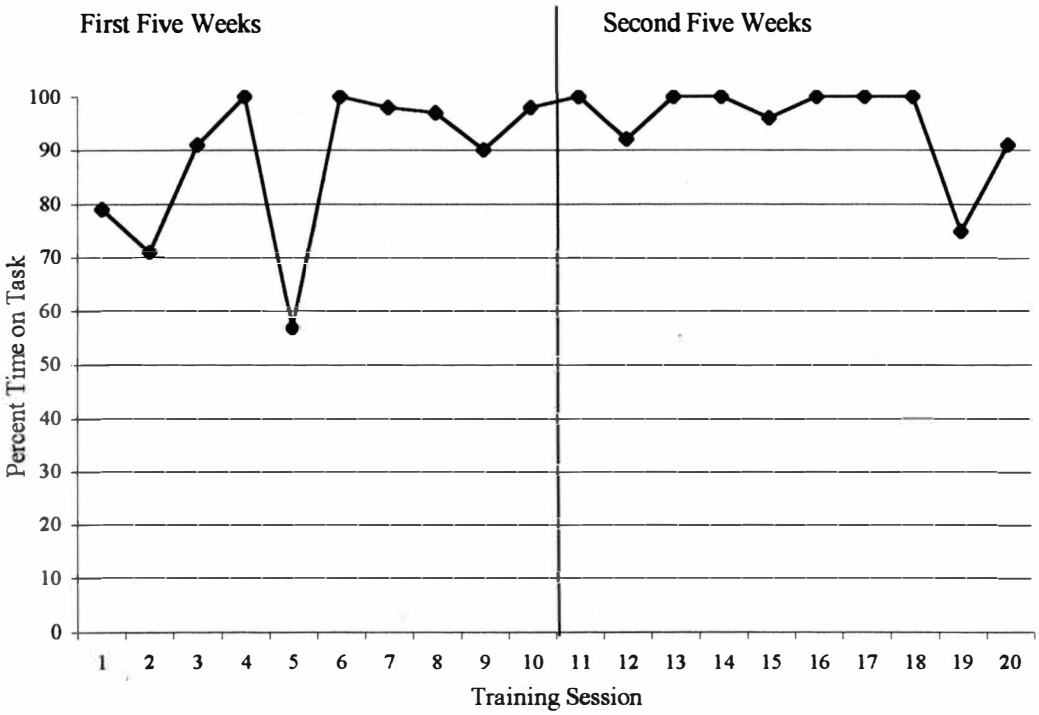


Figure 10. Subject #2: Game 2 Performance

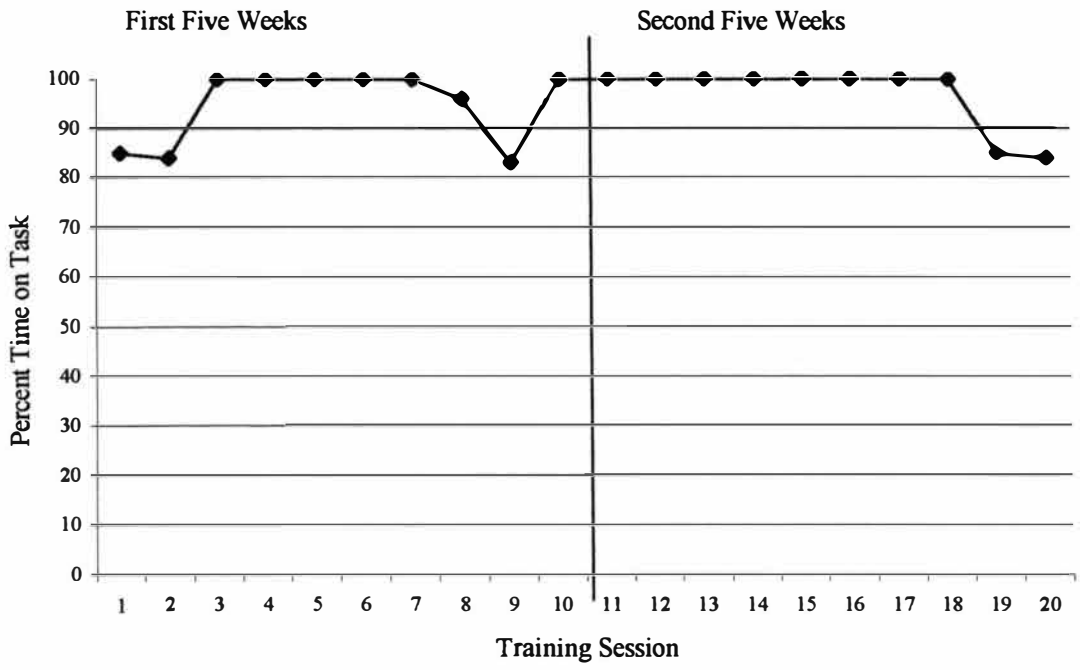


Figure 11. Subject #2: Game 3 Performance

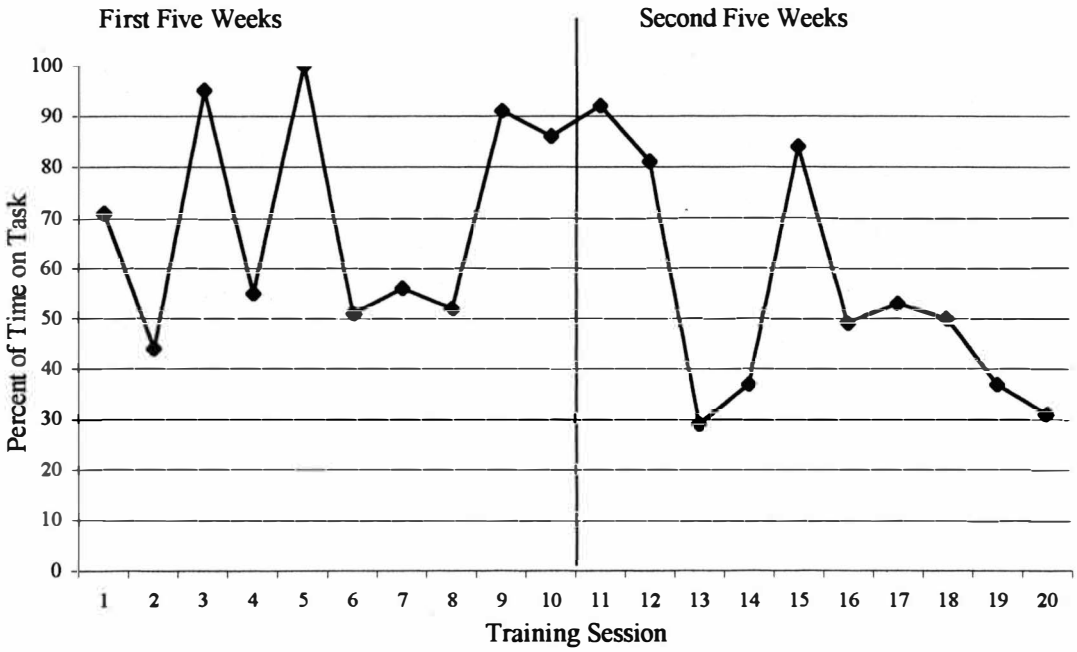


Figure 12. Subject #2: Game 4 Performance

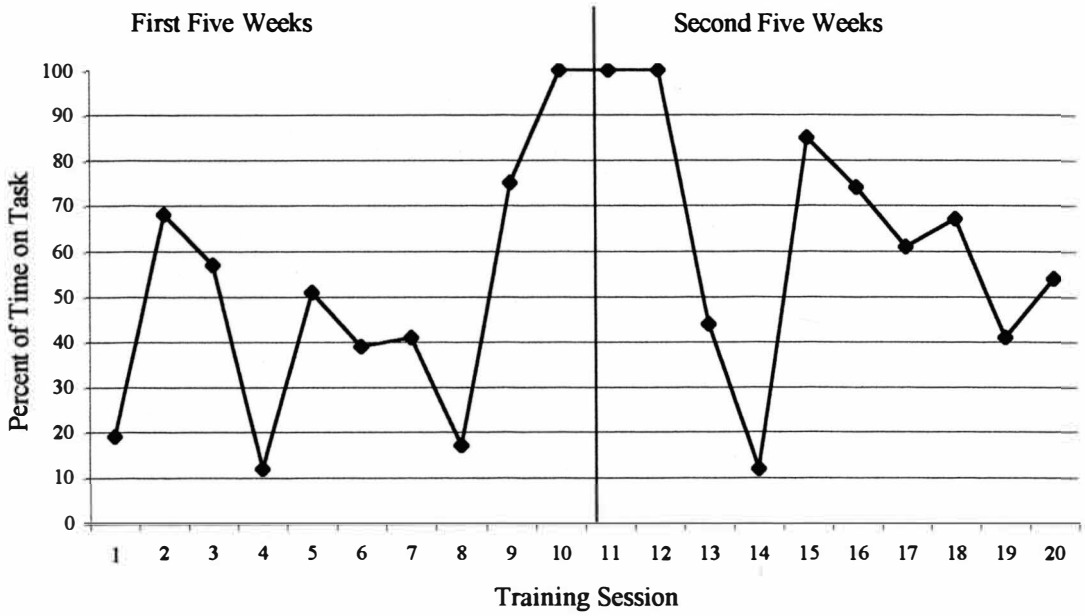


Figure 13. Subject #2: Game 5 Performance

Table 3

Subject #2: Comparison of Mean Percent of Time on Task and Variance in Scores Between First and Second Five Weeks of Training

	Mean		Standard Deviation	
	1st Five Weeks	2nd Five Weeks	1st Five Weeks	2nd Five Weeks
Game 1	92.6%	97.3%	8.05	5.44
Game 2	88.1%	95.4%	13.83	7.58
Game 3	94.8%	96.9%	7.18	6.20
Game 4	70.1%	54.3%	20.01	69.61
Game 5	47.9%	63.8%	26.74	26.24

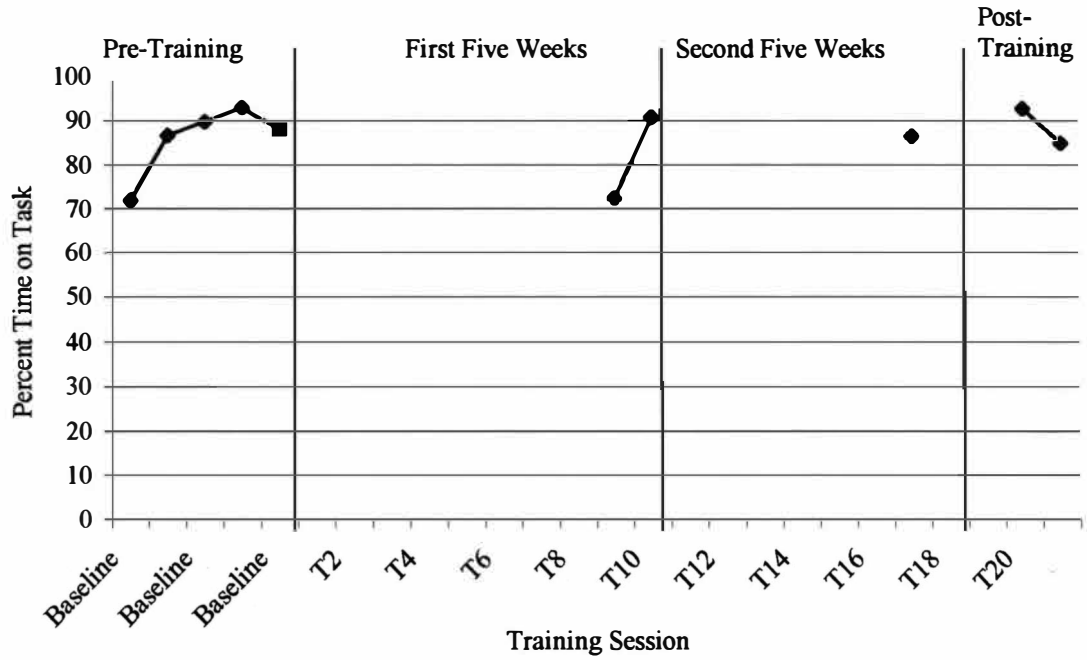


Figure 14. Subject #2: Percent of Time on Task in Classroom Based on Momentary of Sampling of Classroom Videotapes

Hypothesis #3: Conners' Rating Scale and Report Card Grades

Figure 15, a bar graph of Subject #2's scores on the Conners' Teacher Rating Scale-Revised(Short) pre- and post-training, shows improved scores for all four indicators.

Following Play Attention training, Subject #2 had improved grades in math and science. His grades declined or remained consistent with baseline grades for the other subjects. Figure 16 is a graph of report card grades in all subjects for Subject #2 pre- and post-training.

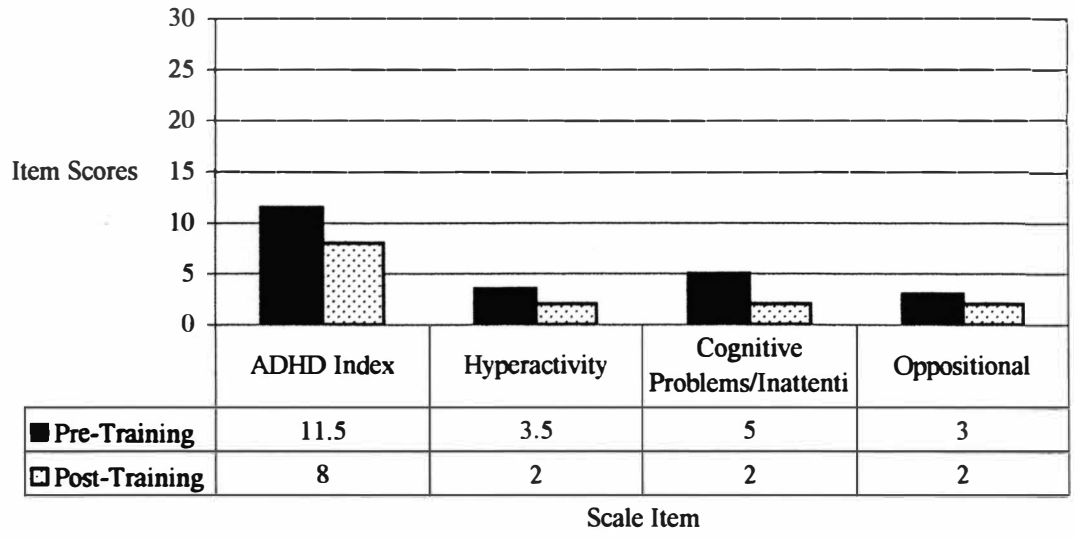
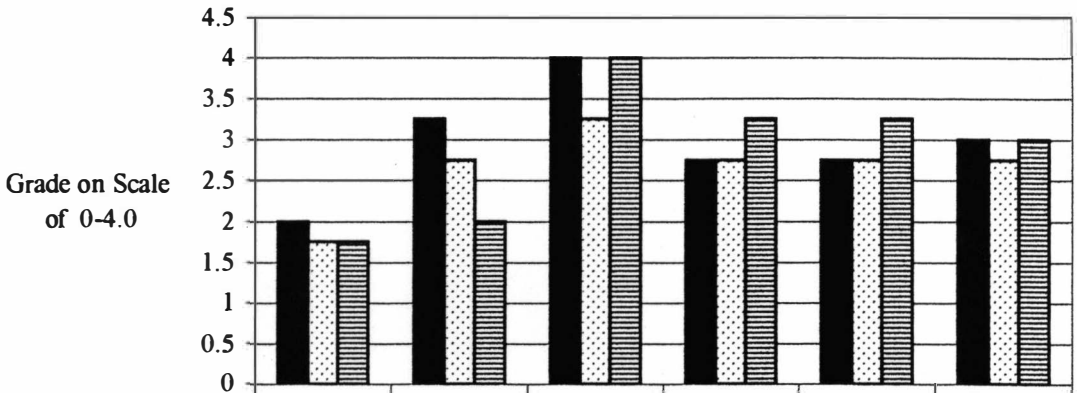


Figure 15. Subject #2: Comparison of Conners' Teacher Rating Scores Pre- and Post-Training



	Reading	LA	Spelling	Math	Science	Social Studies
■ Baseline	2	3.25	4	2.75	2.75	3
□ Baseline	1.75	2.75	3.25	2.75	2.75	2.75
▤ After 16 Sessions	1.75	2	4	3.25	3.25	3

Subject

Figure 16. Subject #2: Comparison of Report Card Grades Pre- and Post-Training

Additional Findings

The Play Attention coach for subject #2 recorded the following observations and comments on the Anecdotal Session Records:

> Very attentive, eager to participate.
> [...] is very eager to be here. When doing the activities he appears to be concentrating maybe too hard because I notice him shaking. I have to tell him to relax.
> [...] states that he can't wait to get out of class so he can "Play Attention." He claims he wants to be an expert at it.
> [Subject stated,] "Sometimes in class, I think of this game and it helps me concentrate on my work."
> [...] thought that he did good on mind maze, but it [the computer data screen] said he was on task 52% of the time. He wondered how that could be.
> [...] dreads Skitter and Hopper games because he said it's his hardest – he received a 98%.
> Because Mind Maze is his favorite, he decided to challenge himself with the

advanced level…He had a hard time with Mind Maze & I could tell he was frustrated.

…was very pleased with getting 100% on 3 in a row.

[Subject] felt that for Level 1, he should have received a better percentage. He stated he felt that he was on task 100%, computer stated 85%.

He said the program made him concentrate in class. When he has a hard time concentrating in class he takes a deep breath & tries again. It also helps him in band. HE NEEDS TO BE THE PLAY ATTENTION SPOKESPERSON!

He described wonderful experiences.

Subject #3

Hypothesis #1: Time on Task During Training

Subject #3 demonstrated improved percent of time on task during training for the first, second, third, and fourth games. The scores for the first five weeks of training are used as the baseline measurements because there is no way to measure performance in the games until training is begun. The mean percent of time on task increased for all of these games when comparing performance during the first and second halves of the training period. The variance in percent of time on task improved only in the third game. Figures 17-21 are graphs of Subject #3's percent of time on task during training in the Play Attention games. Table 3 lists Subject #3's mean percent of time on task and the standard deviation for both the first and second five weeks of training for each of the games.

Hypothesis #2: Time on Task in the Classroom

Figure 22 is a graph of Subject #3's percent of time on task in the classroom

during baseline measurement and post-training. The mean percent of time on task in the classroom during baseline measurement was 50.17% with a standard deviation of 20.62. The mean percent of time on task in the classroom post-training was 76.02% with a standard deviation of 12.98.

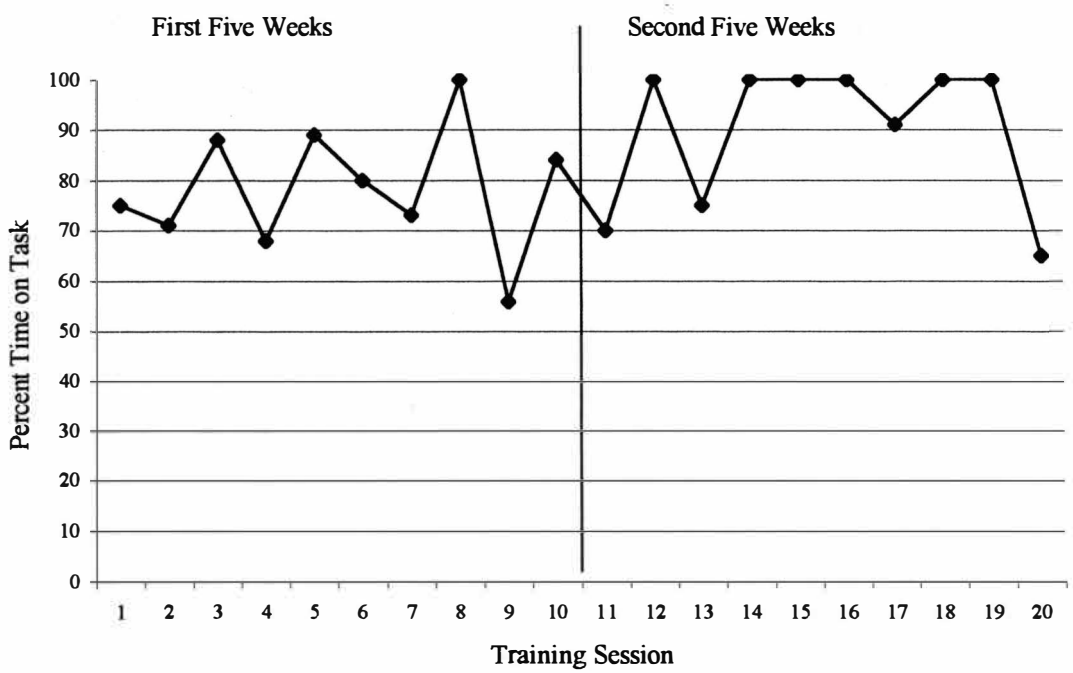


Figure 17. Subject #3: Game 1 Performance

Hypothesis #3: Conners' Rating Scale and Report Card Grades

Figure 23 shows that Subject #3's scores on the Conners' Teacher Rating Scale-Revised (Short) improved for the ADHD Index from twenty-eight to nineteen and for the Hyperactivity indicator from eleven to seven.

Figure 24 compares Subject #3's report card grades pre- and post-training. Grades for math and social studies went up a whole point on a four point scale. Grades for reading and language arts went up three quarters of a point.

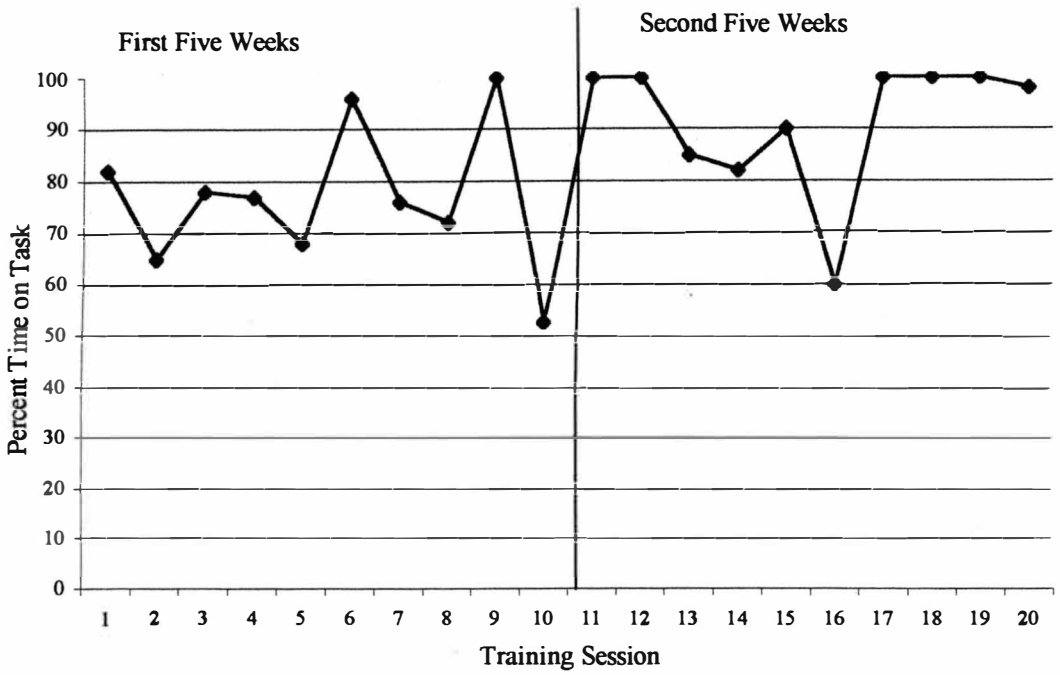


Figure 18. Subject #3: Game 2 Performance

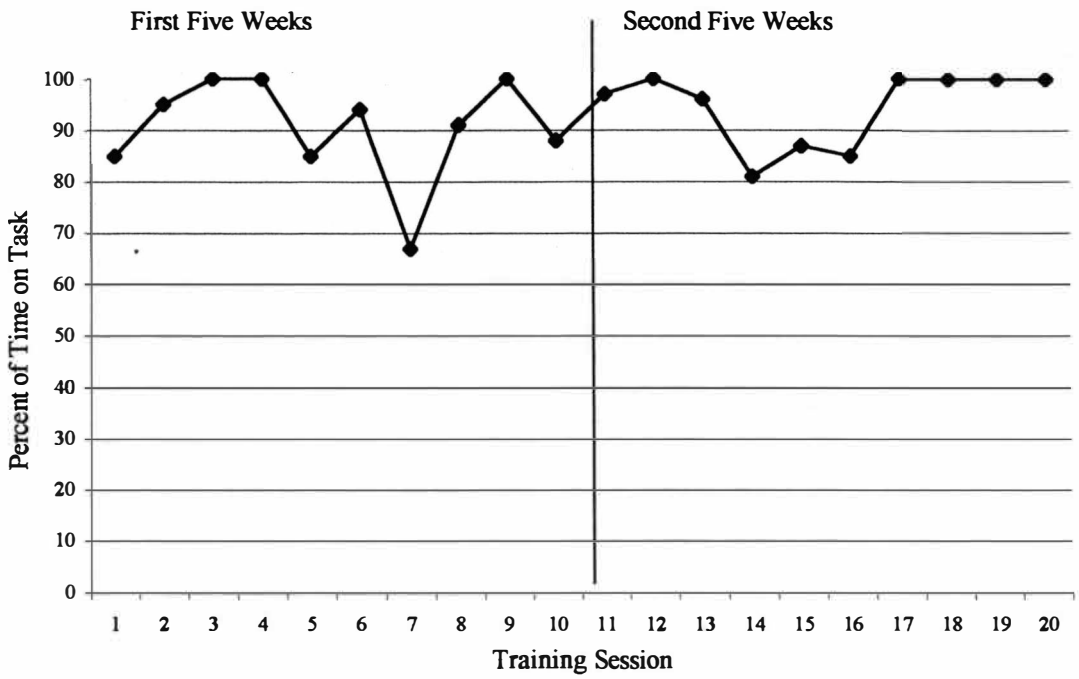


Figure 19. Subject #3: Game 3 Performance

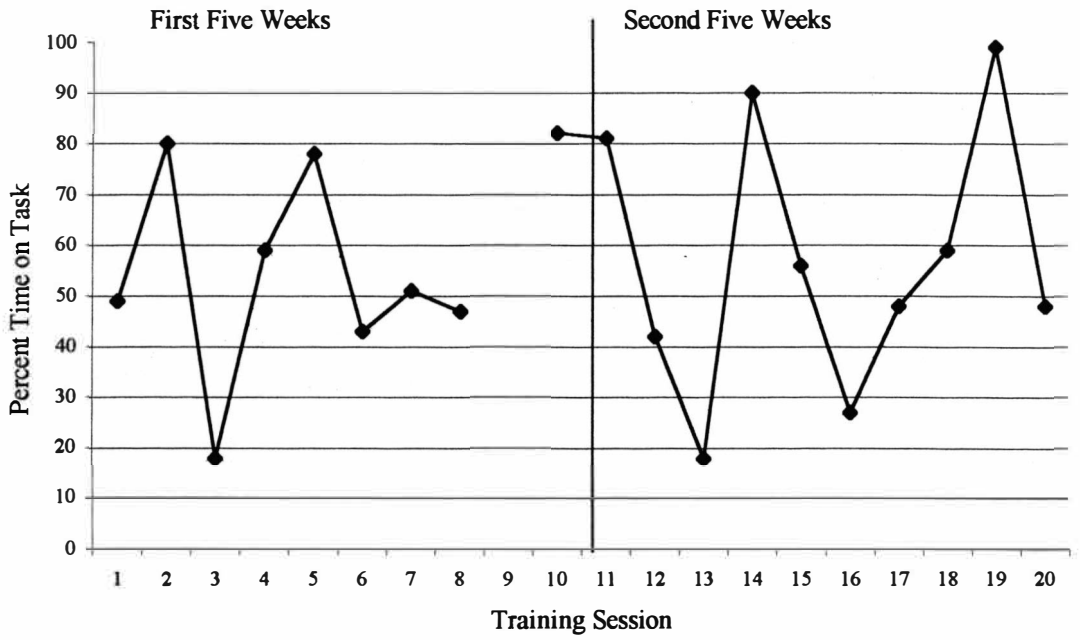


Figure 20. Subject #3: Game 4 Performance

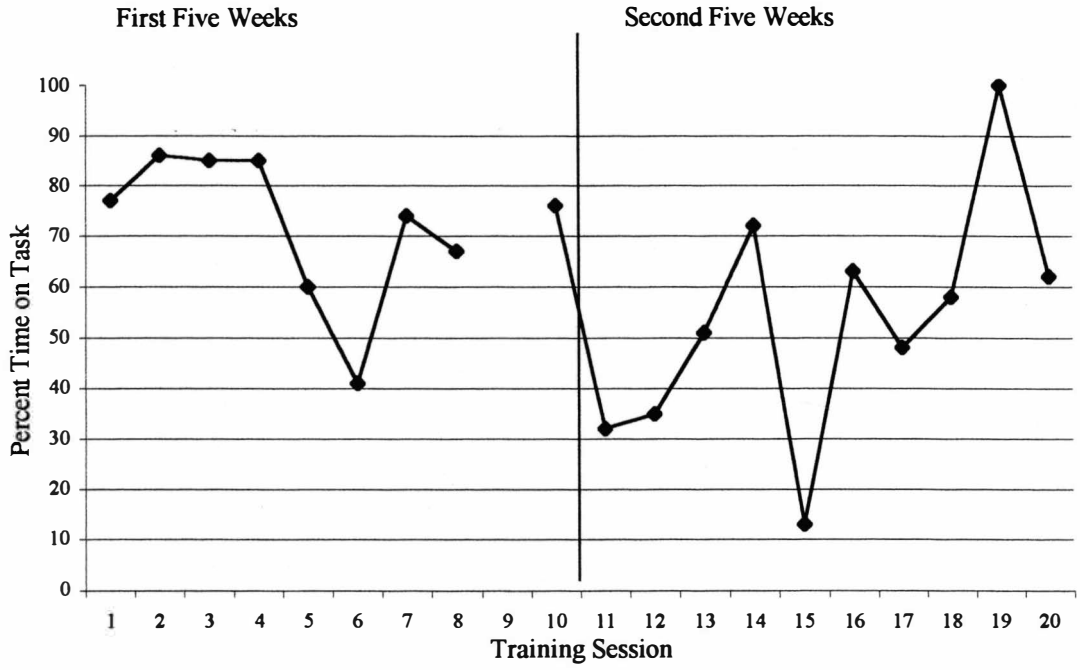


Figure 21. Subject #3: Game 5 Performance

Table 4

Subject #3: Comparison of Mean Percent of Time on Task and Variance in Scores Between First and Second Five Weeks of Training

	Mean		Standard Deviation	
	1st Five Weeks	2nd Five Weeks	1st Five Weeks	2nd Five Weeks
Game 1	78.4%	90.1%	11.88	13.60
Game 2	76.7%	91.5%	12.91	12.37
Game 3	90.5%	94.6%	9.60	6.99
Game 4	50.7%	56.8%	19.49	24.98
Game 5	72.33%	53.4%	13.78	22.73

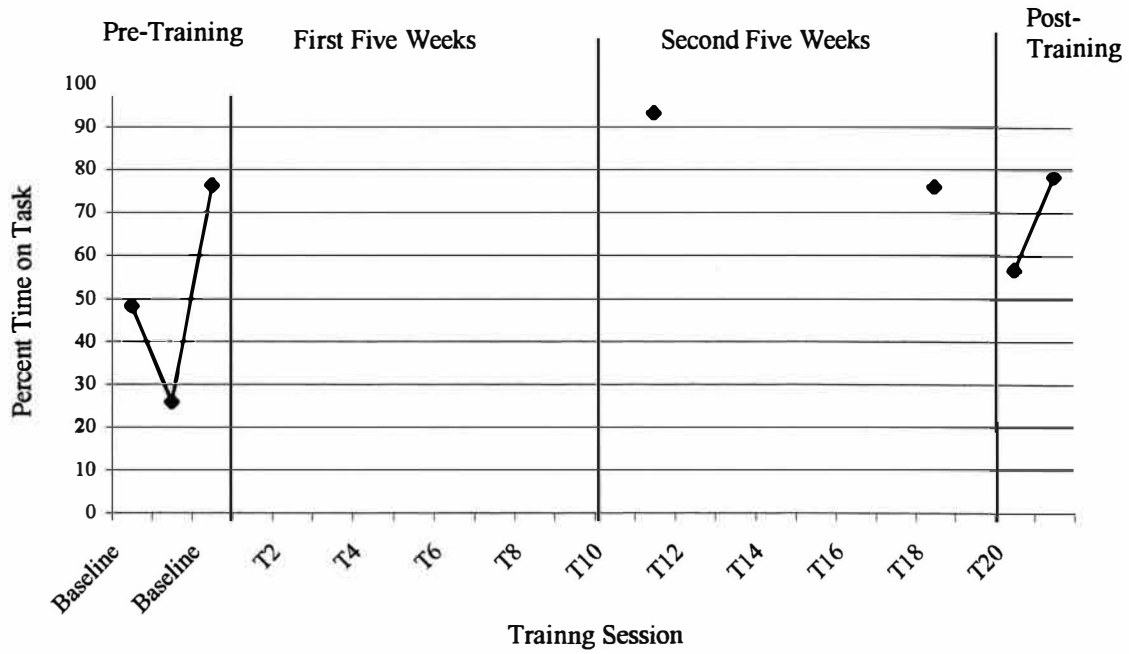


Figure 22. Subject #3: Percent of Time on Task in the Classroom

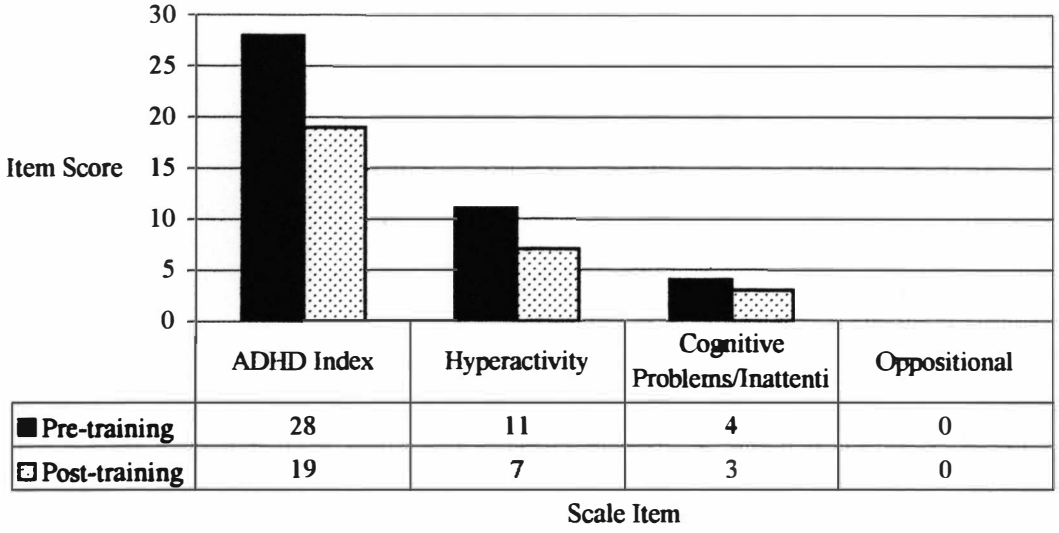


Figure 23. Subject #3: Comparison of Conners' Teacher Rating Scores Pre- and Post-Training

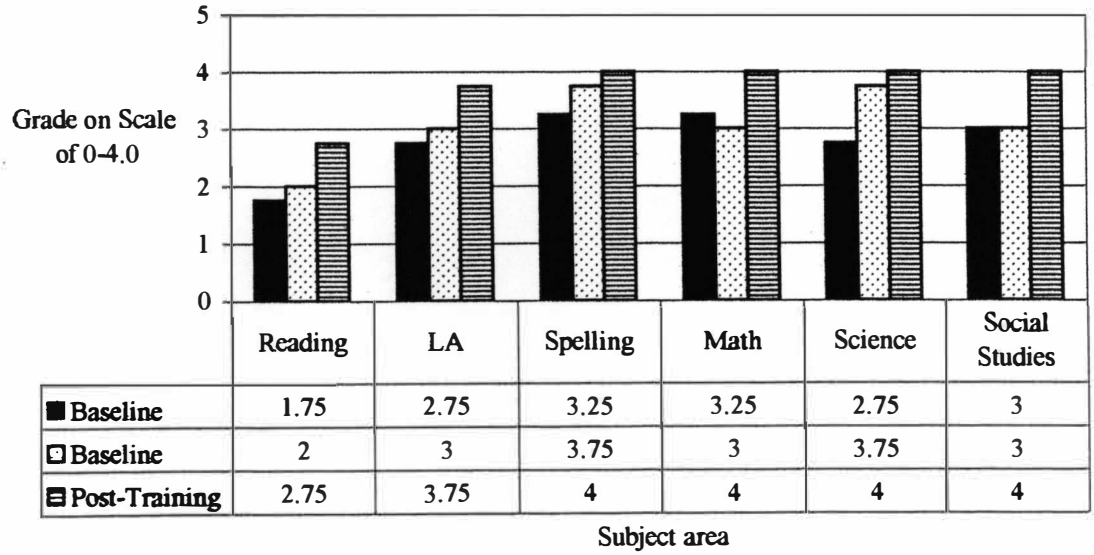


Figure 24. Subject #3: Comparison of Report Card Grades Pre- and Post-Training

Additional Findings

The Play Attention coach for subject #2 recorded the following observations and comments on the Anecdotal Session Records:

> [...] was happy to receive two 100%'s in a row. He said it was a record for him. He was over target during Tower Builder by 3 seconds. He was very impressed by this, stating that usually he is over about one minute or more. Appears quite disappointed when he makes an error on Mind Maze.
>
> [...] reported that things are getting easier in class. When asked if he felt like this was helping, he said, "I think so."
>
> [S's] comments after completion of last session: [...] cried and said thank you. He said that it had helped make school easier.
>
> Mom's comments after last session: She said that [...] had really enjoyed the whole program and that it had made a real impact [...]

CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Results

Table 4 summarizes the results of the study for each hypothesis and for each subject. The main results of the study were as follows:

Hypothesis #1

Hypothesis #1 stated that the subjects would demonstrate an improved ability to attend during the training sessions by increasing the percent of time on task during the Play Attention games. All three subjects increased their percent of time on task during training for at least two of the games.

Hypothesis #2

Hypothesis #2 stated that the subjects would demonstrate improved time on task in the classroom along with improvement in percent of time on task during Play Attention training. Following training, Subjects #1 and #3 increased their percent of time on task in the classroom as measured by momentary sampling of classroom videotapes, while Subject #2 did not.

Hypothesis #3

Hypothesis #3 stated that the subjects would demonstrate improved behavior and/or performance in the classroom as reflected in decreased scores in the Conners' Teacher Rating Scale-Revised(Short) and improved report card grades following ten weeks of Play Attention training. All three subjects had decreased post-training scores on the Conners' Teacher Rating Scale-Revised(Short) as compared to pre-training scores.

Following Play Attention training, Subject #1 had significant improvements in his report card grades for spelling and math, but declined in his grades for reading and social studies. Subject #2 did not have significant changes in his grades. Subject #3 improved his grades (on a four point scale) by one whole point in math and social studies and by three quarters of a point in reading and language arts.

Additional Findings

Additional findings based on recorded comments on the coaches' Anecdotal Session Records were not originally hypothesized. Each of the three subjects made positive comments about the training experience. All three indicated motivation to master the training tasks. All three made at least one statement of belief that the Play Attention training helped him do better in some way in the classroom.

Table 5

Summary of Results for Each Hypothesis and Each Subject

Hypothesis	S#1	S#2	S#3
#1: The subjects will demonstrate an improved ability to attend during the training sessions by increasing the percent of time on task during the Play Attention games.	+	+	+
#2: The subjects will demonstrate improved time on task in the classroom along with improvement in percent of time on task during Play Attention training.	+	-	+
#3a: The subjects will demonstrate improved behavior and/or performance in the classroom as reflected in decreased scores in the Conners' Teacher Rating Scale-Revised(Short)	+	+	+
#3b: and improved report card grades following ten weeks of Play Attention training.	+	-	+

Discussion of the Results

Hypothesis #1

One part of the Play Attention training protocol was not carried out correctly for Subject #1 and Subject #2. Once the subject became proficient at the training games, the protocol called for the coach to read to the subject during one additional game replayed at the end of each session, after all five games had been completed. Instead, the coaches for Subject #1 and Subject #2, beginning with the twelfth session, read to the Subject during either the third, fourth, or fifth game randomly and did not

record during which game the reading occurred. This changed the nature of the task, making it difficult to compare the scores from the first five weeks of training with those of the second five weeks of training for those games.

This study accepts as a basic premise that the Play Attention system adequately measures Beta/Theta ratios in order to accurately provide the trainee with feedback. There are authors who assert that an initial brainwave analysis with multiple electrode placement must be done prior to training in order to accurately place electrodes and set the parameters for training (Barabasz & Barabasz, 1995).

Hypothesis #2

A ceiling effect can be seen for Subject #2 who started out in the baseline data collection phase with a high percent of time on task, not less than 71.9% and as high as 93%. It would be difficult to observe an improvement in a fourth grade student who already has such a high percentage of time on task in the classroom. There were not enough probe measurements during training to analyze this data as for a multiple baseline study as was originally planned.

Hypothesis #3

The Conners' Teacher Rating Scale is a subjective measure dependent on the views of one informant. As such, the results of the Conners' are used her as supporting or non-supporting evidence rather than seen as having merit on their own. It is important to mention that the teachers completing the Conners' Rating Scale knew

that the subjects were involved in the Play Attention training and may have been influenced by this knowledge when responding to the survey.

Additional Findings

The comments of the coaches and subjects were included to assist a practitioner trying to decide if Play Attention training is appropriate for trial with a certain student. Since the training involves such a lengthy and labor intensive commitment on the part of the student, it seemed important to note whether or not the subjects of this study seemed to find the training to be a positive or negative experience.

Limitations of the Study

With the single case study experimental design, the results of this study cannot be generalized. But they can speak about the treatment effect for the three particular subjects under study. The study can also provide a basis for further study and with enough replication, the total group of studies might yield generalizable results. Another practitioner could compare the characteristics of a certain client with those of the subjects of this study to assist in deciding whether or not to try the Play Attention program with that client. However, the practitioner would not be able to predict a treatment effect for the client based on the results of this study (Ottenbacher, 1986).

The study was designed as a multiple baseline study. However, there were insufficient number of baseline and probe data points to be analyzed as for a multiple baseline study. The data were instead analyzed as for a simple ABA design.

Visual analysis via graphs and charts is the primary method of analyzing the data from a single case experimental study (Busk & Marascuilo, 1992). It takes a large change to show up on a graph or chart. Small statistical changes in pre- and post-treatment data may not show up clearly on graphic analysis, but may be clinically significant (Ottenbacher, 1986). This is a consideration in this study because all three of the subjects, especially Subject #2, showed mild or little hyperactivity in baseline videos. In fact Subject #2's baseline Conners' scores were barely out of the normal range. All three subjects had early success with high scores during the Play Attention training. Such baseline data is not likely to be subject to large improvements.

This study was managed by a practicing occupational therapist in a natural school setting. The study was fairly labor and time intensive, especially the video taping. The researcher's work duties and schedules did not allow enough flexibility and time to collect as many data probes throughout the training period for time on task in the classroom as were desired. Not all of the probes that were planned in the study protocol could be carried out because of classroom schedule changes or subject absences. The researcher lacked the flexibility in her day to schedule make-up tapings. This study attempted to examine carry over of the Play Attention training into the classroom. However, conclusions are limited in part by the inability to collect more extensive baseline and probe data via videotaping.

As has been a challenge in most research on biofeedback training and ADHD the lengthy training protocol makes it difficult to determine treatment effect outside of the training environment (Rossiter & LaVaque, 1995). This study of ten weeks tries to

minimize this difficulty. Still, many extraneous factors, including maturation or a change in classroom materials presented, can impact the subjects over such a time period.

One hypothesis had to be dropped from the original study proposal. That hypothesis stated that as they improved in performance during Play Attention training, the subjects would also improve in performance on Readers' Workshop software in the school computer lab. This study attempted to measure reading performance with data generated in the school computer lab by the Computer Curriculum Corporation (CCC) instructional software. All students in this school were scheduled to attend the computer lab three times weekly to work on reading and math skills (Wettlaufer, F., 1999). Many types of reports can be generated based on the student's performance data. This study planned to examine the Today's Session reports which included the students' total attempted exercises, total correct exercises, and percent correct for each session of Reader's Workshop (Reports Guide and Reference). These data were to be collected according to the same baseline schedules as for videotaping and for each session of Reader's Workshop the subjects attended (see Appendix G & H for sample reports). Unfortunately, it was discovered well into the baseline phase that these reports could not be retrieved after the day of the actual CCC session. Therefore, there is minimal baseline data for the three subjects. Additionally, the subjects did not actually work on the CCC Reader's Workshop twice weekly as scheduled. Subject number one had only four data entries, subject number two only eight, and subject number three only four. Therefore, the hypothesis was dropped.

Conclusions

This study confirms the findings of Rossiter and LaVaque (1995) that students with ADD can learn to increase their ratio of Beta to Theta brain waves and so increase attending during feedback training activities in twenty sessions or less. Each of the three subjects demonstrated improved percent of time on task (determined by measuring Beta/Theta) in at least two of the games over the course of training.

For two of the subjects, percent of time on task measured in the classroom increased after training. It cannot be concluded that this is a direct result of the Play Attention Training. The study controlled for major changes in the subjects' medication, behavior program, and educational programming. Still, many other factors could impact ability to stay on task over the course of ten weeks. For example, as the curriculum material changed, the subjects' level of interest might have changed. Or, the teachers' enthusiasm for teaching certain units might have increased. One subject had his seat moved once during the study, which might have reduced distractions.

Assume the increase in percent of time on task for two of the subjects was a direct result of their participation in the Play Attention training program. It still cannot be determined if the intervention effect was a result of the feedback training itself or of the positive comments and encouragement from the coach or of a combination of the feedback training and the coaching.

The study confirmed the claims of Unique Logic and Technology that, with appropriate training, the Play Attention program can be implemented with coaches

who are not trained in biofeedback (www.playattention.com). The costs of the program consisted of the dollar cost to purchase the Play Attention system, the time of the professional supervising the program, the time of the volunteer coaches, the subjects' time, and the time used on a school computer for Play Attention rather than some other use. In this particular case, the training was done at a time when a school computer was not needed for other purposes. As a result of a graduate research study grant, the coaches were paid volunteers receiving a small stipend and mileage reimbursement.

The researcher acted as the supervisor to the coaches and averaged one to two hours per week to carry out the following duties: recruiting three volunteer coaches, training three coaches, recruiting student participants, obtaining informed consent from parents, maintaining supply of food treats used as rewards for session participation, rescheduling for absences, answering coaches' questions, and other miscellaneous tasks. This amounted to approximately five percent of the researcher's paid work week. Although the training in this study lasted twice weekly for ten weeks, Unique Logic recommends at least 40 hours of training to achieve lasting changes in ability to control brainwaves. Based on a 36 week school year and considering absences and special circumstances, it does not seem possible to complete 40 hours of training in less than one full school year unless sessions were three times per week.

The Play Attention hardware and software with a professional's 25 user license cost $2495.00. The system can continue to be used in one site for up to 25 users , each in individual sessions (www.playattention.com). If a school has enough volunteer time

to coach ten students over one school year, the dollar cost for a training program of 40 sessions at the end of one school year would be approximately $250.00 per student plus the cost to pay an employee for time spent coordinating the program. The dollar cost for each training session would be approximately $6.25. Train ten students each year for two years and the cost reduces to $125.00 per student or $3.10 per session plus the cost of coordinating the program. This is much less than the cost of biofeedback training in a private clinic setting (Rossiter & LaVaque, 1995).

The commitment to the recommended 40 hours of training (www.playattention.com) is important to consider when deciding if Play Attention is an appropriate intervention. Even for students training before or after school, the choice might be between valuable extracurricular activities, such as scouts or sports, and Play Attention. However, the Play Attention training proved to be enjoyable for these three subjects and is worthwhile to consider as a supplemental, albeit experimental, intervention. Especially since, for many students, the choice might be between television and other computer video games. Meanwhile, additional research on the carry over into the classroom of this feedback training system should be carried out.

Recommendations for Future Research

Design

Though the most demanding of single case experimental designs, the multiple baseline yields the greatest evidence for treatment effect (Ottenbacher, 1986). Future

researchers should consider lengthening the baseline data collection phase and increasing the number of data probes for momentary sampling of time on task in the classroom so that data can be analyzed as for a multiple baseline study.

There are other general study designs that might prove fruitful in determining the treatment effect of the Play Attention program. One design might include three different matched subject groups: one with Play Attention training with coaching as described in the current study, one with Play Attention training with very minimal coach/subject interaction, and one without the Play Attention program but with the coaching to encourage greater attending in the classroom. This design might tell which is the essential element of the Play Attention program, the computerized feedback training or the coaching or both. An ABAB design in which, after a number of sessions, the training was withdrawn for a period of time and then reintroduced and completed, might show the subjects to improve, regress and then improve again. This would more clearly demonstrate the effectiveness of the intervention.

Subjects

This study required that the subjects not have a special education diagnosis and also not be expected to have a change in programming during the course of the study. Students who were having significant difficulties in the classroom were not eligible because they could expect to have some kind of change in programming or intervention. Students with a special education diagnosis were eliminated in order to reduce confounding factors. This limited the available subjects to those with rather

mild ADD/HD or those whose symptoms were already well controlled by some other intervention. This resulted in the ceiling effect found in some data because the subjects' abilities were already fairly high at baseline. Future researchers should consider subjects who have a medical diagnosis of ADD/HD and a special education label of either Physical or Otherwise Health Impaired or Learning Disabled. Such subjects would be likely have more apparent and more easily measured problems with attention and hyperactivity and less of a chance of a ceiling effect.

Measures

Videotaping to measure time on task in the classroom needs to be planned very carefully with the classroom teacher to ensure that the nature of the activity and the time of day of the activity are always as much the same as possible. A greater number of baseline measurements as well as more numerous probes during training should be done to obtain the most reliable data possible.

Measurements of performance in the CCC lab might have been useful. The researcher must be very familiar with the lab plans and procedures in order to choose lab reports that will yield the data sought. This requires careful coordination with the lab instructor and the classroom teacher.

Protocol

The protocol for training the Play Attention coaches should be revised to ensure a clear understanding of how and when the reading component should be added

to the subjects' training sessions. The researcher must read each Anecdotal Session Record and talk with the coaches frequently to ensure that the Play Attention training protocol is being carried out exactly as specified. This is essential because of the length of time over which the study takes place and the somewhat flexible role of the coaches. It would be ideal to have the same coach for all subjects in order to eliminate the possible impact of different coaching styles.

These recommendations for future studies require an intense time commitment from the researcher. This type of study is too time consuming to be carried out as a part of a clinician's everyday practice. On the other hand, the length of the study and the need to observe carryover into the classroom require that on-site personnel be involved. A partnership between a school and a research institution would be ideally suited to provide the resources needed to study the effectiveness of feedback training for students with ADHD in improving attending behaviors in the classroom.

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Appendix A

HSIRB Approval, Consent Forms and Letters

WESTERN MICHIGAN UNIVERSITY

Date: July 2, 2001

To: Howard Poole, Principal Investigator
Janice DiGiovanni, Student Investigator for thesis

From: Mary Lagerwey, Chair

Re: Changes to HSIRB Project Number: 00-10-10

This letter will serve as confirmation that the changes to your research project "A Study of the Effectiveness of a Commercially Available Feedback Training Program in Increasing the Classroom Attending Skills of Students with Attention Deficit Disorder" requested in your memo dated June 20 and including the written assent of minor subjects which you provided on June 29 have been approved by the Human Subjects Institutional Review Board.

The conditions and the duration of this approval are specified in the Policies of Western Michigan University.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: November 3, 2001

Human Subjects Institutional Review Board

Kalamazoo, Michigan 49008-5162
616 387-8293

WESTERN MICHIGAN UNIVERSITY

Date: 3 November 2000

To: Howard Poole, Principal Investigator
Janice DiGiovanni, Student Investigator for thesis
Susanne Thompson, Student Investigator assisting research
Jaime Eagloski, Student Investigator assisting research
Hattie Walker, Student Investigator assisting research

From: Sylvia Culp, Chair

Re: HSIRB Project Number: 00-10-10

This letter will serve as confirmation that your research project entitled "A Study of the Effectiveness of a Commercially Available Feedback Training Program in Increasing the Classroom Attending Skills of Students with Attention Deficit Disorder" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: 3 November 2001

Western Michigan University
Department of Special Education
Principal Investigator: Janice M. DiGiovanni,OTR
Research Associates: Jamie Ebelewski & Susanne Thomson
Research Advisor: Dr. Howard Poole, Special Education Dept., WMU

My son/daughter has been invited to participate in a research project entitled: *A study of the effectiveness of a commercially available feedback training program in increasing the classroom attending skills of students with attention deficit disorder.* This research is intended to examine the effects of a commercially available, supplemental training program for students with attention deficit disorder. My child has been invited to participate because he/she has a medical diagnosis of attention deficit disorder, with or without hyperactivity, which interferes with performance in the classroom and has no other medical or educational diagnosis. In addition, it has been determined that my child may benefit from participation in this training program to improve classroom attending skills. Training will take place in a classroom at [...], twice weekly at a time approved by me and my child's teacher, either during school hours or immediately after school (only with my agreement to pick my child up after school hours). Training will not interfere with my child's attainment of educational goals. This study will last 12 to 14 weeks. This project fulfills part of the requirement for the masters program in Assistive Technology in Special Education for Janice M. DiGiovanni.

Should I choose to sign this consent document, my child will participate in the following:

Play Attention Feedback Training Program:

- My child will control computer games through the use of attention only. He/she will wear a helmet with sensors that allow this control. This system is based on neurofeedback technology, which has been studied for more than twenty years. This system is an educational learning tool. It is not invasive in any way. It does not take the place of any treatment program prescribed by my child's physician.

- My child will have a "Play Attention Coach" who will set up the system, teach my child how to use the system, monitor my child's progress, assist my child in reflecting on his/her ability to attend, and encourage my child to carry-over this ability in to the classroom.

- My child's coach will be an occupational therapy student from Western Michigan University or Janice M. DiGiovanni, a registered occupational therapist. The coach will be trained in use of the Play Attention System.

- Training sessions will take place in [name of school], twice weekly for 30-40 minutes.

- Prior to initiation of training, my child will be observed or videotaped in his/her regular education classroom anywhere from five to nine times for ten minutes each time. Following initiation of training, my child will be observed and/or videotaped in his/her general education classroom one time for ten minutes during weeks four, seven, and ten of training. No other student in my child's class will know who is being observed or videotaped. Videotapes will be analyzed for my child's time-on-task by occupational therapy students at Western Michigan University. No identifying information about my child will be available from these videotapes.

- Data will also be collected from my child's performance on the reading program in the computer lab during regularly scheduled classroom computer times.

- My child's teacher will complete a Conners' Teacher Rating Scale prior to and after completion of the training program. This scale is meant to provide additional information about the child's behavior in the classroom.

- During this study and training time, my child will continue with any treatment program prescribed by his/her physician and with any classroom interventions, which have been shown to be effective for him/her. Unless it is urgent, my child's teachers will not institute any substantially new behavioral program during the study.

If the Play Attention training program is not shown to be effective for my child, the following will occur:

- Training with Play Attention will be discontinued.

- I will be notified of the results of the training and so will my child's teacher.

- This will take place at any time during the training, if the training appears to have a negative impact on my child.

As in all research, there may be unforeseen risks to the participant. If an accidental injury occurs, appropriate emergency measures will be taken; however, no compensation or treatment will be made available to me except as otherwise specified in this consent form.

One advantage to my child's participation in this study is that he/she will have the opportunity to try an intervention, which has been reported to be effective for some children in improving attention, and decreasing behaviors, which interfere with

learning. As a result of his/her participation, my child may more effectively achieve academic goals in the classroom, and thereby increase his/her confidence as a learner. I will be informed of the results at the conclusion of the study.

All of the information collected from my child will remain confidential. That means that my child's name will not appear on any papers on which information is recorded. The forms will all be coded and Janice DiGiovanni will keep a separate master list with the names of the participants and the corresponding code numbers. Once the data are collected and analyzed, the master list will be destroyed. All other forms will be retained for three years in a locked file in the special education department at Western Michigan University.

I may withdraw my child at any time during the study without prejudice or penalty. If I have any questions or concerns about this study, I may contact either Janice M. DiGiovanni at 616-674-8091 or Dr. Howard Poole at 616-387-5935. I may also contact the chair of the Human Subjects Institutional Review Board at 387-8293 or the vice president for research at 387-8298 with any concerns that I have.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board as indicated by the stamped date and signature of the board chair in the upper right corner of all pages. I should not sign this document if the corner does not have a stamped date and signature.

_____ _____

my child's name (please print) my child's date of birth

_____

parent's name (please print)

Western Michigan University
Department of Special Education
Principal Investigator: Janice M. DiGiovanni,OTR
Research Associates: Jamie Ebelewski, Hattie Walker, Robin Spring
Research Advisor: Dr. Howard Poole, Special Education Dept., WMU

Script for Phone Contact to Request Permission to Obtain
Copy of Subject's Report Card Grades for 2000-01 School Year

Researcher: Hello. This is Janice DiGiovanni the researcher working on the study about the Play Attention computerized feedback program that your son used this past school year. I am calling to ask your permission to obtain a copy of [subject's name]'s report card grades for the 2000-2001 school year from his school file and to use them as data in my research report. As with any other data from this research project, your child's name will be removed from the report card copy and will remain confidential. Although this information will be helpful, your child has completed his participation in the study and you are under no obligation to give me this permission. Do you have any questions about this request?

If Parent has no questions, Researcher will continue as follows. If Parent has questions, Researcher will answer and then continue as follows.

Researcher: So, is it all right with you if I get a copy of [subject's name]'s 2000-2001 report card to use as data in my research report?

If no, Researcher responds: Then I will not be obtaining any additional information about your child. Thank you for you for talking with me today. I hope you have a great summer.

If yes, Researcher responds: Then I will send you a permission form to sign and return to me in a self-addressed, stamped envelope. I will not get a copy of the report card grades until I have received your signed permission. Thank you for your time on the phone. I hope you have a great summer.

Western Michigan University
Department of Special Education
Principal Investigator: Janice M. DiGiovanni, OTR
Research Associates: Jamie Ebelewski, Hattie Walker, Robin Spring
Research Advisor: Dr. Howard Poole, Special Education Dept., WMU

If I sign this form, Mrs. DiGiovanni will get a copy of my report card grades for 5th grade. She will see if my grades improved after I did the Play Attention training. My participation in this study is over and if I do not want Mrs. DiGiovanni to look at my grades and use them in her research, I do not have to sign this form.

_____ _____

subject's signature date

September 20, 2000

Dear Janice:

You have my permission to implement the study entitled *A study of the effectiveness of a commercially available feedback training program in increasing the classroom attending skills of students with attention deficit disorder,* as described in the parental letter of consent, at [name of school] during the 2000-01 school year.

It is my understanding that three students will participate in the study and that no student will participate without the written consent of the parent or guardian, as well as the verbal consent of the student's teacher. I further understand that you will schedule all aspects of the study so as not to interfere with the educational goals of the individual student or the classroom teacher. I am aware that trained occupational therapy students from Western Michigan University will carry out the training phase of the study. I expect this study to be implemented by you in accordance with the standards of the Human Subjects Institutional Review Board of Western Michigan University, ensuring the safety and confidentiality of students at [...] School. You have agreed to provide me with a report of the results of the study.

With all of this in mind, you have my full support in carrying out a project that aims to improve students' abilities to learn in the classroom.

_____

[principal's name]/principal/school name

Appendix B

Subject Recruitment Memo

To: [teacher's name], teacher for the Classroom Assistance Program
From: Janice M. DiGiovanni, OTR
Re: proposed research study and opportunity for [...] students

In January, I will have the volunteers and program to do feedback training to improve attending skills with three students. To see what the program is all about, you can go to playattention.com on the web. The training will take place twice weekly, 30-40 minutes, for 10 weeks. Students eligible for this program should have as many as possible of the following characteristics:

- medical diagnosis of ADD or ADHD
- no other medical, psychiatric, or educational diagnosis
- no severe social/emotional issues other than those resulting from the ADD/HD
- in grade 3, 4, or 5
- significant difficulty attending to teacher instruction and seat work
- participating in CCC reading or math program in computer lab
- no history of excessive absences
- no history of repeated lice infestation
- teacher consents to student's participation twice weekly
- teacher consent to allow observation and/or videotaping of the student in the classroom setting
- parental consent to participate (When prospective subjects are identified, I will go over the consent form in detail with parents and obtain signed consent prior to subjects inclusion in the study.)

Kathy: Think about this and let me know what students you think would benefit most. Of course, I would contact the teacher and parents of prospective students to explain exactly what is involved and obtain written permissions. Thanks for your help.

Appendix C

Data Collection Forms for On-task Behavior

OBSERVATION OF ON-TASK BEHAVIOR

Date_____

Subject #_____ Tape #_____

Observer_____

Minute	00	10	20	30	40	50
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

total +'s = _____ total –'s = _____

time on-task = $\frac{\text{+'s}}{\text{+'s + –'s}}$ X 100 = _____%

Comments:_____

_____

Note. From "Direct Observation of Academic Learning Time," by R. Wilson, 1987, Teaching Exceptional Children, Winter, p. 16. Copyright 1986 by CEC. Adapted with permission.

VIDEOTAPE RECORD

Tape ID # _____ Subject # _____

Date taped _____

Tape order # _____ Study Phase _____

Tape ID # _____ Subject # _____

Date taped _____

Tape order # _____ Study Phase _____

Tape ID # _____ Subject # _____

Date taped _____

Tape order # _____ Study Phase _____

Tape ID # _____ Subject # _____

Date taped _____

Tape order # _____ Study Phase _____

Tape ID # _____ Subject # _____

Date taped _____

Tape order # _____ Study Phase _____

Appendix D

Coaches' Anecdotal Record Form

COACHES' ANECTDOTAL SESSION RECORD

Subject # ____ Date of Scheduled Session_____

session start time _____ session stop time _____

_____ subject present _____ subject absent

comments regarding scheduling conflicts:_____

_____

equipment function: _____ O.K. _____ problems

comments regarding equipment function:_____

_____

_____

subject's performance &/or readiness to participate:

_____ typical _____ atypical

comments regarding subject's performance &/or readiness to participate:

_____

_____

_____

Appendix E

Sample Play Attention Data Record

08/28/00 PLAY ATTENTION DATA -- [redacted]
12:49PM All User Data

Game/ Complete	Date/ Time	Duration/ Score	Avg Focus Avg Process	On-Task	Game Data
Total Time:		8 Hr 27 Min			
Glider	07/05/00	0:21	167	0:21	
No	06:01PM	138	61	100%	
Mind-Adv	05/10/00	10:16	131	8:29	Max Level: 5
	01:17PM	155	148	82%	Good Tries: 31
					Bad Tries: 30
Tower-Int	05/10/00	8:19	78	5:33	Blocks In 6min: 12
Yes	01:06PM	68	134	66%	Over Target: 2:19
Mind-Int	05/03/00	10:12	390	6:49	Max Level: 6
	01:21PM	150	135	66%	Good Tries: 30
					Bad Tries: 21
Glider	05/03/00	5:00	121	4:40	
Yes	01:10PM	1683	63	93%	
Tower-Adv	03/22/00	7:38	63	7:38	Blocks In 7min: 17
Yes	06:23PM	89	51	100%	Over Target: 0:38
Tower-Adv	03/20/00	9:49	71	7:38	Blocks In 7min: 13
Yes	02:20PM	77	60	77%	Over Target: 2:49
Tower-Adv	03/20/00	13:23	123	8:57	Blocks In 7min: 8
Yes	02:07PM	62	70	66%	Over Target: 6:23
Tower-Int	03/15/00	10:44	271	7:46	Blocks In 6min: 9
Yes	02:25PM	59	94	72%	Over Target: 4:44
Tower-Beg	03/15/00	5:10	155	5:10	Blocks In 5min: 12
Yes	02:14PM	62	70	100%	Over Target: 0:10
Glider	03/15/00	5:00	140	5:00	
Yes	02:08PM	1677	71	100%	
Glider	03/13/00	5:00	63	1:36	
Yes	02:26PM	1716	127	32%	
Glider	03/13/00	5:00	68	1:59	
Yes	02:19PM	1481	109	39%	
Glider	03/13/00	5:00	84	0:44	
Yes	02:12PM	965	125	14%	
Glider	03/13/00	5:00	82	3:31	
Yes	02:06PM	5075	144	70%	

[redacted]

APPENDIX F

Study Timeline

STUDY TIMELINE / 2000-01 SCHOOL YEAR

September 27.....Attend HSIRB workshop.

October 1.....Submit application for HSIRB approval.

November 16.....Deliver subject recruitment memo to Kathy Howard. Make initial contacts with parents as soon as permissions received.

December 10.....Target date to obtain all parental consent forms.

December 11.....Begin baseline data collection. Distribute Conners' Teacher Rating Scale for each subject.

December 23-January 7.....holiday vacation/no school

January 8-12.....Complete baseline data on subject #1. Continue with #2 and #3. Begin independent coding of classroom videotapes.

January 15-19.....Complete baseline data on subject #2. Continue with #3. Begin Play attention training with subject #1.

January 22-26.....Complete baseline data on subject #3. Continue Play Attention training with subject #1. Start Play Attention training with subject #2.

January 29-2.....Continue Play Attention training with subjects #1 and #2. Start Play Attention training with subject #3.

February 5-9.....Week 4 data collection for subject #1.

February 12-16.....Week 4 data collection for subject #2.

February 19-23.....Week 4 data collection for subject #3.

February 26-2.....Week 7 data collection for subject #1.

March 5-9.....Week 7 data collection for subject #2.

March 12-16.....Week 7 data collection for subject #3.

March 26-30.....Complete Play Attention training with subject #1.
Week 10 data collection for subject #1.

April 2-6.....Complete Play Attention training with subject #2.
Week 10 data collection for subject #2.

April 9-13.....Complete Play Attention training with subject #3.
Week 10 data collection for subject #3.

April 16.....Distribute Conners' Teacher Rating Scale for each subject.
Complete coding of final classroom videotapes.
Begin graphing and analysis of data.

Spring Semester.....Complete report of study results in fulfillment of requirements for a masters degree in special education.

APPENDIX G

Study Budget

BUDGET

Personnel	
Stipends for 3 occupational therapy students acting as Coaches/camera persons	450.00
Equipment	
1 Play Attention helmet	129.00
Materials	
Videotapes	25.00
Copying costs	10.00
Computer disks	10.00
Paper	10.00
Total	**634.00**