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The Effectiveness of Electronic Games (Atari) Reinforcers for Increasing Appropriate Behavior in Handicapped Children

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THE EFFECTIVENESS OF ELECTRONIC GAMES (ATARI) AS
REINFORCERS FOR INCREASING APPROPRIATE
BEHAVIOR IN HANDICAPPED CHILDREN

by

James M. Payant

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ABSTRACT

The Effectiveness of Electronic Games (Atari) as
Reinforcers for Increasing Appropriate
Behavior in Handicapped Children

by

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Utah State University, 1981

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Ten subjects ranging from 9 to 16 years in age with IQ's ranging from 23 to 62 were randomly selected as contingent or noncontingent subjects for two experiments. Five subjects received contingent access to two electronic games for performance within a specified learning session, while five subjects received noncontingent access to the games. These experiments were designed to determine the effect on performance, attending, and compliance skills in the classroom, when contingent access to the electronic games was based on performance. The development of fine motor skills and/or eye-hand coordination skills as a result of game usage was examined. The generalization of any effect to the remainder of the classroom day was also evaluated.

The experimental design for these experiments was a single subject multiple baseline design for data on performance with the additional collection of attending and compliance data in a multiple baseline fashion. Probes were utilized to assess generalization effects.

A change in performance related to experimental manipulation was noted in three of five of the contingent subjects, while support for subsequent change in attending and compliance was demonstrated by fewer subjects (one subject in regard to attending; three subjects in regard to compliance). No changes in performance, attending, or compliance related to experimental manipulation were demonstrated by subjects receiving noncontingent access to the games. Nine of ten subjects (contingent and noncontingent) demonstrated gains in age equivalencies on the Upper Limb Coordination subtest of the Bruininks-Oseretsky Test of Motor Proficiency in excess of the duration of the experiment. In addition, six of ten subjects demonstrated gains on the Fine Motor Composite of this test.

(72 pages)

CHAPTER 1

INTRODUCTION

Reinforcers and leisure time activities for handicapped children are often difficult to identify, implement, and maintain. A source of reinforcement that also benefits the child's development is even a rarer commodity. As with the normal population, a handicapped child's life contains idle time to be utilized in leisure and play activities. The literature indicates a need for leisure time activities for the handicapped child (The IEP and Nonacademic Services, 1977; A Systems Model for Developing a Leisure Education for Handicapped Children and Youth [K-12], 1976). Leisure time activity for handicapped children has been receiving recent attention in that several books and professional publications have been written concerning the subject (O'Morrow, 1976; Stuart, 1976; Watson, 1975; Wehman, 1976; Wertlieb, 1976). The role of adaptive physical education and leisure time education in the development of individual educational plans for the handicapped as mandated in Public Law 94-142 is also referred to in a recent article (The IEP and Nonacademic Services, 1977). It is reported that toys often provide parents with necessary stimuli to hold their distractible child's attention and offer a starting point for efforts to extend the child's attention (Newson & Newson, 1979). Newson and Newson (1979) state ". . . our aims in using play remedially are firstly, to compensate for restricted experiences; secondly, by participating in the child's play, to expand her capabilities, especially the more general abilities of attention and cooperation which she will need for school . . . and finally perhaps to use the motivation of play to provide the exercise and the development of necessary skills" (p. 194). If a child's play activities can be made contingent upon performance in the classroom and resultantly increase the child's performance and appropriate classroom behavior, the play activities then also act as reinforcers. Ellis (1973) states that the Premack Principle or contingent access to toys may be effectively implemented with toys of "intrinsic" reinforcement value. Numerous studies in the literature demonstrate the effectiveness of contingent access to play in modifying various classroom behaviors (Rowbury, Baer & Baer, 1976; Pierce & Risley, 1975; Salzberg, Wheeler, DeVar, & Hopkins, 1971; Hopkins, Schutte, & Garton, 1971; Osborne, 1969). If leisure time activities also improve skills necessary for further learning, in addition to improving classroom behavior, the utility of this type of activity becomes twofold.

It is often the initial task of a teacher to gain control of a child's attention before proceeding with the academic tasks (Brooks, Morrow, & Gray, 1968; Kozloff, 1973). The operant control of attention span in the classroom has been demonstrated in the literature (Alabiso, 1975; Ayllon, Layman, & Kandel, 1975; Walker, Hops, & Johnson, 1975). One method of motivating a child to attend requires a reinforcer of sufficient strength to outweigh the distracting stimuli. It may also require the development of attention skills through shaping procedures.

Atari, Inc., develops and manufactures numerous computer controlled games. The potential of the electronic games as a reinforcer and a teaching device for working with handicapped children is unknown. If the Atari electronic games function as a reinforcer for handicapped children, and/or improve eye-hand coordination, and/or increase attention span, the games would be extremely useful in the classroom setting. The educational or reinforcing utility of electronic games has not been adequately demonstrated in the published research. As increasing numbers of such games appear on the market, it will be useful to examine their utility and effectiveness in improving eye-hand coordination as well as attention span with the handicapped population. The question of generalization of improved attending skills and eye-hand coordination learned through practice on the games to the classroom setting should also be examined. The assessment of progress in these skills with standardized tests and observational data will also be necessary. If the utilization of these games as a reinforcer rapidly improves classroom behavior, while actually improving the general eye-hand coordination and attention span of the handicapped child, the games then become a useful source of leisure time activity as well as a teaching device for the child.

Purposes of Research

The purposes of the proposed research are:

1. To determine the effect of contingent access to the electronic games on performance measured as the percent of problems

completed correctly or number of tasks completed during a 10-minute interval in a specified learning session.

2. To determine the effect of contingent access to the electronic games on attending behavior in the classroom when the criterion for access is performance.

3. To determine the effect of contingent access to the electronic games on compliance behavior in the classroom, when the criterion for access is performance.

4. To determine whether noncontingent access to the electronic games results in any changes in attention span, compliance, and performance in a specified learning session or in other learning sessions during the classroom day.

5. To determine the effectiveness of two electronic games on increasing attention span and improving eye-hand coordination on the games and as assessed on standardized test instruments.

CHAPTER II

REVIEW OF LITERATURE

This review of the literature examines the rationale for research in the development of eye-hand coordination, attention span, and general classroom behavior through game-like or motor activities. No direct research utilizing electronic games has appeared in the literature, but similar activities have evidenced change in classroom or learning skills.

The value of unstructured play activities in the development of motor skills has been shown for years. Bills (1950) noted personal changes among elementary school age children in gross and fine motor skills following as little as six individual and three group play therapy sessions. The theoretical literature noted that education of children through motor activity may be the most appropriate mode of instruction, especially with children exhibiting limited intellectual capability. Humphrey (1975) states that children being predominantly movement oriented will learn more quickly through pleasurable physical activity than through traditional academic learning tasks. He also theorizes that during the early school years (ages six to eight) learning is limited frequently by a relatively short attention span rather than only intellectual abilities. It would appear that under most circumstances a very high interest level is concomitant with pleasurable physical activities simply because of the expectation of pleasure children tend to associate with such activities (Humphrey, 1975). He also noted that certain perceptual motor skills can be significantly improved for certain children who take part in a physical program for specified periods of time (Humphrey, 1976). It appears that both structured and unstructured learning sessions result in change of performance in perceptual-motor skills in relatively short periods of time (six individual and three group play sessions). The unstructured play sessions tend to be more creative and are not dependent upon a set of more or less fixed exercises (Bills, 1950). Linford, Jeanrenaud, Karlsson, Witt, and Linford (1971) demonstrated that a change in activity level is also attainable with Down's Syndrome children. Through operant reinforcement contingencies, Linford, et al., generated normal levels of energy expenditure in play with two Down's Syndrome children. Van Etten and Watson (1977) also demonstrated improved motor skills with handicapped children utilizing enjoyable practice sessions involving music and games.

Toy preference or stimulus qualities of toys preferred also has been examined. A reliable preference for complexity over simplicity was noted (Gramza, Corush, & Ellis, 1972; Saegent & Jellison, 1970). Saegent and Jellison found that complex stimuli continued to grow in preference with the frequency of exposure, while preference for simple stimuli at first increased, then decreased markedly. Ellis (1973) identified that reactive toys (those not static when acted upon, but responsive) tended to be optimally reinforcing, in that they tend to maintain arousal and interest through stimulus uncertainty, complexity, and novelty.

This supports the notion of utilizing electronic games as a reinforcer and learning activity.

Marholin and Steinman (1977) cited numerous studies that have verified the utility of specifically arranged contingencies to develop social and academic behavior within the classroom setting. The viability of reinforcing specific classroom behaviors and skills has been demonstrated in behavioral research. Walker, Hops, and Johnson (1975) demonstrated an increase in appropriate classroom behavior through behavior modification or more specifically utilizing a token economy. Numerous other studies have also substantiated these results (O'Leary & Drabman, 1971; Winett & Winkler, 1972; Walker, Hops, & Johnson, 1975). The problem of generalization of classroom treatment effects has also been a point of study for researchers. Overwhelming support for reinforcing achievement and/or performance to maintain on-task behavior has been established (Aaron & Bostow, 1978; Ayllon, Layman, & Kandel, 1975; Ayllon & Roberts, 1974; Kirby & Shields, 1972; Sulzer, Ashby, Hunt, Konarski, & Krams, 1971; Winett & Roach, 1973). These various studies have examined effects of reinforcing performance of various academic activities in contrast to reinforcing on-task behavior. Performance in various subjects such as arithmetic (Kirby & Shields, 1972), reading and spelling (Sulzer, Ashby, Hunt, Konarski, & Krams, 1971) have been reinforced. In all of the studies cited above, generalization and effectiveness of obtaining control of classroom behaviors has been better when reinforcement of performance rather than appropriate classroom behavior has occurred. It is hypothesized by Marholin and Steinman (1977) that the failure to demonstrate previously trained behavior in a new environment is due to the absence of discriminitive stimuli that were established during training. Most frequently the discriminative stimulus is the teacher and in his/her absence classroom behaviors deteriorate rapidly. Marholin, et al., suggests that by reinforcing performance, the student is still required to demonstrate performance by successively completed work. The teacher's absence effects the classroom behavior less drastically in this situation. In view of this research, the contingent access to the electronic games was based on a changing performance criterion, rather than on on-task behavior.

One final area of concern is the modification of attention span through operant procedures. Alabiso (1975) demonstrated that lab training in span, focus, and selective attention generalized to a classroom setting. He trained hyperactive children in a lab or research setting by reinforcing attending and the duration of attention. The training positively affected the child's attending skills in the classroom.

This review of the literature appears to support the notion that complex activities or toys should be effective as reinforcers for improving classroom behavior, in addition to increasing attention span and improving eye-hand coordination with handicapped children. Electronic games have not been used in the past, but games and motor activities functioning in a similar role have resulted in improvement in these specified goals.

CHAPTER III

METHODOLOGY

Subjects

Ten school age subjects ranging from 9 to 16 years in age with IQ's ranging from 23-62 as assessed utilizing the Stanford-Binet Intelligence Scale (form L-M, administered between 3/21/80-5/15/80) were chosen for these experiments from students attending the Exceptional Child Center, a Utah State University Affiliated Facility. Table 1 provides the age, sex, experiment, and IQ of each subject included in this study.

Table 1

Critical Information on Subjects

SUBJECT	SEX	AGE (Yr.-Mo.) (At time of test)	IQ
1-C*	M	16-5	23
1-N**	F	11-5	44
2-C	M	10-10	62
2-N	M	12-11	45
3-C	F	12-7	50
3-N	F	16-2	33
4-C	M	9-0	49
4-N	M	13-4	46
5-C	F	11-7	48
5-N	M	13-5	40

*C = contingent access, Experiment 1

**N = noncontingent access, Experiment II

The proposal was approved by the Human Subjects Committee and a written informed consent to participate (see Appendix A) was signed by a parent of each child participating. Subject selection was based on the following criteria: The child demonstrated a short attention span in a group or individual situation as indicated by no attending in 30% of the 10-second intervals observed (see Methods section) and each child was viewed by the classroom teacher as a child requiring increased compliance skills. The children selected also demonstrated no apparent gross motor deficit or sensory deficit, which would prohibit the use of the electronic games. Five of the subjects selected randomly were assigned to participate in Experiment 1: Contingent use of the electronic games, while the remaining five subjects participated in Experiment II and received noncontingent use of the games. The random selection was completed by first pairing the subjects by IQ, sex, and baseline performance, then randomly selecting one from each pair for contingent access and the other for noncontingent access to the games.

Setting

The electronic games, Orbit and Starship, are respectively two player and one player computer controlled games simulating space flight. A 23-inch T.V. monitor is mounted in the top of an upright floor resting cabinet with the monitor tilted back from vertical. The T.V. monitor viewing screen is a Plexiglas panel that also displays colorful graphics. The object of the games is to destroy alien spacecraft while maneuvering through star and asteroid fields.

There are varying levels of difficulty on the two games. The one player game varies in difficulty by moving a lever to increase or decrease the speed at which the spacecraft enters the screen. The two player game has 10 choices ranging from beginner to super expert with increasing difficulty involved. No specific age level approximations are provided by the company regarding the difficulty of these games, but the easiest mode of each game was utilized for the purpose of these experiments to maximize success. Only Subject 2-C had access to similar games in his home, in that his family owns a video game which functions with their T.V. All children included in the study were allowed access to the games before the study commenced to enable each child to sample the potential reinforcer available during the intervention phase of this experiment. During a weekly reinforcement time in the classroom, the children were allowed to choose from various activities; including table games, outside activities, small edible reinforcers (peanuts, candy), or the electronic games. All subjects included in the study chose the electronic games as their first choice.

The games were situated in a small room within the Exceptional Child Center. The room was carpeted, but empty with the exception of a few chairs and those materials necessary for this program.

Behaviors and Recording Procedures

A. Attention Span: The percentage of time a child attended to their instructor or instructional materials was recorded. Attending was defined as eye contact with the materials or instructor and/or responding to the instructor's requests.

The child's attention span was assessed utilizing a time sampling technique. A 10 minute time sample was divided into 10 second observing and 5 second recording intervals indicated by a pre-recorded tape. A data sheet was used by the observer to record the absence or presence of complete attention during each 10 second interval. The percentage of intervals in which attending was present was calculated using the formula that follows: $\frac{\text{\# of attending intervals x}}{\text{total \# of intervals}}$ 100 = % of intervals attending. This method of assessing attention span was compared to duration data collected with a stopwatch during one of each of the subjects' contingent or noncontingent 10 minute recording sessions previous to access to the games to insure the reliability of the interval recording method. The child's attention span during game use was assessed in a similar fashion once weekly to evaluate changes in attending skills during game use. A second observer concurrently, but independently, observed once per week to obtain reliability data. For attention span the number of agreements between observers on each 10 second interval was divided by agreements plus disagreements and multiplied by 100 to obtain a reliability coefficient.

B. Eye-Hand Coordination for Fine Motor Skills: These motor acts are defined as small muscle movements of the fingers, hand, and forearm that generally involve some element of eye-hand coordination. Fine motor acts are a composite of response speed, visual motor control, and upper limb speed and dexterity (Bruininks & Bruininks, 1977). These skills were measured by the following standardized tests. The following list includes subtests and their respective reliability coefficients reported in the respective test manuals:

1. Southern California Sensory Integration Tests (Subtests: 1) motor accuracy [.67 - .93; interval consistency reliability], 2) design copying [.60 - .89; test retest]).
2. Bruininks-Oseretsky Test of Motor Proficiency (Subtests: test-retest reliability, 1) upper limb coordination [.61], 2) response speed [.60], 3) visual motor control [.70], 4) upper limb speed and accuracy [.86]).

C. Performance: Achievement during a learning session upon which the use of the games was contingent was recorded during Experiment I. During Experiment II, performance was recorded in the learning session immediately preceding game access. The performance during generalization probes was recorded in a specific noncontingent learning session for Experiment I and in a session other than that immediately preceding game access in Experiment II. These probes were completed weekly in the same session for each subject throughout the study. Achievement or performance was indicated in two ways. The first method required a percentage of correct responses, while the second means of assessing performance was by the number of correctly completed tasks during a specified time limit (e.g., the number of Distar math tasks completed in a 10 minute recording interval). This second method simply is the frequency of a specific task completed correctly within a specific time interval. Two types of performance data were necessary to accommodate the data collection process completed in the classrooms at the Exceptional Child Center. These measures were utilized in the form of a changing criterion design to allow access to the games for the group receiving contingent access (Experiment I). A changing criterion design allows for stepwise change in the criterion rate for the target behavior which provides contingent access. It allows the subject to be successful and gain access to the games at varying levels of performance before reaching the 90% performance criterion rate. This acts as a dependent measure of reinforcer effectiveness for the group receiving contingent access. The performance of subjects in the noncontingent use of games (Experiment II) was recorded for the session immediately preceding the access to the games to assess for any serendipitous effects due to close time proximity. Reliability data was not necessary on performance data, in that it is permanent nonobtrustive data.

D. <u>Game Scores</u>: The scores (per game) attained by the child during game usage were recorded. The child was allowed to play each game once daily. The games were each one minute in duration. One game requires only one player, while the second game requires two players. The presentation order alternated daily to control for any reinforcing effect of having a second player engaged in game play. The experimenter acted as the second player and minimized any verbal interaction with the subject, with the exception of instructions to improve game playing.

E. Compliance - Noncompliance: Compliance was defined as the initiation of a response to a given request within a five second interval. Requests to complete academic tasks were not included in the total number of requests. Tasks such as "What is 3 + 4?" were not included in the compliance data, while requests such as "Please, sit down." were included in the data. Pilot data indicated 15 to 20 such requests per 10 minute interval. Upon commencement of these experiments, it was discovered that some learning sessions did not include a sufficient number of requests. Appendix B was written and distributed to each instructor of a child in the experiments. Appendix B included a list of possible requests to be made during a learning session. It also stated that an instructor may be cued by the observer to complete such requests. Compliance - Noncompliance was measured in the following fashion. Observation occurred during a 10 minute interval of the learning session upon which game playing was contingent or immediately preceding access. Of the total requests made by the instructor during this session, the percentage of compliance was computed using the following formula: % compliance = $\frac{\text{requests completed (within 5 seconds)}}{\text{total \# requests}} \times 100$. The percentage of noncompliance was computed in a similar fashion. The computed percentages for compliance were graphed daily for each subject.

College students or staff members of the Exceptional Child Center naive to the purposes of the experiment served as observers. They observed and recorded the information on compliance as explained above. A second person observed concurrently, but independently, once per week for reliability assessment. Reliability or percentage agreement between observers for compliance data was determined by dividing the lowest percentage obtained by first independent observer by the highest percentage compliance by the other independent observer and multiplied by 100.

Experimental Design and Procedures

Design

The experimental design for these experiments was a single subject multiple baseline design (Baer, Wolf, & Risley, 1968) for data on performance with attending and compliance data collected and graphed in a multiple baseline fashion. Probes similar to Horner and Baer (1978) were used to assess for generalization to the classroom. The multiple baseline design requires that the experimental manipulation be introduced in sequential fashion and at different points in time for each subject. If changes in behavior are due to the presentation of the experimental condition, the changes occur sequentially as the experimental condition is presented to each subject and not previous to the intervention. Thus, the design controls for the influence of extraneous variables such as effects of time or baseline conditions. The probe data allows evaluation of generalization to the classroom with a minimal amount of interference to the daily routine of the classroom. Figure 1 is a graphical representation of the research.

Observer Training

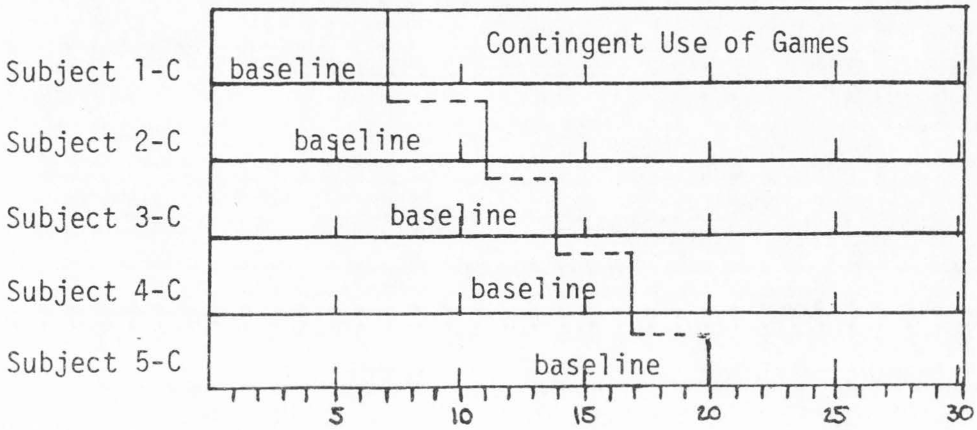
Observers were trained using videotapes. Six videotapes of 5 minutes duration each were prepared and assessed in regard to compliance and attention by a team of observers. Before the study commenced, an agreement of 90% by all observers was required on both behaviors. These videotapes were utilized throughout the study in bi-weekly re-evaluations of the observer's ratings in an effort to control for observer drift (Kent, Kanowitz, O'Leary, & Cheiken, 1977).

Baseline

Following the selection of subjects and prior to any intervention, data concerning performance in the child's contingent learning session was collected for approximately five days or until stability was achieved on each subject to commence intervention. Subjects with noncontingent access to the games (Experiment II) had the same data collected in the learning session immediately preceding access to the games.

A pre-assessment of the child's eye-hand coordination or fine motor skills was completed under the direction of an occupational therapist supervising the administration and scoring of the

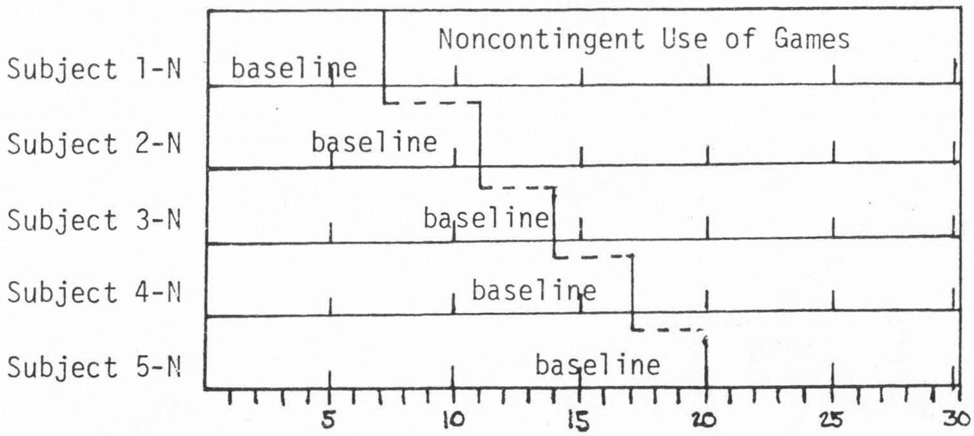
Experiment I



Solid vertical line indicates point at which probe data initiated.

TIME APPROXIMATE (IN DAYS)

Experiment II



Solid vertical line indicates point at which probe data initiated.

TIME APPROXIMATE (IN DAYS)

Figure 1. Experimental design (Experiment I and Experiment II).

previously mentioned subtests of the Southern California Sensory Integration and Bruininks-Oseretsky Test of Motor Proficiency by the examiner.

Following the collection of baseline data, each subject in Experiment I was informed by the examiner that they could play the electronic games if a set criterion determined by the mean percentage of correctly completed tasks during baseline was achieved. Each subsequent subject was provided identical information and encouraged to "work hard." Subjects beginning the intervention phase of Experiment II were informed only that they should "work hard" to gain access to the games. These subjects were allowed access to the games independent of their behavior in regard to performance, attending, and compliance.

Generalization

In addition to the daily record of performance and compliance in the contingent learning session, weekly probes were conducted to examine performance in other academic sessions by calculating the percentage of correct responses or number of tasks completed per 10 minute interval on one other learning session. The probe learning sessions were selected when observers and appropriate performance data were available. The day and time of probe sessions remained constant for all subjects throughout the study. Probes concerning attention span were also completed weekly in a learning session to assess generalization to other sessions throughout the classroom day. Both of these probes utilized techniques described in the methods section. This data was collected weekly on a specific day in one specific noncontingent learning session. Similar data was recorded in Experiment II by collecting probe data on a specified learning session other than the session immediately preceding access to the games.

Post Intervention Phase

All of the test measures utilized during the baseline phase were repeated following completion of the 24-day intervention phase to assess changes resulting from the intervention phase.

Data Analysis

The data collected was graphed in a multiple baseline fashion and analyzed for specific treatment effects in a single subject format.

Experiment I: Contingent Access to Electronic Games

The purposes of Experiment I include: (1) Determining the effect of contingent access to the electronic games on performance measured as the percent of problems or tasks completed correctly in a specified learning session, (2) determining the effect contingent access to the electronic games had on attending behavior, when the criterion for access was performance, (3) determining any changes in compliance behavior in the classroom when the criterion for access was performance, (4) determining any changes in eye-hand coordination as a result of game use.

After a five day baseline on performance, the stability of the baseline was ascertained. Stability was defined as no more than one standard deviation from the mean score of performance during the baseline data collection. If the baseline was stable, Subject 1 received contingent use of the electronic games. At three day intervals each of the remaining subjects received contingent access to the games if their baseline data was stable. Access was in a multiple baseline order; thus Subject 2 received a minimum of eight days of baseline and each additional subject received at least three days more baseline than the preceding subject. Previous to intervention, each child was given the opportunity to view and play the electronic games in order to insure that they had sampled the potential reinforcer that was available. The staggered access to the games was utilized in an attempt to demonstrate the reinforcing effects of the games by assessing changes in classroom behavior and actual performance on a specific program contingent for game use. The use of the games was initially contingent upon each child completing a criterion determined by the mean value of tasks completed daily during baseline in a contingent learning session. A changing criterion design (Hartmann & Hall, 1976) determined by the mean value of performance during each previous two days of intervention continued until the criterion of 90% correct responding was attained. If the child's performance during the first two days of intervention exceeded the original criterion, the mean value for those first two days became the new criterion. If the child's performance was below the original criterion following two days of intervention, the mean value of those days became the new criterion. This allowed flexibility for variation in difficulty of task through the quarter and also allowed each subject more frequent access to the electronic games. This was necessary to evaluate the use of games on eye-hand coordination within the contingent subjects. The compliance behavior during the classroom session was also monitored as a second determining factor of the reinforcing value of the games. Five subjects were allowed access to the games contingent upon performance in this classroom situation. This experiment continued for approximately 24 days of contingent game use for Subject 1 and with the other subjects receiving approximately three days less respectively.

Experiment II: Noncontingent Access to Electronic Games

The purposes of Experiment II were to determine whether noncontingent access to the electronic games resulted in any changes in attention span, eye-hand coordination, performance in the classroom (as measured by the percentage of problems or tasks completed correctly in the learning session immediately preceding game use), and compliance in the classroom.

Five subjects received noncontingent use of the games with staggered access (multiple baseline) with a pre-post evaluation of their eye-hand coordination. The same data was collected for these subjects as was collected for the contingent access subjects of Experiment I. The daily performance, compliance and attending data was also collected in the learning session immediately preceding game access. The same probe data collected in Experiment I was also collected during a specified learning session other than the session immediately preceding game access.

This group allowed assessment of time required practicing the games to initiate change in motor skills as well as allowing the experimenter the opportunity to assess any difference in effectiveness of generalization of motor skills from game practice to the classroom for contingent and noncontingent access to the games.

CHAPTER IV

RESULTS

Reliability

Previous to commencement of these experiments, the two students selected as observers completed six training sessions utilizing the videotapes prepared for training the observation of attention span and compliance. During each training session each observer reviewed and evaluated three of the six 5 minute tapes prepared for training. The interobserver reliability on attention span across the six training sessions ranged from 88.3% to 100% across the observers with an average reliability coefficient of 94.5%. The reliability of compliance behavior over the six training sessions ranged from 83.3% to 98.5% with an average reliability coefficient of 92.2%. Following these training sessions and achievement of the criteria stated for these experiments, the actual classroom observation commenced. Three additional reliability assessments were completed utilizing the training tapes during the actual experiments as one means of assessing reliability on these two behaviors. The reliability coefficients obtained during these post-training sessions ranged from 90% to 98.3% with an average mean coefficient of 94.8% in regards to attending. The reliability coefficients obtained concerning compliance ranged from 90% to 96.7% with a mean of 92.8%. This indicated a continuance of reliability throughout the 30 days of these experiments.

Three sessions were also evaluated by comparing each observer to their own previous evaluations of three of six videotapes prepared for training. This procedure was completed in an effort to control for observer drift (Kent, Kanowitz, O'Leary, & Cheiken, 1977). The three reliability coefficients obtained to assess observer drift for Observer I ranged from 91.7% to 98.3% with a mean of 96.1%. Observer II obtained reliability coefficients ranging from 93.3% to 98.3% with a mean of 95%. These coefficients indicate that there was no significant drift in reporting in regards to attending or compliance.

Reliability evaluations were also completed once weekly between an observer and the researcher during actual 10 minute intervals of recording in the classroom. The percentage of agreement between observers in regards to attending during these six evaluations ranged from 90% to 100% with a mean of 97.5%, while the percentage of agreement in regards to compliance ranged from 93.3% to 100% with a mean of 92.5%.

Two other forms of reliability checks were completed in regards to attending skills. The reliability of attending skills during game use ranged from 95% to 100% with a mean of 98.5% between the examiner and either one of the observers, indicating accurate reporting of this data. The final form of reliability data collected was in regards to the method of obtaining the percentage of time attending utilizing 10 second intervals. The method was compared to duration data collected utilizing a stopwatch during one session for each of the 10 subjects included in the study. Over the 10 sessions, percentage of intervals was compared to percentage of time involved in attending by dividing the lower percentage obtained by the highest percentage obtained and multiplying by 100. In all cases except for one session which varied only .5%, the percentage of intervals was lower than the percentage of time by 1.1% to 15% with a mean of 6.7% higher than the interval method of assessment. This indicates that the interval method of observation of attending skills utilized in this study consistently underestimated the time involved in attending by the subjects.

Overall, the realibility coefficients obtained throughout this study indicate consistent and reliable reporting of attending and compliance skills in all settings across observers. The data indicates, however, the interval data on complete attending appear to be a consistent underestimate of overall attending over the 10 minute intervals.

Experiment I: Contingent Access to Electronic Games

Figure 2 provides a graphical representation of performance, attending, and compliance during baseline and intervention phases of Experiment I. Performance data was recorded in open circles, attending behavior in triangles, and compliance behavior in squares. Any dotted lines present on the graph indicate days where data was not collected. This data may not have been collected for various reasons including the subject's absence, the observer's absence, or a special activity within the classroom

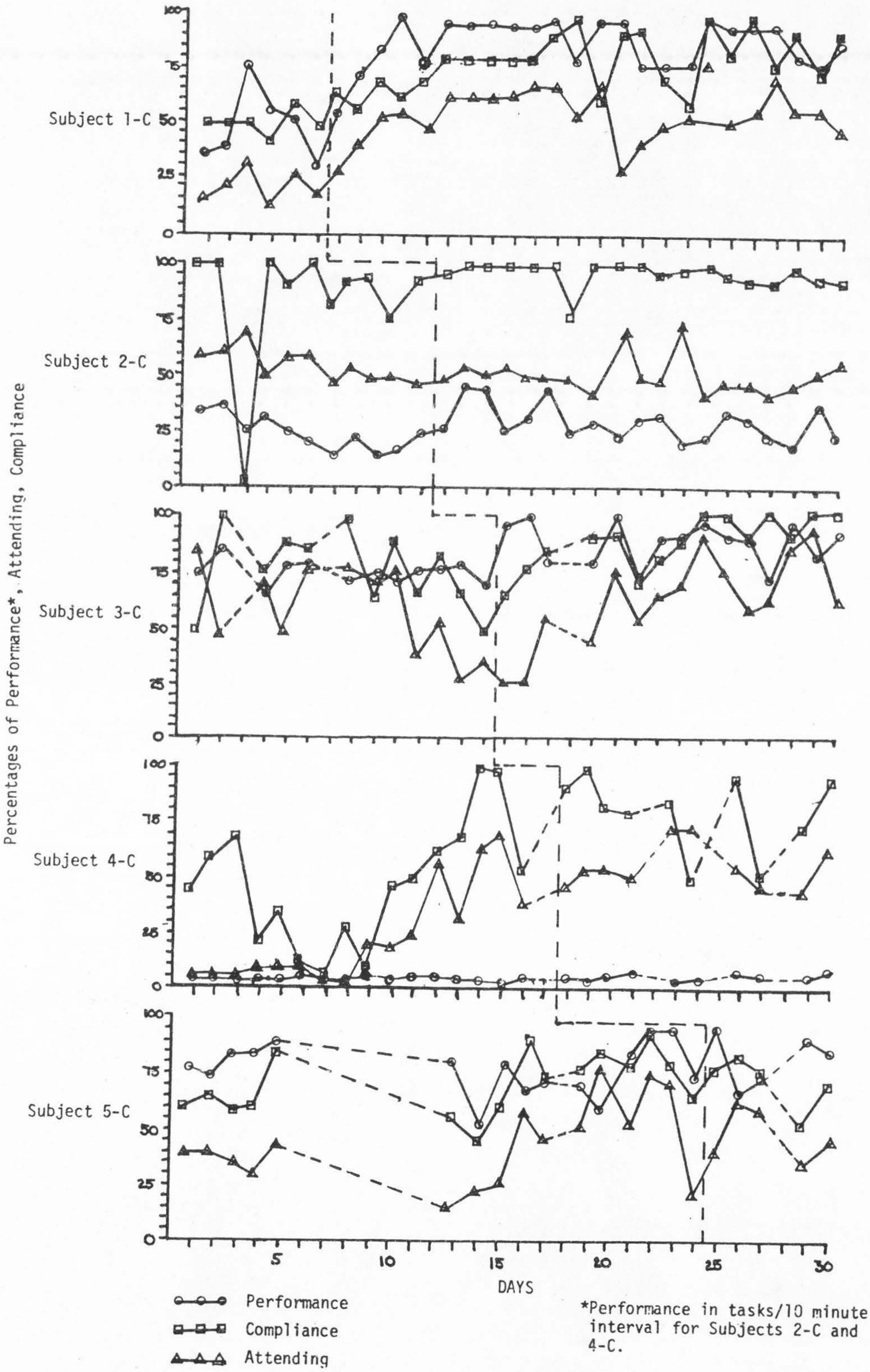


Figure 2. Multiple baseline of Experiment I.

which prevented the subject from completing the specified learning session.

The general overall trend following intervention was an increase in performance, attending, and compliance for all five subjects, although changes were small for some subjects. Considerable intersubject variability was present and gains became more apparent when the data was summarized in tabular form. Table 2 lists the tasks completed by each contingent subject during the contingent learning session and the generalization probes. Table 3 presents average baseline and intervention levels on each of the dependent variables for each subject, while Table 4 indicates net gains by each of the five subjects from baseline to intervention phases.

Table 2

Tasks Completed by Subjects in Experiment I

Subject	Contingent Learning Session	Noncontingent Learning Session
1-C	Sorting Clothes	Language
2-C	Sullivan Reading	Time Telling
3-C	Speech	Distar Reading
4-C	Distar Math	Distar Reading
5-C	Speech	Time Telling

Table 3

Average Percentages of Performance, Attending, and Compliance (Experiment I)

Subject	Baseline		
Subject	Performance	Attendance	Compliance
1-C	48.1%	20.8%	51.3%
2-C	25.5*	56.5%	83.5%
3-C	75.1%	60.8%	76.5%
4-C	2.7*	24.7%	48.8%
5-C	81.5%	44.9%	74.2%

Subject	Intervention		
Subject	Performance	Attendance	Compliance
1-C	88.4%	54.3%	78.5%
2-C	31.1*	57.8%	95.2%
3-C	89.9%	63.8%	89.5%
4-C	3.8*	61.8%	80.0%
5-C	87.1%	52.5%	80.4%

*Tasks per 10 minute interval completed correctly

Table 4

Net Gains
(Experiment I)

Subject	Performance	Attendance	Compliance
1-C	40.3%	33.5%	27.2%
2-C	5.6*	1.3%	11.7%
3-C	14.8%	3.0%	13.0%
4-C	1.1*	37.1%	31.2%
5-C	5.6%	7.6%	6.2%

*Tasks per 10 minute interval completed correctly.

As can be seen in Table 4, the net gains in performance recorded in percentages ranged from 5.6% to 40.3% with a mean gain of 20.2%. The net gains in performance recorded in tasks completed correctly during a 10 minute recording interval ranged from a 1.1 to 5.6 increase with a mean of 3.4. Increases in attending data ranged from 1.3% to 37.1% with a mean gain of 16.5%, while increases in compliance data ranged from 6.2% to 31.2% with a mean gain of 17.9%. The overall average gains across all subjects in Experiment 1 are presented in Table 5.

Table 5

Average Gains (Experiment I)

Performance (3)	20.2%
Performance (2)*	3.4
Attending	16.5%
Compliance	17.9%

*Tasks per 10 minute interval completed correctly.

Generalization Data. In addition to the data collected during the contingent learning sessions, probe data regarding performance, attention span, and compliance were also completed weekly in a specific noncontingent learning session to assess generalization to other learning sessions. Table 6 presents the average baseline and intervention levels for each subject, while Table 7 indicates net gains in regards to performance, attending, and compliance during the six or seven probe days for each subject.

Gains were noted in all dependent variables from baseline to intervention across all subjects included in Experiment I. Some gains even exceeded gains within the contingent learning session. These gains were in performance and attending for Subject 2-C; attending for subject 3-C; and attending and compliance for subject 5-C. The average gains for all subjects included in Experiment I are presented in Table 8. Average gains noted

Table 6

Average Percentage of Performance, Attending, and Compliance for Probe Data

Subject	Baseline		
	Performance	Attending	Compliance
1-C	45%	30%	45%
2-C	68.8%	37.5%	85%
3-C	3.5*	75.0%	73.5%
4-C	3.3*	23.3%	49.2%
5-C	82.9%	55.0%	73%

Subject	Intervention		
	Performance	Attending	Compliance
1-C	59.5%	54.5%	69.5%
2-C	79.4%	58.1%	91.7%
3-C	6.3*	88.3%	80.0%
4-C	5.0*	63.3%	93.3%
5-C	84.6%	67.5%	88.5%

*Tasks per 10 minute interval completed correctly.

Table 7

Net Gains for Probes

Subject	Performance	Attending	Compliance
1-C	14.5%	24.5%	24.5%
2-C	10.6%	20.6%	6.7%
3-C	2.8*	13.3%	6.5%
4-C	1.7*	40.0%	44.1%
5-C	1.7%	12.5%	15.5%

*Tasks per 10 minute interval completed correctly.

Table 8

Average Gains on Probes
(Experiment I)

Performance (3)	8.9%
Performance (2)	2.3
Attending	22.2%
Compliance	19.5%

*Tasks per 10 minute interval completed correctly.

during the probes collected weekly indicate gains in all dependent variables, though to a lesser extent than during the contingent learning session with the exception of the average gains in attending and compliance skills on probe days.

Attending During Game Use. Attending during game use was also assessed to determine improvement with continued game use, but the level of attending to the games was high from the onset of intervention and showed no apparent trends. All subjects included in Experiment I demonstrated attending skills between 75% and 100% of the 10 second intervals assessed with a mean of 98.5% attending.

Game Scores. Game scores were also recorded daily to assess improvement on the games, but with the exception of Subject 2-C, who improved from a score of 350 to 1650 on game 1, no pattern of improved game scores with continued game use was noted. No subjects demonstrated decreasing scores, but maintained fairly consistent scoring throughout the duration of the experiment. Subject 2-C was the only subject to have access to similar games in the home.

Fine Motor Data. The final form of data collected on subjects included in Experiment I was the pre-post measures of fine motor skills. No significant differences in standard scores in regard to changes in performance were noted on either subtest of the Southern California Sensory Integration Test. Significant differences in standard scores on the Bruininks-Oseretsky Test of Motor Proficiency were also absent with the exception of significant age (surpassing duration of experiment) age equivalent differences on the Upper-Limb

Coordination subtest and Fine Motor Composite age equivalents. The Fine Motor Composite include the response speed, visual-motor control, and upper limb speed and dexterity subtests. Table 9 represents the pre-post age equivalent scores for the Upper Limb Coordination subtest and the Fine Motor Composite, while Table 10 indicates gains and days of game use for each subject in addition to average gains across all five subjects.

Table 9

Age Equivalent Scores on Upper Limb Coordination and Fine Motor Composite (Bruininks-Oseretsky) for Subjects (Experiment I)

Subject	Pre - A.E. U.L.C.(yr.-mo.)	Pre - A.E. F.M.C.	Post - A.E. U.L.C.	Post - A.E. F.M.C.
1-C	6-2	<4-2	6-8	4-2
2-C	5-5	5-8	6-8	5-2
3-C	6-8	4-8	7-5	5-2
4-C	4-5	<4-2	4-8	<4-2
5-C	4-5	<4-2	5-11	4-5

Table 10

Gains in Upper Limb Coordination and Fine Motor Composite (Experiment I)

Subject	Gain U.L.C. (Yr.-Mo.)	Gain F.M.C.	Days of Game Use
1-C	0-6	∿0-1	16
2-C	1-3	-0-6	10
3-C	0-9	0-6	11
4-C	0-3	0	7
5-C	1-6	∿0-3	4
Total	51	4	
Ave. Gain	10.2	.8	

∿ = approximately

The average gain noted on the Upper Limb Coordination subtest over the 30-day experiment was 10.2 months, while the gain on the Fine Motor Composite equaled only .8 months.

Experiment II: Noncontingent Access to Electronic Games

Figure 3 provides a graphical representation of performance, attending, and compliance during baseline and intervention phases of Experiment II. Changes at the time of intervention were generally small and not necessarily immediate. The changes were more apparent when the data was summarized in tabular form. Table 11 provides a list of tasks completed in the learning session immediately preceding game use and during generalization probes. Table 12 provides the average performance, attending,

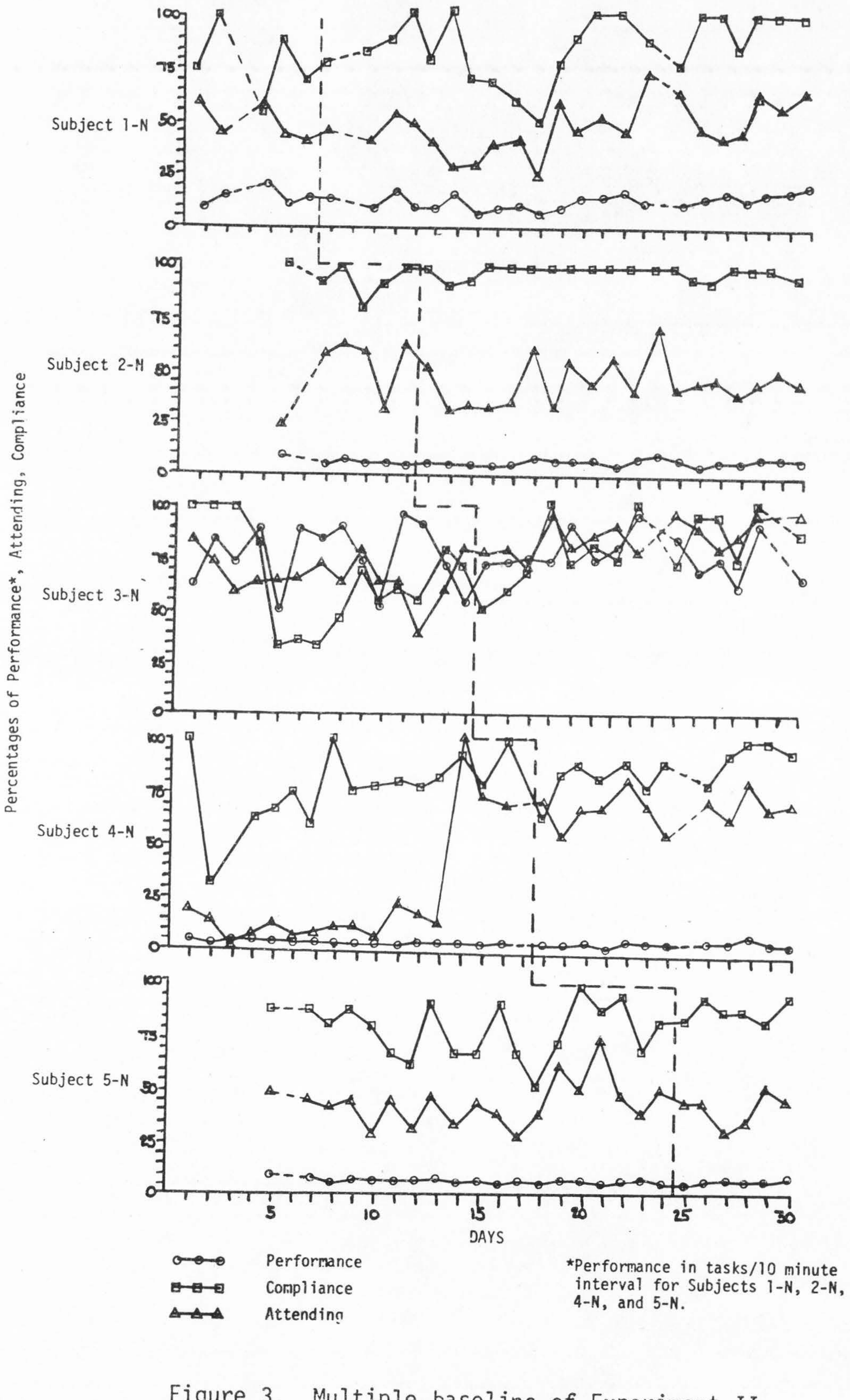


Figure 3. Multiple baseline of Experiment II.

Table 11

Tasks Completed by Subjects in Experiment II

Subject	Learning Session Immediately Preceding Game Use	Learning Session Removed from Game Use
1-N	Distar Reading	Distar Math
2-N	Fine Motor Matching	Sight Reading
3-N	Time Telling	Sight Reading
4-N	Distar Math	Distar Reading
5-N	Fine Motor Matching	Sight Reading

Table 12

Average Percentages of Performance, Attending, and Compliance (Experiment II)

	Baseline		
Subject	Performance	Attending	Compliance
1-N	14*	50.0%	79.0%
2-N	6.7*	52.9%	93.2%
3-N	77.3%	66.6%	66.5%
4-N	3.1*	25.6%	72.5%
5-N	5.6*	46.4%	82.0%
	Intervention		
Subject	Performance	Attending	Compliance
1-N	14.2*	50.3%	86.6%
2-N	7.8*	50.1%	97.9%
3-N	76.7%	84.6%	79.7%
4-N	4.5*	68.8%	87.0%
5-N	8.2*	46.6%	88.6%

*Tasks per 10 minute interval completed correctly.

and compliance percentages for baseline and intervention phases of Experiment II for each of the subjects, while Table 13 provides the net gains in each of the dependent variables.

Table 13

Net Gains for Session Immediately Preceding Access (Experiment II)

Subject	Performance	Attending	Compliance
1-N	.2*	.3%	7.6%
2-N	1.1*	-2.8%	4.7%
3-N	-.6%	18.0%	13.2%
4-N	1.4*	43.2%	14.5%
5-N	2.6*	.2%	6.6%

*Tasks per 10 minute interval completed correctly.

As can be seen in Table 13, the net gain in the only performance recorded in percentage was -.6%. The remaining four subjects had data recorded in tasks completed correctly during a 10 minute recording interval. The increase in tasks completed ranged from .2 to 2.6 with a mean of 1.3. Increases in attending behavior ranged from -2.8% to 43.2% with a mean gain of 11.8%, while increases in compliance behavior ranged from 4.7% to 14.5% with a mean gain of 9.3%. The overall gains across all subjects in Experiment II are presented in Table 14. Table 14 indicates that although some gains were noted on attending amd compliance, these gains were lower than with the subjects in Experiment I.

Table 14

Average Gains (Experiment II)

Performance (1)	-.6%
Performance (4)*	1.3
Attending	11.8%
Compliance	9.3%

*Tasks per 10 minute interval completed correctly.

Generalization Data. Probe data collected was similar to that obtained in Experiment I on performance, attending, and compliance in a learning session other than the one immediately preceding game access. These probes were completed weekly to assess variations in performance from one learning session to another. The data collection for these probes was similar to those described in the methodology section. Table 15 presents the average baseline and intervention levels of each subject, while Table 16 indicates net gains in performance, attending, and compliance during the six or seven probes for each subject in Experiment II. Gains were noted across all dependent variables assessed during probes.

Table 15

Average Percentage of Performance, Attending, and Compliance for Probe Data (Experiment II)

	Baseline		
Subject	Performance	Attending	Compliance
1-N	4*	50.0%	60.0%
2-N	32.5%	70.0%	92.5%
3-N	82.5%	58.8%	45.0%
4-N	4.8*	15.6%	61.3%
5-N	82.9%	55.0%	73.0%

	Intervention		
Subject	Performance	Attending	Compliance
1-N	4.4*	57.5%	60.5%
2-N	55.8%	88.3%	96.7%
3-N	86.3%	78.3%	85.0%
4-N	6.3*	58.3%	88.3%
5-N	84.6%	67.5%	88.5%

*Tasks per 10 minute interval completed correctly.

Table 16

Net Gains on Probes (Experiment II)

Subject	Performance	Attending	Compliance
1-N	.4*	7.5%	.5%
2-N	23.3%	18.3%	4.2%
3-N	3.8%	19.5%	40.0%
4-N	1.5*	42.7%	27.0%
5-N	1.7%	12.5%	15.5%

*Tasks per 10 minute interval completed correctly.

Table 17 provides the average gains across all subjects included in Experiment II in regards to performance, attending, and compliance during probes.

Table 17

Average Gains on Probes
(Experiment II)

Performance (3)	9.6%
Performance (2)*	.95
Attending	20.1%
Compliance	17.4%

*Tasks per 10 minute interval completed correctly.

Increases are demonstrated in the probe data over all dependent variables. These gains are larger than those noted in Table 14 presenting average gains in the sessions immediately preceding game use with the exception of performance data recorded in tasks completed correctly per 10 minute interval.

Attending During Game Use. Attending during game use was also assessed in Experiment II to determine improvement with continued game use, but as with the subjects in Experiment I, the level of attending to the games was high from the first day of access and remained near 100% attending throughout the experiment.

Game Scores. Game scores also did not indicate any improvement on the games, as they remained fairly constant through the duration of the experiment.

Fine Motor Data. As with the subjects in Experiment I, only the pre-post age equivalent scores for the Upper Limb Coordination subtest and Fine Motor Composite demonstrated any significant change in fine motor skills or eye-hand coordination. Table 18 represents the pre-post age equivalent scores for the Upper Limb Coordination subtest and the Fine Motor Composite, while Table 19 indicates gains and days of game use for each subject in addition to average gains for all subjects of Experiment II. The average gain indicated on the Upper Limb Coordination subtest over the 30-day experiment for the subjects of Experiment II was 9.2 months, while the gain on the Fine Motor Composite over the same period was 3.2 months.

Table 18

Age Equivalent Scores on Upper Limb Coordination and Fine Motor Composite (Bruininks-Oseretsky) for Subjects (Experiment II)

Subject	Pre - A.E. U.L.C.	Pre - A.E. F.M.C.	Post - A.E. U.L.C.	Post - A.E. F.M.C.
1-N	5-2	4-2	6-8	4-8
2-N	<4-2	<4-2	4-2	4-2
3-N	4-8	<4-2	5-5	4-5
4-N	6-2	4-2	7-5	4-5
5-N	4-8	<4-2	4-11	4-5

Table 19

Gains in Upper Limb Coordination and Fine Motor Composite (Experiment II)

Subject	Gain U.L.C. (yr.-mo.)	Gain F.M.C.	Days of Game Use
1-N	1-6	0-6	23
2-N	∿0-1	∿0-1	19
3-N	0-9	∿0-3	15
4-N	1-3	0-3	12
5-N	0-3	∿0-3	6
TOTAL	46 (mo.)	16 (mo.)	
Ave. Gain	9.2 (mo.)	3.2 (mo.)	

∿ = approximate

CHAPTER V

DISCUSSION AND CONCLUSIONS

Purpose 1 of these experiments was to determine the effect of contingent access to the electronic games on performance in a specified learning session. The effect of contingent access to the electronic games on performance varied across subjects included in Experiment I. This is demonstrated by the multiple baseline design data shown in Figure 2. Subjects 1-C, 2-C, and 3-C demonstrated immediate gains in performance on the first day of intervention. The gains resulted in performance levels that were higher than that shown during any day of baseline. Subject 2-C demonstrated a subsequent decrease shortly following intervention. This subject's initial gain may indicate a novelty effect, but in that this subject had similar games in the home, this is unlikely. It is more likely that short access to the games (two minutes daily) was frustrating for the student. This subject also had the highest IQ of all subjects in the study, indicating a possible correlation with IQ and reinforcing value for short periods to game access. Subject 4-C and 5-C's performance was generally not different from that shown during the last few days of baseline; although means taken during baseline and contingent access to the games demonstrated gains in performance from baseline to intervention. Such gains for Subjects 4-C and 5-C cannot be accounted for by the experimental manipulations made, since the changes did not occur at the time the contingency was introduced. The gains for the other three subjects occurred sequentially as the contingency was introduced, thus lending support to the conclusion that the changes were due to the contingent access to the games. The results obtained were recorded across a variety of tasks including: Sorting, reading, speech, and Distar math. The gains achieved by Subjects 1-C, 2-C, and 3-C support the literature demonstrating the effectiveness of contingent play in modifying various classroom behaviors (Rowbury, Baer, & Baer, 1976; Pierce & Risley, 1975; Salzberg, Wheeler, DeVar, & Hopkins, 1971; Hopkins, Schutte, & Garton, 1971; Osborne, 1969). The gains demonstrated by three of the subjects also support the utility of specifically arranged contingencies to develop academic behavior within the classroom setting cited by Marholin and Steinman (1977) and numerous others. Since Subjects 4-C and 5-C did not demonstrate sequential changes, the most obvious conclusion would be that contingent access to the electronic games was not a functional reinforcer for these subjects. The subjects' behavior around the researcher indicated differently. The children were extremely eager to gain access to the games as indicated by their increased verbalizations with the researcher and repeated requests for game access previous to, during, and following these experiments. Following the experiment, the electronic games have continued to function as reinforcers in changing or shaping other appropriate classroom behaviors. Such anecdotal information may indicate that the games were reinforcing enough to increase their verbal requests. It is also possible that the experimenter had acquired conditioned reinforcing value. The classroom teacher also noted significant changes in Subject 4-C's behavior throughout the classroom day, in that there was an increase in attending skills and compliance. Since the games seemed to be reinforcing, other possible explanations for the lack of behavior change need to be examined. The results obtained by Subject 4-C may indicate that some of the variability between subjects is a result of the differences in the difficulty of the prescribed tasks. Subject 1-C demonstrated the greatest gains on a task that was extremely easy (sorting), while Subject 4-C demonstrated a minimal gain on a relatively difficult task (Distar math). Since Subject 4-C was involved in an extremely difficult task, there was a frequent loss of access to the games by failing to meet criterion. This may have resulted in decreased reinforcing value for the games themselves. Subject 5-C received an operation to correct hearing acuity during the long absence indicated by the lack of data from day five to day thirteen of baseline. The resultant increased performance during baseline minimized the likelihood of significant gains at the time of intervention, in that the subject was approaching 100% success. Further variability from session to session also resulted from varying classroom conditions such as special activites going on in the classroom, varying noise levels, tours observing the children, or other students' misbehavior disrupting the session; conditions fully out of control of the experimenter.

Changes in attending behavior as a result of contingent access to the games for increasing performance was less adequately demonstrated. Concomitant change in on-task behaviors, including attending and compliance, have been demonstrated in various studies across numerous tasks (Aaron & Bostow, 1978; Ayllon, Layman, & Kandel, 1975; Ayllon & Roberts, 1974; Kirby & Shields, 1972; Sulzer, Ashby, Hunt, Konarski, & Krams, 1971; Winett & Roach, 1973). Changes in attending skills were therefore observed to determine whether contingent access for performance resulted in subsequent changes in attending, purpose 2 of the experiment. Subject 1-C was the only subject who demonstrated increased attending at the time of intervention and who maintained that change above baseline levels. Subject 3-C demonstrated a gain shortly after intervention and returned to or slightly above baseline levels as intervention continued. This change also appeared to reverse a declining trend in attending present during the later days of baseline. Subjects 4-C and 5-C maintained or slightly improved increased levels of attending demonstrated during the later days of baseline. This would lend some support to the researchers cited earlier who did demonstrate or indicate changes in on-task behaviors by reinforcing performance. The most probable explanation for the variability in attending skills across contingent subjects is that some of the tasks did not require a high rate of attending in order to be completed. The variability in change of attending skills might also be related to several factors in the classroom. Subject 4-C exhibited an increase in attending behavior on day twelve of baseline, which was the result of a new instructor (classroom teacher) during this learning session. This change was maintained upon intervention and surpassed baseline levels on three days. Subject 5-C exhibited a generally increasing trend in attending skills following an operation (completed between day five and thirteen of baseline) to improve hearing acuity. Subject 5-C exhibited a return to baseline levels when contingent access to the games was implemented, following a large decrease in attending on the day before intervention. The gain following the operation most probably was indicative of the improved hearing, but further gains were absent following intervention leading the researcher to believe that no change in attending skills resulted at the time of intervention. The data obtained for Subject 1-C and to a lesser extent Subjects 3-C, 4-C, and 5-C during Experiment I supported previous research cited.

The third purpose of Experiment I was to evaluate the effect of contingent access to the electronic games on compliance when performance provides access. As cited earlier, many researchers have demonstrated changes in on-task behavior when reinforcing academic performances. Changes in compliance behavior were evident in Experiment I for Subjects 1-C, 2-C, and 3-C. They all exhibited changes in compliance at the time of intervention, while Subjects 4-C and 5-C did not. While all subjects demonstrated gains when comparing the mean compliance during baseline with intervention, the gains by Subjects 4-C and 5-C cannot be accounted for by the introduction of the contingent access to the games. Gains by

Subjects 1-C, 2-C, and 3-C occurred as the contingent access was provided thus supporting the conclusion that changes were due to the experimental manipulation. The most obvious conclusion once again must be that the games lacked sufficient reinforcing value for Subjects 4-C and 5-C. In that the subjects' verbalizations indicated differently, other plausible explanations need to be explored. Subject 4-C was involved in an extremely difficult task in Distar math, thus resulting in frequent loss of access to the games by failing to meet criterion. This may have resulted in decreased reinforcing value for the games themselves. Subject 5-C's improvement in performance, attending, and compliance following an operation to improve hearing acuity may have limited the area for improvement at the time of contingent access, since a majority of 5-C's performance (the criterion variable) levels were between 80% to 100% in the last days of baseline. Each subject's IQ, age, and sex were compared to the gains demonstrated across all dependent variables and these factors played no consistent part in the variability across subjects. As with performance, compliance seems to vary with the difficulty of the task, a change in instructor, and/or a change in daily classroom distractions.

The average gains in performance, attending, and compliance for noncontingent subjects (Experiment II) were smaller than for the contingent subjects. Generally, no significant changes occurred at the time of intervention for any noncontingent subject with the exception of Subject 1-N in regards to compliance. These results suggest that any change in these dependent variables was a result of other factors in the classroom or factors related to the observation of these subjects. Fluctuations in each of these dependent variables may have resulted from the range of difficulty in the task encountered daily in a specified learning session. The presence of an observer in conjunction with the instructions to "work hard" could possibly account for: Generally increasing trends in performance, attending, and compliance for Subject 1-N near the end of the intervention phase; a slight increase in performance with fairly consistent 100% compliance behavior for Subject 2-N following several days of intervention; and generally higher attending and compliance behavior beginning on day four of intervention for Subject 3-N. Subject 4-C had a change in instructor on day twelve of baseline to the classroom teacher. This could possibly have resulted in the significant gain on day fourteen that was maintained at a significantly higher rate for the duration of these experiments. Since a multiple baseline design requires that changes occur when or shortly after the experimental manipulation was introduced, the changes that occurred were not controlled experimental fluctuations (Baer, Wolf, & Risley, 1968). No gains were expected in performance, attending, or compliance for these subjects since no specific contingency had been arranged (Marholin & Steinman, 1977). Any changes that did occur were due to classroom variations not controlled by this experiment.

The variations or fluctuations evident in the noncontingent subjects allows examination of the contingent subjects' gains to changes in noncontingent subjects resulting from other classroom variations or observation. The gains within the contingent subjects exceeded the noncontingent subjects by 20.8%, 2.1 (task), 4.7%, and 8.6% respectively in performance, attending, and compliance during contingent sessions or sessions immediately preceding game access for Experiment II. This data is related to the first part of purpose 4 of this research, to determine whether noncontingent access to the electronic games resulted in any changes in performance, attending, and compliance in the classroom.

The second part of purpose 4 was to assess generalization by using the probe data collected for these experiments (Horner & Baer, 1978). A change in performance, attending, and compliance occurred in at least one other learning session during the subjects' day after the subjects received access to the games. Gains were noted in all contingent and noncontingent subjects. The average gains calculated from probe data for the contingent subjects (Performance: 8.9%; Performance [task]: 2.3; Attending: 22.2%; Compliance: 19.5%) from baseline to intervention was essentially the same for performance, attending, and compliance as their noncontingent counterparts (Performance: 9.6%; Performance [task]: .95; Attending: 20.1%; Compliance: 17.14%). Since no contingencies were involved during probe sessions, these differences most probably are the result of general improvement over the quarter in the classroom and not the result of experimental manipulation. The increased performance, compliance, and attending across tasks during the day for this experiment is difficult to account for, in that the contingent and noncontingent subjects demonstrated approximately equal gains. It seems possible that attending and compliance increased equally during contingent and noncontingent access to the games because the playing of the games themselves required attending and compliance and those changes generalized to other times of the day. Thus, gains in these skills resulted in improved performance for both contingent and noncontingent subjects. Changes seemed logically related to game access since change for subjects in both experiments occurred only after access to the games. The generalization and effectiveness of obtaining control of classroom behaviors has been demonstrated (Kirby & Shields, 1972; Sulzer, Aṣhby, Hunt, Konarski, & Krams, 1971) when reinforcing performance.

It appears that significant changes (exceeding the duration of the experiment) in Upper Limb Coordination occurred with all contingent and noncontingent subjects, with the exception of Subject 2-N. Development of motor skills has been demonstrated by Bills (1950), Humphrey (1976), and Van Etten and Watson (1977) following play-like activities and this research further supports this notion. Additional gains on the Fine Motor Composite of the Bruininks-Oseretsky Test of Motor Proficiency were also noted for Subjects 3-C, 5-C, 1-N, 3-N, 4-N, and 5-N. Subjects 1-C, 4-C, and 2-N demonstrated little or no gain, while Subject 2-C exhibited a 6-month loss over the duration of the experiments. The average gain on the Upper Limb Coordination subtest for contingent subjects was 9.2 months over varying amounts of game access. The average gain on the Fine Motor Composite for the contingent subjects was .8 months, while the average gain for the noncontingent subjects was 3.2. When the subjects were rank-ordered in regard to the number of days of access to the games, the gains did not covary with increased game usage. This leads the examiner to the possible conclusion that the test-retest reliability for these subtests was not sensitive enough over the short duration of these experiments. This is especially true for the Fine Motor Composite, while there were more consistent gains in regard to the Upper Limb Coordination subtest. More stringent control of the remainder of a child's classroom day and the exclusion of other motor activities might have clarified these results. Increased time on the games may also demonstrate more significant changes in fine motor skills. The gains noted were on the subtests most resembling the skills necessary for game use, while the subtests including design copying tasks utilizing paper and pencil demonstrated no gains. Thus, gains were exhibited in Upper Limb Coordination as determined by standardized assessment instruments. This fulfilled purpose 5 of this research to determine the effect of change in motor skills as a result of game usage.

Improvement or change in attending skills and game scores were used to evaluate improvement of eye-hand coordination on the games themselves, purpose 5. There was a lack of improvement in attending skills for all subjects and an improvement in game scores for Subject 2-C only. The lack of improvement in attending skills is most probably a result of the initial high level of attending for all subjects. This resulted in a "ceiling effect" allowing no gains to occur. The game scores were generally extremely low and only Subject 2-C, who had video games in the home, demonstrated gains. This may indicate that the games were too difficult for the subjects to demonstrate improvement during the time interval allowed by these experiments. Especially since no instructions or feedback was given by the experimenter on how to improve game scores. These methods of assessment were probably not finite enough to identify change. Repeated exposures for longer periods of time might have clarified these results.

Future Research

While some of the purposes of this experiment were achieved, further research in the area of electronic games as reinforcers and learning devices is needed. The reinforcing value of the games was demonstrated for some subjects, supporting Gramza, Corush, and Ellis (1972) and Saegent and Jellison (1970) in regards to the reinforcing utility of a complex "vs" simple toys and reactive "vs" statis toys. It should be noted that the short access to the games may not have continued to function as a reinforcer for all subjects. Subject 2-C, who demonstrated the highest IQ, initially changed his performance during the contingent session, but gradually returned to near baseline responses. An examination of the length of each exposure or greater frequency of exposures should be examined in regards to its effect on the reinforcing value of the games. The relationship of IQ and need for longer access may also be an interesting and useful area to examine. The data collected also generally supported the idea of reinforcing performance to maintain on-task behavior, attending, and compliance for several of the subjects (Aaron & Bostow, 1978; Ayllon, Layman, & Kandel, 1975; Ayllon & Roberts, 1974; Kirby and Shields, 1972; Sulzer, Ashby, Hunt, Konarski, & Krams, 1971; Winett & Roach,1973). Though some indication of change in regards to fine motor skills was noted, continued and longer exposure to electronic games may clarify and strengthen the knowledge regarding the training capabilities of the electronic games increasing on the market today.

In an effort to more definitively demonstrate change in performance, attending, or compliance, future researchers need to gain more stringent control of classroom activites. No children included in the study should receive any other form of fine motor training. No subject should change instructors during the experiment and a consistent classroom environment is necessary. This may be accomplished by completing all learning sessions in the same controlled room. It would also be useful to assess change in performance on the same task for all subjects, therefore eliminating a variation of gain due to ease of the task. The specific games utilized for these experiments may also have been too difficult for the subjects to demonstrate gains over the time period allowed. Increased time or higher functioning students may have increased the gains evident on the games. It might also be useful to implement less difficult games with the same population or to provide instruction and feedback on how to improve performance scores on the games.

Further research in the effectiveness of electronic games as reinforcers and learning devices needs greater control than allowed in the classrooms utilized in this experiment. The duration of the experiment should be increased to allow for more gradual change across the changing criterion design, reducing the requirement for rapid change to obtain access to the games. The ideal design would control for experimenter attention exclusive of game access; game access exclusive of experimenter attention; and a combination of each of these factors. A control group to control for normal development over time may also be useful.

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APPENDICES

Appendix A

Consent Form

The procedures of the research proposal entitled "The Effectiveness of Electronic Games (Atari) as Reinforcers for Increasing Appropriate Behavior in Handicapped Children" have been explained to me orally by the principal investigators. I have been given the opportunity to ask questions and I understand that the procedures are of minimal risk to my child and do not disrupt my child's ongoing program. I understand that I may discontinue my child's participation in the project at any time. I also understand that any data collected will be kept completely confidential.

I agree to allow my son or daughter, ________________, to participate in the project.

Parents Signature ____________________________

Mother

____

Father

____

Date

Appendix B

Requests

1. "Look at me"
2. "Go get material"
3. "Go get chair"
4. "Sit down"
5. "Hands down"
6. "Hands in lap"
7. "Pick up the ________"
8. "Go get kleenex"
9. "Sit straight"
10. "Stand up"

The trainer will be cued by the observer to ask at least ten requests listed above or similar requests during the ten-minute observation period. The same request may be repeated when appropriate.