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ABSTRACT

This study examined the relationship of tutorial enrichment of cognitive processes and reinforcement of lengthened response latency to measurements of impulsivity in 3- and 4-year-old children in a typical preschool setting. In a pretest-posttest control group design, 48 impulsive subjects (24 male and 24 female) were randomly assigned to tutorial and nontutorial groups, producing eight cells with six observations per cell. Subjects were administered the Kansas Reflection Impulsivity Scale for Preschoolers (KRISP), Form A, and the Slosson Intellingence Test. Tutorial subjects then received tutoring with standard curriculum materials in two sessions per week for a 6-week period. During tutorials, subjects were provided with at least two opportunities for reinforcement per minute for lengthened response latency and systematic search strategies. At the same time nontutorial subjects continued their usual preschool routine. After 6 weeks, all subjects were administered the KRISP, Form B. The findings indicated that impulsivity was modifiable through the tutorial process, although the process was more effective for the 3-year-olds than for the 4-year-olds. The belief in orthogonality of efficiency and impulsivity was corroborated, as were the stability and independence of the impulsivity trait. (JMB)

MODIFICATION OF IMPULSIVITY IN YOUNG CHILDREN

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

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COLLEGE OF NUTRITION, TEXTILES,

AND HUMAN DEVELOPMENT

BY

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We hereby recommend that the Dissertation prepared under our supervision by Deanna R. Wright Tate

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be accepted as fulfilling this part of the requirements for the Degree of Doctor of Philosophy

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ABSTRACT

Modification of Impulsivity in Young Children

Deanna R. Wright Tate

Recent trends in research have led to the determination that reflective and impulsive cognitive tempo affect cognitive performance. Cognitive tempo is a stable trait over time, tasks, and testing atmosphere. It is linked with age, sex, body build, play behavior, activity level, reading performance, animistic reasoning, error production and conceptual strategy. The purpose of this research was to examine the relationship of tutorial enrichment of cognitive processes and reinforcement of lengthened response latency to measurements of impulsivity in 3 and 4-year-old children in a typical preschool setting. Using a pretest-posttest control group design, 24 male and 24 female impulsive subjects were randomly assigned to tutorial and non-tutorial groups producing 8 cells with 6 observations per cell. Subjects were administered the Kansas Reflection Impulsivity Scale for Preschoolers, Form A, and the Slosson Intelligence Test. Tutorial subjects then received tutorial sessions twice weekly for a 6 week period using standard curriculum materials. During tutorials, subjects were reinforced at a rate not less than 2.00 per minute for lengthened response

latency and systematic search strategies. Non-tutorial subjects continued their usual preschool routine. After 6 weeks, all subjects were administered the KRISP, Form B. The 2 x 2 x 2 analysis of variance of pretest scores indicated only a main effect for sex, males being more impulsive than females. The 2 x 2 x 2 factorial analysis of covariance employed for hypothesis testing used pretest scores and IQ scores as covariates. It revealed that tutorial subjects were significantly less impulsive than non-tutorial subjects on the posttest. A significant age-treatment interaction was examined using adjusted group mean scores which revealed that the tutorial treatment produced more change for the 3-year-old tutorial subjects in relation to their non-tutorial peers than was true of 4-year-old tutorial subjects in relation to theirs. Impulsivity posttests revealed no other significant main or interaction effects. The 2 x 2 x 2 factorial analysis of covariance was repeated for efficiency scores with no significant main or interaction effects apparent. Pearson product moment correlations computed between impulsivity and efficiency change scores and the characteristics of socioeconomic status, IQ, reinforcement rates, and absences revealed no significant correlations for impulsivity, and only a significant inverse correlation between efficiency change and number of absences for tutorial subjects.

These findings indicated that impulsivity was modifiable through the tutorial process for these subjects. The tutorial process was more effective in producing change for these 3-year-olds than for these 4-year-olds. The belief in orthogonality of efficiency and impulsivity was corroborated, as were the stability and independence of the impulsivity trait. Salient aspects of the tutorial process remain to be identified.

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Chapter 1

Introduction

For centuries philosophers, scholars, and scientists alike have been interested in the nature of intelligence and related phenomena. Plato and Socrates attempted explanation many centuries ago. Interest in the nature of intelligence has been a continuing theme throughout the centuries. Research interest in the intellectual development of young children has evolved within the last century, taking cyclical swings.

Historical Perspective

Before the turn of this century European scientists such as Sir Frances Galton were already conducting research and writing on mental inheritance. Although Galton's work was inconclusive, it spurred other scientists to develop interest in mental phenomena. When Alfred Binet began his work constructing a mental ability assessment tool, he and his co-workers met with more success than Galton. Binet and Simon's first scale of mental ability, published in 1905, proved to be effective in differentiating children who met with school success and those who did not. American scholars

began to use and modify the Binet-Simon scale. H. H. Goddard published a translation and adaptation in 1910, and L. M. Terman developed the Standard revisions of the Binet scale, the first appearing in 1916. Such efforts laid a foundation for the investigations to follow.

In the 1920's and 1930's two new influences extended the horizons in the study of intelligence and its effects on young children. Jean Piaget began an extensive and ongoing series of research projects into the nature of cognition in children (Maier, 1969). His interest in the field had been spurred by his work in the laboratory of Alfred Binet during 1919-1921. Another major influence was the growth of the nursery school movement in the United States which was largely stimulated by research centers and universities. During the 1930's and 1940's research appeared which focused on the effects of the nursery school experience on intelligence. Findings were inconclusive. According to one view (Wellman, 1932; Skeels, Updegraff, Wellman, & Williams, 1938), nursery school experience produced an IQ gain; according to another (Olson & Hughes, 1940; Goodenough & Mauer, 1940), this was not so. The controversy raged for several years over the conflicting results of such studies since measured change challenged the commonly held belief in a fixed intelligence. By the close of the 1940's interest had shifted to the effects of nursery school experience on the

child's social and emotional development, and remained there for the better part of the next two decades.

The successful launching of Sputnik by the Soviet government in the later 1950's seemed to awaken the general public to the importance of childhood learning and achievement. Intellectual development of young children became a major area of study once again. Scholars began to rediscover the works of Piaget, which had previously received little notice in the United States. However, in the United States, researchers and practitioners were primarily interested in how to increase achievement and learning at a young age, despite Piaget's findings that seemed to negate this approach. In the 1960's, the United States government sponsored this view when it adopted massive plans for Headstart, which was designed to ameliorate the effects of the impoverished life-style of disadvantaged young children.

The major attempts of the society to offset environmental limitations were supported by the views of Hunt and Bloom. Hunt (1961) argued that certain traditional beliefs in psychology had prevented serious consideration of the value of preschool enrichment in stimulating intellectual development. One of the beliefs under question was the concept that intelligence is fixed at birth and is not subject to alteration by the environment. Hunt maintained that

development of the intellect, like all other development, is the result of interaction between the organism's fixed developmental potential and its environment (Hunt, 1961, 1964). Moreover, Bloom reviewed longitudinal studies and concluded that environmental factors exert the most influence in the years under four, and that half of adult intelligence can be predicted by the age of four years. Thus, the preschool years appeared to be of utmost importance.

Research evolved directed toward diagnosing the nature of intellectual disadvantages of impoverished children, disclosing antecedent conditions and implementing prescriptive approaches to bring about changes. A variety were explored: the Gray-Klaus Early Training Project (Gray & Klaus, 1965, 1970; Klaus & Gray, 1968); Deutsch's Therapeutic Curriculum (Deutsch, 1965); Bereiter-Englemann's Pattern Drill (Bereiter & Englemann, 1966); Kamii's Piagetian-Derived Program (Kamii & Radin, 1967); Bushell's Behavior Analysis Program (Evans, 1971); Nimnicht's New Nursery School (Nimnicht, McAfee, & Meier, 1969); Gordon's Florida Parent Education Model (Hess & Croft, 1972); Ameliorative Preschool Project (Robison & Schwartz, 1972); Perry Preschool Project (Weikart, 1967); British Infant School (Blackie, 1967); Tucson Early Education Model (Hess & Croft, 1972; Evans, 1971); Bank Street Early Education Program

(Gilkeson, 1969); and the Primary Education Project (Hess & Croft, 1972).

Commitment to Early Childhood Education

Bloom's review and related research has contributed to development of a bandwagon effect. The logic proceeds as follows: If so much is learned in the preschool years, and if such exposure to a learning situation is helpful to disadvantaged children, then why should not this early learning experience be extended to all children? Preschool teachers seem to desire inclusion of more academic materials in their curriculum. Although there is not universal agreement among scholars that more academic materials should be brought into the preschool programs (Elkind, 1970; Edwards, 1971), for most preschool teachers the questions remain: What? When? and How?

In considering any technique or program for intellectual enrichment of a preschool program, very basic issues preceed any evaluation of specific learning activities. At least these three capabilities are crucial to learning: (a) Learning is largely dependent upon the organism's ability to perceive salient aspects of any set of stimuli. If the organism is unable to attend to certain stimuli while temporarily screening out others, creating order out of the environment may be especially difficult. Selective

perception aids learning. (b) The development of concepts, broadly organized classification systems, relies on the perceptually related ability to recognize if two stimuli are alike or different. In the preschool child, this ability operates on a very rudimentary level (Wann, Dorn, & Liddle, 1962). (c) Such discernment of similarities and differences is aided by the ability to reflect upon the stimuli and to inhibit any response long enough to make such discernment possible. Wright (1973) says the following:

> Fundamentally reflection-impulsivity is an individual characteristic somewhere between an intellectual ability, such as might be measured by an intelligence or aptitude test, and a personality trait such as might be measured on a personality inventory. It is a measure of a person's performance for, or tendency toward, approaching information-processing tasks in a generally rapid, fluent, but imprecise way (impulsive) versus the opposing tendency to approach such tasks with caution, deliberation, and great concern for accuracy (reflective). (pp. 1-2)

Impulsiveness is positively correlated to error production on certain cognitive tasks (Kagan, 1965); therefore, the cognitive tempo of reflectivity appears to facilitate performance on such tasks. It is the purpose of this paper to examine the characteristic cognitive tempo of young children.

Reflectivity-Impulsivity as a Dimension of Analytic Response Mode

Reflectivity-impulsivity as a dimension of cognitive style has received little attention from researchers, especially in the light of its probable practical applications. The most systematic research series published to date has been done by Jerome Kagan and his associates at Harvard University since 1964. It is especially noteworthy that all research to date indicates that reflection and impulsivity are stable traits functioning across a great variety of situations and experimental conditions (Kagan, 1965; Rosman, Day, Albert, & Phillips, 1964).

Repucci (1970) was able to identify reflection and impulsivity in children as young as 27 months. Repucci, Kagan, and others are presently studying whether or not reflection-impulsivity are functioning as early as 4 months of age (Repucci, 1970). This research suggests that a cognitive tempo correlated with problem-solving is functional long before problem-solving per se becomes a capability. Thus, a child who is impulsive at an early age would have a strongly developed habitual practice of impulsivity before he developed enough problem-solving ability to perceive that his impulsive nature was dysfunctional to information-processing situations.

Wright (1973) indicates that neither reflectivity nor impulsivity alone are always helpful or harmful to the child.

Impulsive children may have an advantage in fluent expression in art and design, rhythms and body movement, or in creative expression. Conversely, extreme reflectivity may be a disadvantage if the child is agonizingly slow and hypercritical of his own work. However, the reflective child would be more likely to encounter initial success in problem-solving tasks than an impulsive child of the same age and level of intelligence. Two effects appear to favor the reflective child. First, the early likelihood of success in intellectual endeavors should favor his self-conception as a capable person. Second, because of his success, he should receive more positive responses from the significant others in his life. According to the sociological role assignment theory (Johnson & Medinnus, 1969), a person is predisposed to fulfill those roles which are assigned to him, even if they are dysfunctional or damaging to self-esteem. Thus it appears that it would be beneficial for an impulsive child to become able to discriminate tasks and settings requiring a reflective approach and to become able to adjust his own behavior accordingly. By this change, the child would increase his probability of initial and continuing success in performing cognitive tasks. This would provide him with more opportunities for positive feedback concerning his ability to deal with information-processing situations.

Means of Modification in Learning

What is an effective means for accomplishing a change in the cognitive tempo of a child? The process of modeling presents one approach. Modeling is one of the earliest forms of learning for young children. Children learn by modeling the behaviors of others long before they have the capacity to produce speech. This process continues to be an effective technique for producing change throughout life. Kagan, Pearson, and Welch (1966b) discovered that impulsive first grade children exhibited greater reflectivity after being exposed to a reflective model when they were led to believe that they shared many characteristics with them. Yando and Kagan (1968) discovered that first grade children taught by reflective teachers showed greater reflectivity in the spring of the school year than they had exhibited in the fall.

In studies with grade school boys, Denney (1972a, 1972b) found that viewing the various cognitive tempos of a video-taped model altered the cognitive tempo of the boys on immediate posttesting. He also found that exposure to various conceptual strategy models was differentially effective upon the children. Younger children were more responsive to less sophisticated conceptual strategy models and older children to more sophisticated conceptual strategy models. Denney concluded that the mere presentation of a model as a

sufficient condition for acquisition of a new conceptual strategy is questionable. Whether such a modeling process would be effective in producing change in cognitive tempo for 3 and 4-year-old children is unknown, since no experimental work has been attempted with such a group in relation to modification of cognitive tempo.

Another approach to producing change in cognitive tempo may be through tutorial experience. The tutorial approach appeared to be effective in increasing reflectivity with older children (Kagan, 1966c; Egeland, 1974), and in changing behavior in relation to other types of learning (Koch & Meyer, 1959; Sigel, Hooper, & Roeper, 1968; Kohnstamm, 1968). Blank and Solomon (1968) found that a series of tutorials in which the teacher attempted to direct a preschool child's thinking were effective in improving IQ scores. Perhaps a similar series of tutorials directing thinking in the area of cognition and consideration of alternatives would also be effective in increasing an impulsive preschool child's reflectivity. This is the basis of this study, to determine if this is the case.

Purpose

The purpose of this study was to determine: (a) the extent to which tutorial sessions with a content of tasks related to the cognitive skills of comparison and contrast,

and patterning, would significantly modify measures of impulsivity and efficiency for 3 and 4-year-old children; (b) the extent to which measured impulsivity and efficiency of 4-year-olds after training would exceed significantly that of 3-year-olds after training; (c) the extent to which measured impulsivity and efficiency of 3 and 4-year-old girls after training would exceed significantly that of 3 and 4-year-old boys after training; and (d) the extent to which the trained group would exceed significantly the untrained group on the impulsivity and efficiency measures.

The specific research hypotheses to be tested were: (a) the experimental group which receives cognitive training will be significantly less impulsive at the .05 level than will the untrained group on the posttest; (b) subjects who are 4-years-old will be significantly less impulsive at the .05 level on the posttest than will the 3-year-old subjects; and (c) female subjects will be significantly less impulsive at the .05 level on the posttest than will male subjects. (d) subjects will not be significantly different in impulsivity at the .05 level on the posttest when categorized by sex and age, sex and treatment, age and treatment; or sex, age and treatment; (e) experimental subjects will not be significantly different from the control subjects in efficiency at the .05 level on the posttest; (f) 4-year-old subjects will not be significantly different from the

3-year-old subjects in efficiency at the .05 level on the posttest; (g) female subjects will not be significantly different from male subjects in efficiency at the .05 level on the posttest; (h) subjects will not be significantly different in efficiency at the .05 level on the posttest when categorized by sex and age; sex and treatment; age and treatment; or sex, age, and treatment; and (i) no significant correlations at the .05 level exist between impulsivity or efficiency changes and socioeconomic status; mental ability; reinforcement rates; or absences from tutorials.

Basic assumptions of the study were: (a) cognition is the process to be affected in the tutorial setting; (b) reflectivity is important to cognition; (c) increasing the ability to be reflective is a valuable and feasible goal for impulsive young children; (d) learning cognitive skills is more important to information-processing performance than learning facts.

Delimitations

The study was delimited in the following ways: (a) reflection-impulsivity was considered only in the context of mean response time and total error production on tasks of response uncertainty as measured by the Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP); (b) subjects were 48 children enrolled in 3 and 4-year-old classes of nursery schools and child care centers in the Denton, Texas,

area during the spring semester, 1975. (c) the time interval for participation in tutorials did not exceed six weeks; (d) tutorial sessions were 30 minutes or less per session and were terminated if the child lost interest; (e) tutorials included no more than three children at one time.

Limitations

The limitations of this study were: (a) the population of the Denton, Texas, area is rather homogeneous in socioeconomic class. Therefore, the subjects were largely from the middle socioeconomic groups. (b) potential centers were chosen on the basis of availability and willingness to cooperate; (c) subjects varied in their willingness to participate; (d) the experimental arrangement may have produced a confounding influence as a result of the experimenter conducting both tutorial sessions and administration of the KRISP; (e) the KRISP is based upon somewhat limited (N=900+), homogeneous (primarily middle class subjects) norms.

Definition of Terms

Analytic response mode. The analytical response mode is the tendency to analyze and differentiate the stimulus field as opposed to the strategy of categorizing precepts based upon the stimulus field as a whole. It is characterized by a more reflective cognitive tempo. (Evans, 1968).

Cognition. Cognition in the context of this paper refers to the thinking process. It is not to be confused with intelligence.

Cognitive skills. Comparision and contrast include the abilities of perceiving various characteristics of the stimuli presented and making judgments about their similarities and differences. Patterning is the ability to replicate a sequence of stimuli through perception of the sequence and creation of a similar one. Classification is the ability to group stimuli according to one or more shared characteristics.

Cognitive style. Cognitive style is a characteristic approach assumed by the person in performing cognitive tasks. The types discussed in the literature include those who are analytic, relational, constraint-seeking, or hypothesis-seeking in cognitive style.

Embedded Figures Test (EFT). The EFT is a match-to-sample test in which the child is shown a model and asked to find and touch a similar figure which has been embedded in an irrelevant background. (Repucci, 1970).

Haptic Visual Matching Task (HVM). The HVM is a match-to-sample task in which the child explores haptically, without visual access, a three dimensional wooden form for an unlimited time. Then he chooses from a visual array the drawing which illustrates the form he explored haptically (Kagan, 1965).

Intelligence. Intelligence is the product of cognition or the thought processes. It is the "general adequacy for functioning in life situations" (Stott & Ball, 1968, p. 266). This product is difficult to measure empirically. It is not to be confused with the Intelligence Quotient (IQ).

Intelligence Quotient. IQ is a notation used for a score obtained when specific tests are administered. Although commonly called intelligence tests, it is doubtful whether such tests actually reflect intelligence as described above. The IQ score is an expression of mental age divided by chronological age. The IQ scores reported in this paper will be computed from administration of the Slosson Intelligence Test (SIT). It is a short form verbal test based upon the Stanford-Binet Test, Form L-M. The SIT yields an IQ score which correlates highly with the Stanford-Binet. These scores, as with all scores derived from testing young children, should be regarded with caution.

Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP). The KRISP is a match-to-sample test in which the child chooses from an array of similar visual figures the one which is an exact copy of the standard stimulus. Response time and total error production are used to compute a score which is an operational measure of reflection-impulsivity and efficiency. It is especially designed to test children 3 to $5\frac{1}{2}$ years of age.

Mastery. Mastery is defined for the purpose of this study as the completion of an accurate response by the subject in the tutorial without teacher assistance.

Match Familiar Figures Task (MFF). The MFF is a match-to-sample test in which the child is asked to select from an array of similar visual stimuli the one which is identical to a standard visual stimulus. Decision time has been used as an operational measure of reflection-impulsivity (Kagan, 1965).

Reflection-impulsivity. The cognitive tempo of reflectivity is a tendency to respond with caution, deliberation, and concern for accuracy when confronted with situations of response uncertainty. The cognitive tempo of impulsivity is the tendency to respond in a generally fluid, rapid, but imprecise way (Wright, 1973).

Tutorial. A tutorial is a one-to-one relationship of teacher-to-child in a goal-oriented activity. Each child is engaged by himself with the task with continuous guidance and feedback from the teacher. In order for a tutorial to be successful the content must be developmentally appropriate and inherently interesting to the child. An experienced teacher should be able to conduct more than one tutorial at the same time if the tasks and materials are similar (Robison & Schwartz, 1972a).

Summary

The purpose of this research was to examine the relationship of tutorial enrichment of cognitive processes and reinforcement of lengthened response latency to measures of impulsivity in three and four-year-olds in a typical preschool setting. It was hoped that this study would contribute to the body of knowledge available on this subject.

Chapter 2

Review of Literature

Initial success at cognitive tasks and resulting positive reinforcement have an observable influence upon a child's conception of himself as a competent learner. Professionals working with young children can facilitate initial success through the recognition of reflection-impulsivity patterns and their assistance to the child in developing a cognitive tempo appropriate to the task. However, research into the nature of this trait is only at a most rudimentary level.

According to Evans (1968) the most systematic series of studies to date dealing with the cognitive tempo denoted as reflection-implusivity is that of Kagan and his colleagues. He explains as follows:

> Kagan and his colleagues several years ago began studying children's cognitive styles. Their research led them to describe a dimension involving the tendency to analyze and differentiate the stimulus field as opposed to the strategy of categorizing precepts which is based upon the stimulus field as a whole. Eventually instruments were devised which measured individual differences in the

extent to which children make analytic responses to stimulus material. An analytic response mode is said to be characterized by a reflective, as opposed to a more impulsive, mode. (p. 357)

This review of the literature focuses on analytic response modes designated as reflectivity and impulsivity and the possible epigenesis of those response styles. In addition, related studies include those which deal with aspects which appear to be directly related to reflection-impulsivity: activity levels of young children; conflict-choice; early sex differences in behavior of young children; genetic factors; early social behavior and cognitive style; verbal rehearsal; and play behavior. To be reviewed because of their implications for the methodology of this and related research studies are the effect of tutorials, language as it is related to learning; and discrimination learning.

Reflection-Impulsivity

An early report of Kagan et al (1964) consisted of a series of eight studies using as subjects children in grades one through four. According to the investigators, psychologists had previously assumed the striking differences between the cognitive products of children were due primarily to vocabulary differences and a richer knowledge repertoire. Researchers had tended to neglect individual

differences in information processing and cognitive tempo. The Kagan studies indicated indices of reflectivity showed a linear increase with age during the school years. They also reported that long response time on recognition tasks showed a greater stability over time and more intertask stability than either analytic attitude or scores of errors in recognition. The reflective-impulsive dimension appeared to be a basic component of these children's behavioral organization. Three possible explanations for this were constitutional predisposition, degree of involvement in the tasks, and anxiety over performance on the task. Kagan and co-workers reported "There is a growing evidence suggesting that one of the consequences of minimal brain damage during the perinatal and postnatal periods is increased restlessness and distractability during the preschool and early years" (p. 33). The relationship of gross motor activity at ages below eight and nonanalytic concepts at age eight suggests that the basic determinants of impulsivity may be present early in development. Finally, the results indicated that the impulsive child was apt to implement mentally the first idea which occurred to him when presented with complex problems with varied response possibilities. This tendency serves to increase the impulsive child's likelihood of failure. When he reaches a dead-end in the problem-solving sequence, he is likely to become more anxious, thus impairing

his selection and evaluation of a second possible solution. This maladaptive cycle may become entrenched with time. The child may withdraw from involvement in problem situations, becoming apathetic or hostile toward intellectual stimulation. (Kagan et. al., 1964).

In a study of the reflection-impulsivity dimension in relation to a serial learning task, third grade subjects were administered three different conditions (Kagan, 1966b). Subjects previously identified as reflective or impulsive and matched between groups on WISC verbal skills were administered two lists of words. Then one group was told that their performance was poor; a second group was told that the next lists were difficult; and controls were told nothing. Impulsive subjects in all groups produced more incorrect words than reflective subjects both before and after experimental intervention. Reflective boys who were told the next lists were difficult showed the largest increase in incorrect words. There was no significant relationship between WISC verbal skills and error production for either category of subjects. Boys produced more errors and larger increases in errors than girls. Kagan says:

> The major implication of this work is to emphasize the significance of a conceptual tempo variable for cognitive products. Investigators working with "culturally deprived" children believe that one

> reason for their poor intellectual performance is their impulsive orientation. The brain-damaged child as well as the reading-retarded child is more apt to be impulsive . . . . Therapeutic regime for these children should consider the potential value of training reflection as a conceptual habit, indépendent of the specific substantive content of the material to be mastered. (p. 24)

Kagan (1965) studied reflection-impulsivity with first and second grade children in connection with their reading recognition. He found that impulsive subjects with fast response times and high error scores made more errors in reading English words on two testing occasions than did reflective subjects with long response times and low error scores. Decision times operated relatively independently of traditional intelligence test scores. There was a high correlation between head-eye fixations on the MFF test and mean response time. This was felt to indicate that subjects were using the time interval to consider the possible alternatives which were presented. Again Kagan pointed out that specific training in reflection should be used in both kindergarten reading-readiness programs and in remedial work with reading-retarded children.

When Kagan (1968) considered reflection-impulsivity in relation to body build, he found that boys in the third,

fourth, or fifth grade who were shorter and broader than their age mates were more likely to be impulsive than reflective. Impulsive boys in the third grade tended to perceive themselves as shorter than reflective boys of similar bodily proportions. Body size was not as salient an attribute for girls.

Ward (1968a) in a study of the divergent thinking aspect of creativity found no relationship between semantic and figural tests of divergent thinking and a reflective-impulsive response style in kindergarten children. In a second study, Ward (1968b) measured reflection-impulsivity in kindergarten children using the usual match-to-sample tests and those with a content lacking the match-to-sample aspect. Two testing conditions were used, a permissive testing context and a context of evaluation of performance by test administrator. Ward found that individual differences in cognitive tempo were reliable across variations in test content and testing atmosphere. In this study anxiety over test performance and possible inadequacy of performance was not a determinant of impulsive responding.

In an attempt to investigate the problem of identifying process variables that might contribute to the differential effectiveness of instructional treatments for modifying children's concepts of life, Berzonsky (1974) considered

reflectivity and internality and their influence upon animistic thinking. In this context, internality was identified as the extent to which an individual assumes that his personal efforts are instrumental in determining the rewards he receives. Reflectivity accounted for significant differences in 6 and 7-year-old children's animism scores. The effects of internality, and a potential reflectivity-internality interaction, were not significant. Berzonsky suggested that reflective animistic youngsters might benefit more from a training treatment than comparable impulsive youngsters.

Reflectivity as an influence on focusing (information processing) behavior was studied by Nuessle (1972) who found that ninth grade subjects were more reflective than fifth grade subjects. In addition, he found that reflective subjects were more proficient focusers than impulsive subjects. He concluded that use of a habit of reflectivity seemed to result in more intense information retrieval-recoding efforts in those subjects.

Meichenbaum and Goodman (1969) studied 30 kindergarten subjects who were categorized as impulsive or reflective and given verbal controls on a finger tapping response and a lever pushing task under both overt and covert self-instruction conditions. Under conditions of covert self-instructions impulsive subjects exhibited greater magnitude of errors than did reflective subjects. In a later study,

Meichenbaum and Goodman (1971) found that when impulsive subject were given both exposure to a model and instructions in self-verbalizations, they produced increases in response latency and decreases in errors.

Reflective and impulsive preschool children were tested on a forced choice memory task in a study by Siegel, Kirasic, and Kilburg (1973). Experimental conditions systematically varied the possibility that correct responses could be made on the basis of verbal labels, purely visual feature analysis, or both. Reflective children consistently made more correct choices than did impulsive children. The researchers concluded that both verbal labeling and visual feature analysis were responsible for the superior performance of the reflective subjects.

Impulsive subjects were trained to be reflective under two tutoring conditions in a study by Kagan, et al (1966b). One tutoring condition consisted of persuading the child that he and the trainer shared attributes. The second tutoring group was not led to believe in shared characteristics. The training in both groups consisted of attempts to increase reflectivity on the HVM, a design matching task, and an inductive reasoning test. Both groups of first graders showed longer response times after training. The condition of perceived similarity to a same sex trainer facilitated training for some girls, but not for boys.

Yando and Kagan (1968) measured the reflectivity of 160 randomly chosen first graders at the beginning of the school year. The subjects were placed in the classes of 10 impulsive and 10 reflective teachers. In the spring, the children were assessed again, and their change scores were related to teacher tempo. Children taught by experienced reflective teachers showed a greater increase in response time than all the other children. The effect was more marked for boys than girls. The implications were clear that some attention needed to be given to the placement of impulsive boys with reflective teachers so that the boys might become more reflective and increase their probability of success with reading and other problematic situations.

Direct instructions have had some effectiveness in modifying reflection-impulsivity in children as well. Denney (1973) instructed reflective and impulsive children to hasten or delay response on a test of conceptual strategies. Children who were instructed to hasten their responses did so as well as increasing their use of hypothesis-seeking strategies. Children who were instructed to delay responses did so without changing their strategy. Denney concluded that cognitive tempo might be one, though not an exclusive, factor underlying conceptual strategy.

Egeland (1974) attempted to train a group of impulsive second grade inner-city children to improve their search

strategies on match-to-sample exercises. A second group was trained only to delay responses. Both groups showed significant increases in response time and decreases in errors on the MFF immediate posttest. On a delayed posttest given 2 months later, the search strategies group maintained their improvement while the delayed response group regressed somewhat in error production. A control group showed no change in error or latency scores. In a comparison to performance on reading tests, both training groups improved performance on vocabulary subtests and the search strategies group also showed improvement on the comprehension subtest. Egeland concluded that training impulsive children to delay responses and improve search strategies not only increased their reflectivity, but this newly increased reflectivity generalized to performance on reading achievement measures.

Cognitive Style and Conceptual Strategy

Kagan (1966b) states that information processing is composed of three sequential operations; "An initial categorization of relevant information, storage of the coded categorization, and finally, the imposing of transformations . . . on the encoded data" (p. 487). Children and adults seem to have clear preferences in style with respect to the type of stimulus analysis that precedes initial coding and the degree of reflection upon classification and hypothesis

selection. Kagan cites two variables which influence cognitive style. First, persons who are analytic tend to fractionate a stimulus into small subunits while nonanalytic persons tend to label and react to a larger unit of stimulus material. Secondly, reflective and impulsive persons exhibit characteristic speeds of response in carrying out solution hypotheses. Kagan concludes that, "Analysis is relatively independent of reflection, and each of these variables contributes variance to a variety of cognitive products" (p. 489).

Kagan's discourse provided a model which has stimulated a variety of research efforts into reflection-impulsivity and its influence on conceptual style. Ault, Crawford, and Jeffrey (1972) recorded the visual scanning strategies of 9-year-old subjects on the MFF. They found that while all subjects used the same strategy of comparing the standard to one or two variants, reflective and efficient (fast and accurate) subjects were more systematic and made more comparisons than did impulsive and inefficient subjects. Teacher ratings indicated that, of these children, only reflective children were rated highly attentive, and that boys were seen as more hyperactive than girls regardless of their identified cognitive tempo. In a later study, Ault (1973) compared the problem-solving strategies of first, third and fifth grade children with various cognitive tempos.

The comparisons indicated that reflective and efficient children achieved scores on a test of problem-solving strategy which appeared more mature than those exhibited by impulsive children. In addition, younger reflective subjects achieved scores equivalent to those of older impulsive subjects.

Several attempts have been made to modify cognitive strategies. Zelniker, Jeffrey, Ault, and Parsons (1972) gave impulsive children a match-to-sample task where only one of the stimuli differed from the standard. After training with ten such items, the impulsives made fewer errors on a MFF posttest. The researchers concluded that finding the stimulus that differed from the standard evidently trained the child to search more thoroughly. Zelniker and Oppenheimer (1973) later found that such differentiation training was superior to match-to-sample training when impulsive subjects were compared on different information processing techniques. Subjects who had received differentiation training were significantly more proficient at distinquishing features among stimuli than were either match-to-sample trained groups or control groups. Zelniker, Cochavi, and Yered (1974) attempted to determine the relationship of an imposed modification of response latency on analytic and nonanalytic cognitive styles of second graders. They found that when analytic children were required to respond quickly, they continued to exhibit analytic responses, but when nonanalytic

children were required to respond more slowly, they began to exhibit more analytic responses. This study provides support for the view that change in conceptual style is accomplished most easily in the direction of increased conceptual sophistication.

Denney (1972a, 1972b) attempted to determine the effect of exposure to a videotaped model on both conceptual style and cognitive tempo. He found that exposure to the conceptual style of a model performing a cognitive task had a significant effect upon the conceptual style of the second grade subjects on both similar and dissimilar tasks (Denney, 1972b). In a second study with 6 and 10-year-olds, Denney (1972a) found that younger children are more responsive to less sophisticated conceptual strategy models and older children are more responsive to more sophisticated conceptual strategy models. The changes in conceptual strategy attributed to exposure to a model as measured immediately after the viewing had generally reversed on follow-up testing one week later. These findings seem to argue for a developmental progression in acquisition of conceptual strategies and for limited change from such a brief exposure to a model. In terms of cognitive tempo, Denney (1972b) found that exposure to the cognitive tempo of the model had a significant effect upon the response latencies of the subjects. These changes generalized to an independent task that subjects had not

seen performed by the model. Error scores remained unchanged for all groups. Denney speculated that if models had demonstrated more efficient scanning strategies as well as varied response latencies, the subjects might have reduced error production as well. Cognitive tempo appears to bear a relationship to conceptual strategy, although the nature of that relationship is not completely clear.

Play Behavior and Activity Level

Repucci (1970) compared play behavior of 27-month-old children to their measured reflectivity as demonstrated by response time on a conflict-choice within a two-choice discrimination task series. She found that reflective children had greater sustained play times than impulsive children, and that reflectivity was negatively correlated to mobility in the testing room. She concluded that the trait of reflection-impulsivity was being demonstrated in play behavior, and that reflectivity was already discernable at 27 months of age. In considering the activity level of children, Schaefer and Bayley (1963) found that very active 10-month-old boys were rated low on attentiveness during the period from 27 to 96 months of age. Maccoby, Dowley, Hagen, and Degerman (1965) found that the ability to inhibit movement was related to intellectual ability among nursery-school children, but the more intelligent children were not

characterized by any generalized inhibition of movement throughout their daily activities. Rather, they were able to inhibit movement in situations which required them to do so. Scarr's (1966) study of activity motivation with twins in relation to reaction time reinforced the belief in some inheritability for all preferred reaction-time measures. She also noted that the number of activities in which a child engaged was related to genetic factors. In general, the preferred mode of reaction time of the subject was similar to the preferred reaction time of the parent.

Goldberg and Lewis (1969) found discernable differences in play behavior of boys and girls as early as 13 months of age. Pedersen and Wender (1968) reported a relationship between a style of play behavior at $2\frac{1}{2}$ years and test performance at 6 years on measures which bear a resemblance to the MFF test and the EFT. The implication is that later reflectivity and impulsivity may be detectable in the preschool years through the analysis of play behavior. This also appears to have been confirmed by the Repucci (1970) study.

Learning and Language

In considering the relationship between learning and language, Johnson and Medinnus (1969) write, "Symbolic communication, or language, is so closely related to learning

that any attempt to separate them, even for the purposes of discussion, is doomed to failure because of the tightness of their bond" (p. 146).

There are great differences in the language capabilities among members of different primate orders in development of learning sets. Koch and Meyer (1959) found that while monkeys may take 100 or more trials to acquire learning sets, very young humans developed them quite rapidly, often in fewer than 10 series of problems. The language ability which humans possess is especially helpful in the ability to generalize and transpose, which involves the ability to make a relational choice. For instance, if a child were trained to choose the higher of two tones, and if he were able to use words to describe the learning principle involved, he seems capable of transposing and generalizing it to new stimuli, no matter how far removed these may be from the original (Alberts & Ehrenfreund, 1951; Kuenne, 1946).

The lower class child appears to be especially disadvantaged in the language development area, and this may be one cause of his more limited cognitive performance. Hess and Shipman (1965) found that lower-class mothers were more restricted in the total verbal output than were middle-class mothers. Middle-class mothers also used more abstract words and more complex sentences. The middle-class child appears

to have a better language model. Such research is the reason many remedial programs for the disadvantaged emphasize language development so strongly.

Young children seem to have an understanding of a great deal more language than they are able to formulate, or perhaps they have language they as yet do not use. Flavell, Beach, and Chinsky (1966) tested an hypothesis of production-deficiency in speech with kindergarten subjects. Subjects were given a memory task, and simultaneously direct observations were made of their spontaneous verbalization. Most subjects did not use naming and rehearsal as a cognitive "trick" to aid their recall. Possible explanations for this include: (a) specific linguistic immaturity; or (b) general cognitive immaturity, both verbally and non-verbally. Subjects who rehearsed the names during the delay period were demonstrating a capacity for sustained attentional focusing in the absence of both and perceptual and social supports. Coding and rehearsal represents a systematic plan for coping with the task requirements.

Discrimination Learning and Conflict

Jones (1970) reported a discrimination task study with nursery and kindergarten subjects. In addition to finding that subjects had dominant response tendencies, she discovered that the mechanism of inhibition of a response was

poorly developed and not always functioning even at age 5, and that response inhibition played a significant role for children under 5 years when the task was relatively easy.

The production of response uncertainty by producing a conflict situation has been considered by Berlyne (1957a, 1957b, 1960, 1965), who reported that the following factors influence response time: (a) The more alternative responses available, the more difficult the choice (1957a). (b) Free choice produces longer response time than forced choice, confirming the influence of equality of strength (1957a). (c) Free-choice response times were the shortest at the intermediate level of intensity. Choice time appears to increase with the degree of conflict (1957a). (d) Uncertainty increases response time (1957b). (e) Increased reaction time in a two-choice discrimination situation is a measurable index of conflict (1960, 1965).

Experimental psychologists, particularly Morrin and Forrin, (1963) and Siebel (1963), have noted that discrimination response time is not only a function of information transmitted, but is also determined by response uncertainty. These viewpoints may provide a bridge between the traditionally isolated research areas of cognition and personality.

Effects of Tutorials

The last area to be considered in this review is the effect which a one-to-one relationship of adult-to-child in a tutorial setting has on various cognitive processes.

Piaget maintains that training has little effect on cognitive processes and does not feel that it is in the best interest of the child to attempt it. However, several researchers are attempting to ascertain the effects of tutorial arrangements on acquisition of Piagetian concepts. Lavatelli (1970) has advocated the use of a tutorial arrangement to facilitate development of cognitive structures in young children. Sigel, et al (1968) found that direct training through Socratic questioning in the areas of classification and labeling, multiplicative relations, and reversibility increased the instance of conservation in his subjects, 4 years, 3 months to 5 years old. These studies provide support for the hypothesis that training programs focusing on prerequisites for relevant cognitive operations influence the resultant structures. Wallach, Wall, and Anderson (1967) found similarly that training in reversibility using divergent stimuli aided children in acquiring the concept of conservation in the quantity of a liquid. The gains were attributed to the fact that the training led subjects to stop using misleading cues.

In an effort to train subjects to exhibit understanding of class inclusion, Kohnstamm (1968) used a practice-drill technique with 5-year-old subjects. Tutorials were one 30 minute session for group one, and two 30 minute sessions separated by 17-23 days for group two. The principles learned in session one were stable over time in group two subjects. This study did not use sophisticated statistical analysis; therefore, it was not determined if the results were significant. However, considerable change appeared to take place as a result of the tutorials.

Wohlwill (1968) and other supporters of Piagetian theory maintain that such studies are isolated attempts to discredit a valid theory and are not to be regarded seriously since they do not contribute to the empirical testing of Piaget's theory. Wohlwill contends that they have not recognized explicitly the essence of Piaget's system and its implications.

The use of the tutorial for a totally different purpose was reflected in the work of Blank and Solomon (1968). The tutorial sessions appeared to be similar in design and content to the Sigel, et al (1968) study. A similar Socratic questioning technique was used, but its purpose in this instance was to expand the verbalizations and abstract thinking of the disadvantaged children involved. Tutorial

sessions were brief, extended over a 4 month period, and raised IQ scores on the Standard-Binet between 7.0 and 14.5 points.

In summary, this review indicates that reflectivity increases with age, with direct instruction, or with exposure to a model among the children studied. Reflectivity appears related to sex, body build, reading performance, animistic reasoning, error production, play behavior, activity level, and conceptual strategy. It does not appear to be related to divergent thinking. Reflectivity appears more cognitively mature than does impulsivity. The relationship of reflectivity to measures of intelligence is still uncertain. Some authorities found no consistent relationship to IQ scores or verbal subtests of the WISC (Kagan, 1964). Other authorities found that reflectives perform better on IQ tests (Michenbaum & Goodman, 1969). A person's individual preference of cognitive tempo seems to be stable over time, tasks, test content, and testing atmosphere.

In retrospect, discrimination ability under conditions of response uncertainty appears related to the characteristic response mode of the individual. Reflectivity-impulsivity appears to be modifiable and of enough practical significance to make increases in reflectivity a desirable goal for the impulsive child. Finally, the tutorial proved to be an effective means of changing behavior. Thus,

literature on reflection-impulsivity led to this study exploring the effectiveness of the tutorial method in increasing reflectivity in young children identified as impulsive.

Chapter 3

Methodology

Subjects

Subjects were 48 children 3 and 4 years of age who were administered the KRISP (Wright, 1971, 1973) and who were classified as impulsive according to the norms of this test. Equal sized groups of 3 and 4-year-old boys and girls were drawn from 2 nursery schools and 4 child care centers serving primarily middle and lower class families in the Denton, Texas, area. (Appendix A) Informed consent for the participation of these children in the study was secured from both parents and administrators of the centers prior to initiation of the study.

The subjects' specific demographic characteristics of race, sex, and birth date were secured from observation and from each center's routine information sheets. Directors also collected from parents a report of occupation and highest educational level of the family member who is the primary wage earner. Each subject's socioeconomic status (SES) was determined from the occupation and education report using the Hollingshead Two-Factor Index of Social Position (Hollingshead, 1957; Haug & Sussman, 1971). The classification produces

categories ranging from I for the highest SES to V for the lowest. Each participant's mental ability was estimated by administration of the SIT. Characteristics of the subjects are presented in Table 1.

Collection of Data

The collection of data related to the modification of impulsivity through tutorial cognitive training required the use of two techniques. First, an appropriate measure of reflection-impulsivity was located. The criteria applied were: (a) The task should be developmentally possible for 3 and 4-year-old children. (b) The task should be neither so simple that responses are automatic nor so difficult as to discourage participation in the task. (c) The task should be such that it can be administered by the experimenter alone without bias. (d) The task should not require elaborate or expensive equipment, and the materials should be commercially available and easily transportable. (e) The task should not rely on a verbal response on the part of the subjects. (f) The task should require an intermediate level of response uncertainty (Kagan, 1965). (g) The task should have either already been subjected to reliability testing, or it should lend itself to such treatment by the experimenter. (h) The data yielded should be easily quantified for statistical treatment.

Table 1

Characteristics of Subjects

Characteristic	Tutorial		Nontutorial		Combined	
	N	%	N	%	N	%
Sex						
Male	12	50.00	12	50.00	24	50.00
Female	12	50.00	12	50.00	24	50.00
Age						
3-years-old	12	50.00	12	50.00	24	50.00
4-years-old	12	50.00	12	50.00	24	50.00
Race						
White	21	87.50	18	75.00	39	81.25
Black	1	4.17	5	20.83	6	12.50
Spanish-American	2	8.33	1	4.17	3	6.25
Socioeconomic Status						
I	1	4.17	4	16.67	5	10.42
II	3	12.50	3	12.50	6	12.50
III	10	41.67	7	29.17	17	35.42
IV	8	33.33	8	33.33	16	33.33
V	2	8.33	2	8.33	4	8.33
SIT IQ						
Above average	13	54.17	14	58.33	27	56.25
Average	7	29.17	7	29.17	14	29.17
Below average	4	16.66	3	12.50	7	14.58
Mean	$\bar{X}$ = 109.63		$\bar{X}$ = 112.13		$\bar{X}$ = 110.88	

In a series of studies concerning the reflection-impulsivity dimension, researchers have used such tasks as Kagan's Match Familiar Figures (MFF) task and the Haptic Visual Matching (HVM) test as assessments of reflection-impulsivity (Kagan, 1965, 1966; Kagan, et al 1966; Kagan et al 1964; Yando & Kagan, 1968). Without exception these studies were completed with children 6 years and older. These tests appeared too difficult for 3 and 4-year-old children to be capable of effective completion (Wright, 1974). Meichenbaum and Goodman (1969) and Ward (1968) applied a modified version of the MFF test to kindergarten children with some success. However, the approach selected which met all the criteria was the KRISP developed by Wright (1971, 1973) which shares the match-to-sample characteristics of the MFF and HVM, but is designed for children 3 to $5\frac{1}{2}$ years of age. Detailed explanation of KRISP administration will be given in the procedures section which follows. The KRISP induces response uncertainty through presenting an array of visual stimuli, one of which is identical to the standard presented simultaneously. The test can be administered and objectively scored at the same time by the experimenter. The measures collected are mean response time and total error production over 10 items. These raw scores are then used to compute a composite impulsiveness score and an independent composite cognitive efficiency score. Wright (1974b) reports that efficiency (fast-accurate to

slow-inaccurate) is in principle independent of and orthogonal to reflection-impulsivity. He says that in general impulsiveness scores are correlated zero with efficiency scores, regardless of the correlation between speed and accuracy (Wright, 1975). Wright (1974c) reports an alternate forms reliability estimate of r = +.72 for response latency and r = +.78 for error production. He regards these as indicating satisfactory inter-form reliability for the KRISP.

Kagan (1965) dealt in considerable detail with the validity of using response time as a measure of reflectivity. He says:

> The validity of these ideas rests heavily on the assumption that children with long response latencies on tasks like the MFF are indeed using that time to consider alternative-solution possibilities. Long-response latencies could reflect merely a strong inhibition in offering any response, perhaps arising out of fear of responding with a strange adult. For the majority of school children with intelligence scores between 90 and 120, however, long delays on the MFF are the result of active consideration of alternatives. The dramatically high correlation (r = .92 and .91) between number of head-eye

> fixations of the standard and response latency to first selection on MFF indicates that the subject was actively considering alternative answers during the long delay and that response latency was a faithful index of decision time. (pp. 626-627)

In the same study (Kagan, 1965), the author provided support for the belief that intermediate response uncertainty is the point at which reflection or impulsivity is maximally influential.

The second technique developed was the tutorial content and its administration. The criteria established for content in the tutorial session were: (a) The content should be developmentally appropriate and inherently interesting to children. (b) Although it need not reflect any particular theoretical stance, it should be consistent with the basic tenets of major cognitive and learning theorists. (c) The contents should lend themselves to ease of determination of mastery without experimenter bias. (d) The contents should consist of small enough units to be broken into segments which will not exceed 30 minutes for completion by most children. (e) The equipment and supplies should be easily available and familiar to most children. The materials chosen were those described by Robison and Schwartz (1972a, 1972b, pp. 10-25). The outlines in this curriculum guide fulfilled all criteria. The specific content and procedures will be outlined in the

procedures section. Mastery is not difficult to assess with these tasks because a specific behavioral action is required by the child to indicate his understanding. The child can demonstrate his knowledge by his actions which can be considered as evidence of mastery. A checklist devised from the content is used to record the child's mastery on each task. (Robison and Schwartz, 1972b, p. 240). As he masters one task, he moves to a more difficult task. This checklist is completed by the administrator of the tutorials as the child progresses through the tutorial sessions insuring that all children receive tasks in sequence.

The materials were expected to be mastered more quickly by some children, but the materials must at some point exceed each child's pretutorial cognitive abilities in order for the tutorial sessions to challenge him to consider alternatives in a condition of response uncertainty. Field trials with these materials by the experimenter over a 6 week period with a similar group of 3 and 4-year-old children indicated that the subjects could be expected to meet some initial success and that the more difficult materials would challenge all the subjects at some point. The abstract patterning tasks appear to be especially difficult initially for most young children. All children were expected to reach a point of response uncertainty in the use of these materials in the tutorial setting.

Experimental Design

The design used for this experiment was the pretest-posttest control group design (Stanley & Campbell, 1963). Although subjects were first grouped by age and sex, and then randomly assigned to a treatment group, the basic structure of the design was:

R O X O

R O O

This design provides excellent internal validity in that effects such as history, maturation, testing, and instrumentation, should affect both groups equally since the subjects are randomly assigned. In addition, the pretest-posttest approach allows the researcher to be aware if some systematically operating effect is causing mortality of subjects.

A limitation of this design according to Stanley and Campbell (1963) is the interaction of the testing and the subject. The pretest itself may bring about some change in the subject, introducing considerable amounts of novel stimuli which may then influence the subject's susceptibility to experimental treatment. The threat of the pretest to external validity indicates that results from a pretested group could not be generalized to a nonpretested group. This and other threats to external validity primarily limit the ability of a

researcher to generalize about his findings. However, we will learn more about the phenomenon in question through replication.

Procedure

Potential subjects were administered the KRISP, Form A until 12 in each of the following four groups had been identified as impulsive according to test norms: (a) 3-year-old boys, (b) 3-year-old girls, (c) 4-year-old boys, and (d) 4-year-old girls. Next, 6 children from each classification were randomly assigned to the experimental group and 6 to the control group. Finally, code numbers were assigned to those children. Odd numbers signified males and even numbers females. The range of numerals from 1-24 was used for 3-year-old subjects, and the range of numerals from 25-48 was used for the 4-year-old subjects. The range of numerals 1-12 and 25-36 indicated experimental subjects and the range of numerals 13-24 and 37-48 indicated control subjects.

The SIT was administered to all subjects by naive administrators, but it was not scored at this time so that the experimenter had no knowledge of measured mental ability during the research. Following the administration of the SIT, the experimenter met in tutorial sessions with each of the experimental subjects either alone or in small groups twice weekly for a 6 week period. Next the KRISP, Form B, was administered to all subjects. Finally, scores were computed for

the KRISP, Forms A and B, and the SIT. In addition, collection of demographic data was completed for each subject. Procedures were sequenced to minimize the knowledge on each subject available to the researcher until after tutorials and all testing were completed.

The administration of the KRISP, Form A, was as follows. Each subject was taken by the experimenter to a private room set up for KRISP administration. The subject was seated on one side of a child-sized table. The experimenter was seated opposite the child with materials for test administration on the table between them. The materials consisted of a manual of instructions, a notebook of match-to-sample materials, a stop watch, a score sheet for the appropriate form, pencil, and a small incentive prize. In order to prevent subject anxiety resulting from knowledge of timed performance, the stop watch was concealed from the subject's view. The subject was administered the KRISP, Form A, according to the instructions and procedures in the KRISP manual (Wright, 1971). The experimenter recorded response time for each item as measured by the stop watch and errors produced on the score sheet as administration proceeded. After administration was completed, the child was given a prize and accompanied back to his classroom.

The tutorial sessions proceeded as follows. Each experimental subject accompanied the experimenter to the private

room which has been set up for each tutorial. Every effort was made to work with subjects as independently as time limitations permitted. Subjects were seen alone, if possible, but never in groups of more than three. Tutorial sessions proceeded as outlined in detail in Robison and Schwartz (1972b, pp. 9-25). The order of the session content was: (a) distinguishing same and different with objects, (b) distinguishing same and different with an object and its picture, (c) distinguishing same and different with pictures only, (d) copying patterns with three-dimensional objects, (e) copying color patterns with two-dimensional objects, (f) copying pattern cards, (g) transforming color patterns to noncolor designs, and (h) creating and extending patterns. Each tutorial began with the opportunity for subjects to manipulate the materials in whatever manner they desired. The subject was presented with tutorial materials and engaged in a cognitive interchange to take time to consider the alternatives and attend to selected stimuli using a Socratic questioning technique similar to Blank and Solomon (1968) tutorial sessions. The nature of the Socratic process is illustrated by verbatim records of two tutorial sessions given in Appendix B. The purpose of the cognitive interchange was to direct the thinking process until the subject was able to give correct independent responses and to give reinforcement for taking the time to do so. The subjects received tutorial training

for a period of 6 weeks. The individual sessions included only one level of content and were discontinued if the child lost interest. They were limited to a maximum of 30 minutes. By rotating subjects, each child received a tutorial session twice weekly. The exact content and order of presentation of materials were according to Robison and Schwartz's (1972b) curriculum so that all subjects received the same sequence. A mastery checklist (Robison & Schwartz, 1972b, p. 240) based on the same order of materials as the curriculum was completed on each subject as he progressed.

During each tutorial session, a reinforcement tally sheet (Appendix C) was kept for each experimental subject to assure that reinforcement for increased response latency and systematic search strategies was provided for each subject at a minimum level of two opportunities for reinforcement per minute. The time at which the session began and the time at which it ended were noted on the sheet. Reinforcement rates for subjects and tutorial sessions were computed according to the following formula:

$$\text{Reinforcement rate} = \frac{\text{Number of instances of reinforcement}}{\text{total time in minutes}}$$

Description of the tutorial sessions in terms of reinforcement provided are shown in Table 2.

Not more than 2 weeks following the completion of training, each experimental subject was administered KRISP, Form B.

Table 2

Reinforcement Rate of Tutorials

Category	Response Latency ($\bar{X}$ Rate per Minute)	Search Strategy ($\bar{X}$ Rate per Minute)	Total ($\bar{X}$ Rate per Minute)
Subject No.*			
1	2.47	2.10	4.57
2	2.44	1.53	3.97
3	3.10	2.23	5.33
4	2.80	1.72	4.52
5	2.87	2.42	5.29
6	2.92	2.31	5.23
7	2.22	1.94	4.16
8	2.71	1.31	4.02
9	2.93	2.42	5.35
10	3.12	2.68	5.80
11	2.11	1.75	3.86
12	2.23	2.01	4.24
25	2.47	2.78	5.25
26	2.30	2.43	4.73
27	2.04	1.74	3.78
28	2.36	2.59	4.95
29	1.87	1.90	3.77
30	2.42	2.34	4.76
31	3.40	2.08	5.78
32	1.70	1.73	3.43
33	1.85	2.02	3.87
34	1.86	1.60	3.46
35	1.91	2.02	3.93
36	3.23	2.48	5.71
$\bar{X}$	2.47	2.08	4.56

Table 2 (Continued)

Reinforcement Rate of Tutorials

Category	Response Latency ($\bar{X}$ Rate per Minute)	Search Strategy ($\bar{X}$ Rate per Minute)	Total ($\bar{X}$ Rate per Minute)
Session No.**			
1	1.56	.94	2.50
2	2.81	.49	3.30
3	3.33	.52	3.85
4	3.04	1.18	4.22
5	2.29	1.75	4.04
6	1.48	2.15	3.63
7	1.74	2.60	4.34
8	2.82	3.74	6.56
9	2.88	2.84	5.72
10	2.50	2.82	5.32
11	2.44	2.38	4.82
12	2.20	2.40	4.60
13***	3.14	2.80	5.94
14***	3.25	4.24	7.49
$\bar{X}$	2.53	2.20	4.73

*Across sessions.

**Across subjects.

***Make-up sessions for those children who missed at least 2 consecutive tutorial sessions (1 full week) through absences.

Control subjects were administered KRISP, Form B, approximately 6 weeks after they had completed KRISP, Form A. In the interim they were exposed to the usual preschool setting with no special treatments. KRISP, Form B, is identical to Form A in design and procedure except that the stimuli on the match-to-sample test items are different. The experimenter secured demographic information on each subject from his information sheet and parent reports after all testing was completed. Raw data resulting from these procedures are listed in Appendix D.

Analysis of Data

The KRISP yielded a mean response time expressed in seconds and a total error score. These were used to compute standard scores for impulsivity and efficiency using Wright's (1975) formulae as follows:

Step 1: Compute for each subject a standard time score:

$$Z_t = \frac{X_1 - \mu_1}{\sigma_1}$$

Where

Z_t = standard time score

X_1 = mean response latency over 10 items

μ_1 = mean time for age and sex group from normative sample (Appendix E)

σ_1 = standard deviation of time for age and sex from normative sample.

Step 2: Compute for each subject a standard error score:

$$Z_e = \frac{X_2 - \mu_2}{\sigma_2}$$

Where

Z_e = standard error score

X_2 = total errors over 10 items

μ_2 = mean errors for age and sex group from normative sample (Appendix E)

σ_2 = standard deviation of errors for age and sex group from normative sample.

Step 3: Use the standard scores to compute an impulsivity score*:

$$I = \frac{Z_e - Z_t}{2}$$

Where

I = impulsivity score

Z_e = standard error score

Z_t = standard time score

*Large positive scores indicate impulsiveness. Large negative scores indicate reflectivity (Wright, 1975).

Step 4: Use the standard scores to compute an efficiency score*:

$$E = \frac{Z_e + Z_t}{2}$$

Where

E = efficiency score

Z_e = standard error score

Z_t = standard time score

*Large positive scores indicate inefficiency. Large negative scores indicate efficiency (Wright, 1975).

The testing of the hypotheses was accomplished by the following statistical treatment. The effect of the treatment factor on two levels, tutorial and nontutorial treatments, was compared in connection with its influence on the age factor, 3 and 4-year-olds, and the sex factor, male and female. Since the subjects were randomly assigned to treatments, the appropriate statistical technique for the analysis of data was the 2 X 2 X 2 factorial analysis of covariance. Eight observations were collected with six units per observation. A matrix of factors and observations is illustrated in Table 3. All three factors were fixed in that: (a) The categories of male and female represented all possible levels for the sex factor. (b) The ages of 3 and 4-year-olds represented the age factors of interest to the investigation. (c) The categories of tutorial and nontutorial levels of the

Table 3

Units and Observations of Subjects

Group	Treatment	
	Tutorial	Nontutorial
Three-year-olds:		
Male	n = 6	n = 6
Female	n = 6	n = 6
Four-year-olds		
Male	n = 6	n = 6
Female	n = 6	n = 6

treatment factor were systematically selected. In addition, age and sex were crossed factors. The factorial analysis of covariance technique provided an efficient method of testing more than one hypothesis about main effects in the same experiment. In addition, it was possible to determine combinations and degrees of factor interaction.

In order to control for the possible confounding effect of mental ability as measured by the SIT on impulsivity scores, the analysis used impulsivity scores on the posttest as criterion and impulsivity scores on the pre-test and the SIT IQ scores as covariates. Efficiency scores were

analyzed in the same manner. The computations provided F-ratios which were examined for significance at the .05 level or beyond. Interpretations of the main effects and interaction effects for significant F-ratios were determined by examination of adjusted mean scores.

Data generated from the experiment also allowed computation of change scores separately for impulsiveness and efficiency from which Pearson product moment correlations were computed to other variables in the experiment.

Chapter 4

Results

Analysis of Variance

In order to determine initial equivalency of the subjects on selected factors, a 2 X 2 X 2 analysis of impulsivity variance test was performed on pretest scores where all subjects' scores were classified by each of the three fixed effects factors: sex, age, and treatment. This technique allows both main and interaction effects to be compared. The direction of significant differences was ascertained by examination of group means for those factors. (Appendix F) This analysis was repeated for efficiency pretest scores. The results of these computations are provided in Tables 4 and 5.

The analysis of variance technique indicated no significant F-ratios for the factor of age or of treatment when impulsiveness pretest scores for all 48 subjects were compared. This indicates that the impulsiveness of the three-year-olds in this study was comparable to that of the four-year-olds initially. Also the tutorial group was comparable to the non-tutorial control group on the initial impulsiveness measure. Similarly, the interaction effects were not

Table 4

2 x 2 x 2 Analysis of Variance: Impulsivity Pretest

Source	Sum of Squares	df	Mean Squares	F	p
Sex	2.6180	1	2.6180	6.8978	0.012*
Age	0.0006	1	0.0006	0.0016	0.968
Treatment	0.5271	1	0.5271	1.3888	0.246
Sex/Age	0.7880	1	0.7880	2.0761	0.157
Sex/Treatment	0.0668	1	0.0668	0.1759	0.677
Age/Treatment	0.0063	1	0.0063	0.0166	0.898
Sex/Age/ Treatment	0.0099	1	0.0099	0.0261	0.872
Within	15.1817	40	0.3795		
Total	19.1983	47			

*Significant, $p < .05$

Table 5

2 x 2 x 2 Analysis of Variance: Efficiency Pretest

Source	Sum of Squares	df	Mean Squares	F	p
Sex	0.9296	1	0.9296	3.6473	0.063
Age	0.0006	1	0.0006	0.0027	0.959
Treatment	0.3816	1	0.3816	1.4973	0.228
Sex/Age	0.0850	1	0.0850	0.3335	0.567
Sex/Treatment	0.0432	1	0.0432	0.1695	0.683
Age/Treatment	0.2611	1	0.2611	1.0243	0.318
Sex/Age/ Treatment	0.0850	1	0.0850	0.3335	0.567
Within	10.1953	40	0.2549		
Total	11.9816	47			

significant. Apparently no interaction of factors systematically influenced impulsiveness pretest scores.

When subjects were categorized on the sex factor, a significant difference appeared in relation to initial impulsivity. The mean score for males was I = 1.517 while the mean score for females was I = 1.050. Since larger positive scores indicate greater impulsivity, it is apparent that males were significantly more impulsive initially than were females.

Efficiency pretest scores demonstrated a similar pattern. Although none of the factors or interaction effects were significant, the sex factor approached significance ($.05 < p < .10$). The direction of the difference was in favor of greater efficiency for females (Male mean E = 0.350; female mean E= 0.072). Subjects categorized by sex, age, and treatment were very comparable on the efficiency pretest measure.

The similarity of the subjects on the factors of age; treatment; and sex, age, treatment interactions on the pretests as well as the comparability of the tutorial and non-tutorial groups on the demographic variables (Table 1) attests to the basic equivalency of groups. Such differences as existed were adjusted statistically by the use of the analysis of covariance technique for hypothesis testing.

Analysis of Covariance

Hypothesis testing for the pretest-posttest control group design requires the use of the analysis of covariance technique with pretest scores as the covariate for most precise analysis (Campbell & Stanley, 1963). In addition, the analysis of covariance technique also allows for reduction of potential error resulting from variance in mental ability among subjects by including the IQ score as a covariate in the analysis. Since the hypotheses require comparisons of the factors of sex, age, and training, the 2 X 2 X 2 factorial analysis of covariance was performed on impulsivity scores, using the posttest score as criterion and the pretest score and IQ scores as covariates. A similar analysis was performed separately for the efficiency scores. The result of these analyses appear in Tables 6 and 7.

The treatment factor (tutorial versus non-tutorial) was the single factor on the impulsivity measure whose main effects were significant ($p < .01$). This demonstrates that members of the group receiving tutorial training which reinforced longer response latencies and search strategies were significantly different following training from the members of the non-tutorial group. The direction of this difference was determined by examination of the adjusted group means of the two groups. The tutorial group had an

Table 6

2 x 2 x 2 Analysis of Covariance: Impulsivity

Source	Sum of Squares	df.	Mean Squares	F	p
Sex	0.0562	1	0.0562	0.1047	n.s.
Age	0.5022	1	0.5022	0.9347	n.s.
Treatment	4.6512	1	4.6512	8.6579	0.005*
Sex/Age	0.0008	1	0.0008	0.0015	n.s.
Sex/Treatment	0.0157	1	0.0157	0.0293	n.s.
Age/Treatment	3.3521	1	3.3521	6.2398	0.025**
Sex/Age/ Treatment	0.0504	1	0.0504	0.0938	n.s.
Within	20.4142	38	0.5372		

*Significant, $p < .01$

**Significant, $p < .05$

Table 7

2 x 2 x 2 Analysis of Covariance: Efficiency

Source	Sum of Squares	df	Mean Squares	F	p
Sex	0.1376	1	0.1376	0.3152	n.s.
Age	0.0249	1	0.0249	0.0570	n.s.
Treatment	0.0145	1	0.0145	0.0333	n.s.
Sex/Age	0.2579	1	0.2579	0.5906	n.s.
Sex/Treatment	0.0325	1	0.0325	0.0745	n.s.
Age/Treatment	0.2126	1	0.2126	0.4869	n.s.
Sex/Age/ Treatment	1.0859	1	1.0859	2.4866	n.s.
Within	16.5949	38	0.4367		

adjusted mean of I = .00789 on the impulsivity measure, while the non-tutorial control group had an adjusted mean of I = .63826. Since larger positive scores indicate greater impulsivity, results indicate that the tutorial group was less impulsive after training than was the non-tutorial group.

The interaction effect of age and treatment was significant on the impulsivity measure ($p < .05$). Since the main effect of treatment was confirmed, the nature of the interaction was determined by examination of adjusted group means for 3-year-old tutorial subjects, 3-year-old non-tutorial subjects, 4-year-old tutorial subjects and 4-year-old non-tutorial subjects. The adjusted means for these groups are presented in Table 8. Computations are provided in Appendix G.

This examination reveals that the nature of the interaction is as follows: while both 3 and 4-year-old tutorial groups were less impulsive than 3 and 4-year-old non-tutorial subjects, the comparison indicated that 3-year-old tutorial subjects exhibited much less impulsivity compared to the 3-year-old non-tutorial subjects than did the 4-year-old tutorial group compared to the 4-year-old non-tutorial group. The interaction is illustrated graphically in Appendix H.

Table 8

Adjusted Group Means: Impulsivity Scores

Group	Treatment		
	Tutorial	Nontutorial	Row Mean
3-year-olds	-.15184	1.02249	.43533
4-year-olds	.16762	.25403	.21083
Column Means	.00789	.63826	.32496

This interaction may indicate that these 3-year-olds were more susceptible to experimental intervention than were the 4-year-olds. An alternative explanation is that the experimental process was more developmentally appropriate to the 3-year-olds than to the 4-year-olds.

The efficiency scores exhibited neither main effect nor interaction effects. A possible interpretation of this finding is that the construct under study and manipulation was impulsivity and its modification. There were apparently no serendipitous changes in efficiency as a result of the tutorial treatment. This would corroborate Wright's (1975) belief in the independence of the two constructs.

Correlations

Pearson product moment correlations were computed between certain of the demographic variables and tutorial reinforcement data to net changes in impulsivity and efficiency from pretest to posttest. The change scores (Appendix D) were computed by deducting the posttest score from the pretest score, producing a numerical system wherein positive scores indicated changes in the direction of less impulsiveness and greater efficiency. The results of the computations are presented in Table 9.

Table 9

Pearson Product Moment Correlations: Demographic and Tutorial Variables to Net Change

Variable	Tutorial		Nontutorial		Combined	
	Impulsivity Change	Efficiency Change	Impulsivity Change	Efficiency Change	Impulsivity Change	Efficiency Change
SES	0.0636	-0.0817	0.0513	-0.1446	0.0771	-0.1139
IQ	-0.0799	0.3526	-0.1223	-0.0316	-0.1175	0.1470
Impulsivity change	1.0000	0.1944	1.0000	0.0463	1.0000	0.1097
Mean response latency reinforcement	0.1696	-0.0026				
Mean search strategy reinforcement	-0.1092	0.2644				
Mean combined reinforcement	0.0551	0.1363				
Absences	-0.0043	-0.4884*				

*Significant, df = 22, $p < .05$

Note: Data on reinforcement and tutorial absences were collected for tutorial subjects only.

Racial classification was omitted from the computations since the coded data represented an arbitrary assignment of a numeral to a racial or ethnic group, resulting in nominal data not appropriate to computation with the Pearson product moment formula.

The number of absences from tutorial sessions was significantly negatively correlated to net changes in efficiency scores, indicating that as number of absences went up, changes in efficiency went down to a significant degree. The relationship of absences to impulsivity change was inverse as well, but very small.

The very small correlations between variables in some instances was just as meaningful as large ones would have been. The small relationship of socioeconomic status and IQ to impulsivity supports the view that impulsivity is a stable trait relatively independent of mental ability and this demographic variable.

While it was non-significant, the correlation of IQ to efficiency change (fast, accurate responding) among tutorial subjects was stronger than among the non-tutorial subjects. Since no such pattern was apparent with impulsivity change, Wright's (1974b) view that efficiency may be related to mental ability while impulsivity is independent of it was supported. In addition, his view that efficiency and

impulsivity are independent of each other on this measurement tool was corroborated (Wright, 1975).

Finally, among tutorial subjects the reinforcement received for use of search strategies was positively correlated to change in efficiency, while reinforcement for increased response latency was positively correlated to impulsivity change. However, these correlations were too small to be significant.

Summary of Findings

In summary the following non-significant relationships were found: (a) There was no significant difference between the impulsiveness of these 4-year-olds and the impulsiveness of these 3-year-olds on the impulsiveness posttest. (b) There was no significant difference between the impulsiveness of these female subjects and the impulsiveness of these male subjects on the impulsiveness posttest. (c) There were no significant differences between the impulsiveness of subjects on the impulsivity posttest when these subjects were categorized by sex and age; sex and treatment; or sex, age, and treatment. (d) There was no significant difference between the efficiency of these 4-year-old subjects and the efficiency of these 3-year-old subjects on the posttest. (e) There was no significant difference between the efficiency of these female subjects and the efficiency of these male subjects on

the posttest. (f) There was no significant difference between the efficiency of the tutorial group members and the efficiency of the non-tutorial group members on the posttest. (g) There was no significant difference between the efficiency of subjects on the posttest when these subjects were categorized by sex and age; sex and treatment; age and treatment; or sex, age, and treatment.

The changes in impulsivity and efficiency scores were independent of: (a) socioeconomic status; (b) mental ability; (c) reinforcement rate received by the tutorial subjects. Impulsivity change of tutorial subjects was independent of the number of absences from tutorials.

Finally, the following significant relationships were found: (a) Members of the tutorial group were significantly less impulsive on the posttest than were the members of the non-tutorial group. (b) Three-year-old tutorial children revealed much less impulsiveness in comparison to non-tutorial three-year-olds that did the tutorial four-year-olds in comparison to the non-tutorial four-year-olds. The interaction effect of age and treatment was significant. (c) Number of absences from tutorials was significantly inversely correlated to efficiency change scores among tutorial subjects.

Chapter 5

Summary and Conclusions

The purpose of this research was to examine the relationship of tutorial enrichment of cognitive processes and reinforcement of lengthened response latency to measurements of impulsivity in three and four-year-olds in a typical preschool setting. Administration of the KRISP assessed impulsiveness and efficiency. The SIT assessed mental ability as expressed in an IQ score. Background information was secured through questionnaires on file with center directors. Monitoring of the tutorial sessions occurred through completion of tally sheets (Appendix C) which in turn provided reinforcement rates for each session. The research design was a pretest-posttest control group design. The 2 X 2 X 2 factorial analysis of variance technique revealed that impulsivity pretest scores were independent of both the main effects of age and treatment and of the interaction effects of sex and age; sex and treatment; age and treatment; age, sex, and treatment. Neither main effects or interaction effects were revealed between groups on efficiency pretest scores.

Males were significantly more impulsive than females on the pretest. This difference, as well as any confounding

influence of IQ scores, were controlled by using the analysis of covariance technique for hypothesis testing.

The 2 X 2 X 2 factorial analysis of covariance using adjusted pretest scores and IQ scores as covariates revealed that tutorial subjects were significantly less impulsive on the posttest than were the non-tutorial subjects. In addition, an age/treatment interaction was significant. The nature of that relationship was that the three-year-olds who experienced tutorials exhibited greater change toward being less impulsive in comparison to their non-tutorial age mates than did the tutorial four-year-olds in relation to theirs.

All other factors and combinations of factors for the impulsiveness measure were insignificant. All factors and combination of factors were insignificant for the efficiency measure.

Pearson product moment correlations which were computed relating impulsiveness change scores to socioeconomic class, IQ, efficiency change scores, reinforcement rates, and number of absences revealed no significant correlations. Correlations of efficiency change scores to the same variables revealed only a significant inverse correlation of number of absences to efficiency change scores. The small correlations between variables corroborates the view of independence of

efficiency and impulsivity and the stability and independence of the impulsivity trait.

These results indicate that the impulsiveness of three and four-year-old boys and girls such as these is indeed modifiable through a process of short, regular tutorial intervention focused on materials creating response uncertainty. In addition these results demonstrate that children like these respond with increased reflectivity to materials very dissimilar to the testing materials when the experience also includes a reoccurring one-to-one relationship with a significant adult who provides reinforcement for increased reflectivity. Future research might focus on identification of the salient aspects of the tutorial process.

Do the materials themselves make a difference? The belief of this investigator is that they do not. What seems important is that the condition of response uncertainty associated with the task be met, accompanied by reinforcement for greater reflectivity. Future research will be necessary to test this belief.

Could it be that a warm, supportive relationship with a reflective adult in a regularly occurring one-to-one setting is a key feature? Some of the children in the tutorial group who made the largest changes in impulsivity also seemed to develop increasing competence in their peer

relationships, in their verbal expansiveness, and decreased dependency. What is the relationship between these factors?

Is it possible that children could be effective modifiers of impulsiveness in a tutorial setting with each other? Perhaps older reflective children could serve as leaders of tutorials with younger impulsive children. This too could be empirically tested.

What is the influence of the frequency and duration of the tutorial sessions? Changes in response style did not progress as visibly in these subjects after approximately four weeks. Future researchers might experiment with sequences of more or less than six weeks duration and frequencies of more or less than twice per week sessions. Other important factors to be investigated would be the durability of the cahnge in the absence of continuing high levels of reinforcement.

The nature of the age and tutorial treatment interaction led to the conclusion that replications of this experiment should be undertaken with other groups of children in this age range to determine if three-year-olds consistently respond in this manner in comparison to four-year-olds. If the interaction is confirmed by replication, important information will be provided about optimal timing of efforts to

help impulsive children to develop the ability to be reflective if that cognitive tempo is more appropriate to the task at hand.

This demonstration of the modification of impulsiveness through the tutorial process gives both parents and teachers a process which they can begin to use with the impulsive child at a young age if they identify that his impulsiveness is interfering with his success at cognitive tasks. However, it must be remembered that reflectivity is not more valuable than impulsivity per se, but only more appropriate to certain types of cognitive performance. In other situations, the impulsive child's tempo may be an advantage. Continued study will focus upon the procedures to be used with reflective young children to help them learn to behave more impulsively when that tempo is more appropriate to the occasion, and to help both reflective and impulsive youngsters learn to discriminate the occasions for which their preferred cognitive tempo is inappropriate so that they can employ a tempo which will optimize their likelihood of success.

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Appendices

Appendix A

Participating Centers and Directors

Appendix A

Participating Centers and Directors

Nursery Schools:

1. Texas Woman's University Nursery School
   Texas Woman's University Campus
   Denton, Texas
   Director: Barbara Jackson

The TWU Nursery School is a laboratory school used as a center for training preschool teachers. Children who attend are primarily those of TWU faculty and students.

2. Lake Dallas Preschool
   Lake Dallas Public Schools
   Lake Dallas, Texas
   Director: Sarah Yetter

The Lake Dallas Preschool is a compensatory preschool designed to provide early intervention in areas of the child's development in which he is deficient.

Day Care Centers:

3. Texas Woman's University Child Care Center
   Texas Woman's University Campus
   Denton, Texas
   Director: Cheryl Fikes

The TWU Child Care Center is a full day child care center open to children of TWU students, providing a program designed to optimize the development of the children who attend.

4. Grace Temple Baptist School and Day Care
   1106 W. Oak
   Denton, Texas
   Director: Ann Richardson

The Grace Temple Baptist Center is a full day child care center open to the public. Children are largely from working families where at least one of the parents is also a student.

5. Denton City-County Child Development Center
   1400 Paisley
   Denton, Texas
   Director: Fonda Honeycutt

The Denton City-County Center is a full day child care center supported by the United Fund. Parents of the children who attend must meet certain criteria as being eeonomically disadvantaged. Many of the children are from one-parent families.

6. Humpty-Dumpty Kindergarten and Day Care

Shady Shores Road

Lake Dallas, Texas

Director: Thelma Bolivar

Humpty-Dumpty is a privately owned and operated full day child care center serving children of working parents.

Appendix B

Verbatim Recording of Typical Tutorials

Appendix B

Verbatim Recording of Typical Tutorials

C = Cindy

E = Experimenter

E.: Are you ready to play? Okay--Let me show you what we are going to do today. Do you remember when we made the rows with the spoons and the straws? Well, we are going to do that same kind of thing, except today we are going to be working with poker chips. And what I am going to do is, I am going to ask you to close your eyes like you did before, and then, while you have your eyes closed, I am going to make a row up here on the top of your paper. I'll say, "Cindy, open your eyes," and I'll give you some chips and I would like for you to make a row below, just the same as my row. One that looks just exactly the same. Think you can do that? I'll bet you can. Are you ready? Okay. Oh, want to close those eyes good? That's the way. Shut them up tight.

C.: I can't. I got sore throat.

E.: Oh, I'll tell you what. You put your head down like you were and that will be just fine. Okay. Remember, each time take your time. Think it over, and look them all over

carefully. Okay, you ready? Here you go, open your eyes, and here's some chips. See what you can do. Just the same as mine. Okay, very good, look them all over carefully. Very good. Okay now, let's check. Is this the same as this, Cindy? (Nods) Okay, what about those two? Are they the same? (Nods) And the next one? (Nods) Okay, what about these last two? (Nods) Very good! Look at the pattern that we have here. I made a red, blue, red, blue pattern. What kind of pattern did you make?

C.: Red, blue, red, blue.

E.: Very good! Your pattern is just the same as my pattern. Very good, so your row is just the same as mine.

C.: How come we're not using the rest? (of the chips)

E.: Oh, we will, in a minute. There's no point in getting them all out until we are ready for them. Okay, put your head down again and I am going to try another one. Remember, take your time each time, and think it over. (Pause) Okay, now, (Pause), okay, let me get you some chips here. Let's see if you can make a row just the same as my row. (Cindy is working) Very good, that's the way to look them over. You're thinking about it, aren't you, Cindy? Okay, do you think your row is just like mine? Okay, let's check, is this the same as this? (Nods) Huh, are those two the same? (Nods) And those two? (Nods) And those two? (Nods) Good,

E. (cont'd): what about these two right here? (Nods) And these? (Nods) Okay, what about these two? (Nods) Very good, that's right. Okay, now, let's check my pattern. Mine is red, red, blue, blue, red, red, blue, blue. What's yours like?

C.: Red, red, blue, blue. Red, red, blue, I mean--Red, red, blue, blue, blue, oops, (corrects herself) red and red, blue, blue.

E.: Good! Okay--your row is just the same as mine. Okay, now, put your head down again and let's try it again, Okay? Okay, let's see what comes up this time.

C.: This is to lay my head on and go to sleep.

E.: Oh, is that how you go to sleep, when you lay your head down. Okay, now, Cindy, see if you can make one just like mine. Now this time there are extra chips, so you use just what you need. Use only the things that you need. Look them over carefully. Very good! Yeah, you are using just what you need, aren't you? Okay, very good! Now, let's check. Okay, now are those two the same, Cindy? (Nods) And those two? (Nods) What about those two? (Nods) Very good. What about the next one? (Nods) And the next one? (Nods) Are the last ones the same? (Nods) Okay, now, let's look at my pattern. Mine is red, red, blue, red, red, blue. Can you tell me about yours now?

C.: Red, blue, red.

E.: You skipped one.

C.: Red, blue.

E.: Okay, let's start back at the beginning, okay?

C.: Red, red, blue, red, red, blue.

E.: Okay, very good! And yours is just like mine. Okay, one more we're going to do.

C.: I'm getting tired.

E.: Yeah, we just have one more. We're going to use white ones this time. Close your eyes tight, and let's see what happens. (Pause) Okay, Cindy, now make a row just like mine and use only the things that you need. Look them over carefully. We've got plenty of time. Okay, very good! Okay, look. Do you want me to check this time and you watch? Okay. That's the same thing. That's the same. And those two are the same. And those two. And the white ones there. Are the last two the same? (Nods) Very good! Okay, and look here what I see. Look here. This one is the same as your sweater, isn't it? And this one is the same as your shirt!

C.: That's my fancy shirt.

E.: It is.

C.: Same as that!

E.: Same as that? Same as your map? Same as the chair? Lots of things are that color, aren't they? Let's look at the pattern. Let's check the pattern. Mine is red, white, blue, red, white, blue. What's yours like? Can you call them?

C.: Red, white, blue, red, white, blue.

E.: Very good! Okay, your pattern is just the same as mine. And we're all through for today. How about that?

C.: I'm gonna make a big building.

E.: You're going to make a building? Okay. (End of Session)

Elapsed time: 10 minutes
Reinforcement rate: 7.80

E = Experimenter

M = Michael

E.: Okay, now, do you remember what we were doing last time, when I made a row at the top of your paper? And you made a row just the same right down here? Okay, I want to see how well you remember. Okay here, let me hold this. You didn't leave me enough (chips) to make you a row. Here, let me have some of them and you can hold the rest to work with, okay? Okay.

M.: Three, four (he counts)

E.: Here's another one.

M.: five, six.

E.: I want to see if you can make a row just like mine. Take your time.

M.: You shut your eyes.

E.: Oh, how can I make a row with my eyes shut? I'll make a row with my eyes open, okay? You can work on that while I make a row, okay? I'm going to do mine right up here. Now, let's see if you can make a row just the same as my row. Can you do that? Look them over carefully. Take your time and think it over. Let's see if you can match yours up and make your row just like mine? Do you think your row is just like mine? Okay, let's check.

M.: Uh huh. (Shaking head no)

E.: Okay, what needs to change? No, you leave my row the way it is and change your row, okay? Change the ones on your row, what goes there? Do you know? (corrects self) What goes right in that space right there? Make your row just like mine.

M.: This one.

E.: Well, let's check and see, okay?

M.: Where is the white one? (Drops chip on floor and retrieves it)

E.: Okay, you dropped one, didn't you? Is this the same as that? (Nods) Okay, is this the same as that space?

E. (cont'd): (shakes head) No, it's empty isn't it? Hold that one in your hand, we'll check the rest of them. Is this the same as that? (Nods) Right, they are both blue. Is this the same as that? (Shakes head) No, okay, you take yours away, right there. Okay, now let's check this one, is this the same as that? (Nods) Right! The white ones are the same. Is this blue one the same as that white one? (shakes head) Okay, take that one away. Let's go back and decide. Which one of the chips in your hand should go right here with this white chip? (Places it) Right, your white chip, right. Okay, which one of your chips should go right here with this red chip? (Places it) Your red chip. Which one should go here with this blue chip? (Place it) Your blue chip! Very good! Now, your row is just like my row. Now, let's look at the patterns. Look, here is a red, white, blue pattern. Red, white, blue. You call off what yours is like.

M.: red, (starts over) red, white and blue, and then red, and white, and blue.

E.: Very good! So your pattern is just like mine. Okay, you know how to do that now, don't you? I'm going to make it even tougher for you. Okay--

M.: What are them?

E.: Well, I'll show you. Just a minute. You remember, you made a red, white, blue pattern like mine? This time the patterns are on cards. This is a red, blue, red, blue pattern. And I want to see if you can take the chips and right down here underneath make a pattern just like mine. A red, blue, red, blue. Okay? Let's see if you can.

M.: And white?

E.: Well, you won't need white this time. Let's put the white ones away. You just need red and blue. Use only the ones that you need. Make a pattern just like mine (M. working) Okay, where does the red one go? Look them over carefully. Okay (Pause) Okay--you used all the ones you had. Let's see if your pattern is the same.

M.: These are--push the red one down.

E.: What?

M.: Push the red one down (pointing to recorder button)

E.: It is (pause to show him) Okay, let's look them over and let's check.

M.: We need something right here.

E.: Okay, what would you put right there, which one? Some of these down here could you put? Okay, what else do you need right there? (Points) Okay, and these are extras, huh? Okay, now, let's check. Okay, my pattern is red, blue,

E. (cont'd): red, blue, okay, let's move yours off now, where you can see just your chips. What's your pattern like?

M.: red, blue, red, blue.

E.: Just like mine! Very good! Okay, now, let's try another one. I'll give you a tougher one; see if you can make a pattern just like mine. Look them over carefully. Okay, make your pattern just like mine. Use what you need.

M.: red, blue, blue, red--(working)

E.: That's the way. Look them over carefully.

M.: blue--

E.: Take your time.

M.: red, red. LOOK!

E.: Okay, let's check. My pattern is red, red, blue, blue, red, red, blue, blue. Now, let's move yours down where we can check yours. Okay, you call yours now while I touch them.

M.: red, blue, (starts over) red, red, blue, blue, red, red, blue.

E.: Very good! Okay, yours is just like mine. Now, now let me put another one out here and we'll try it. Okay, I'll bet you are just really getting the hang of this. I'll bet you can do this one easy. Make a pattern just like mine. Use just the things that you need. You should have some extras this time. Think it over. Look them over

E.: (cont'd) carefully. Make a pattern just like mine. Use the chips you need. Take your time and think it over.

M.: Here's some more chips.

E.: Okay, now, are you all finished? Okay, let's check. You've got a blank space? What could you put there? Where could you find a red chip? Okay.

M.: I want a red chip. (Has lost interest in the task)

E.: Well, this is enough. In fact, this is more than enough.

M.: No, this is a different one now.

E.: Okay, are you finished for today?

M.: Yeah.

E.: Okay, let's stop right here and we'll take up here next time. (End of session)

Elapsed time: 9 minutes
Reinforcement rate:- 3.00

Appendix C

Reinforcement Tally Sheet

Appendix C

Reinforcement Tally Sheet

Time: Begin _____ End _____

Code Number _____

NAME _____

CENTER _____

DATE _____

MATERIALS # _____

RESPONSE LATENCY:

TAKE YOUR TIME.

THINK IT OVER.

LOOK THEM ALL OVER CAREFULLY.

THERE IS NO HURRY.

OTHER

SEARCH STRATEGIES:

HOW CAN YOU DECIDE?

DEMONSTRATE

Reinforcement Tally Sheet
(cont'd)

PRACTICE

LOOK AT ORIGINAL & ALTERNATIVES

SELECT A COMPONENT & COMPARE TO ALL

LOOK FOR SIMILARITIES & DIFFERENCES

SUCCESSFULLY ELIMINATE DEVIATIONS UNTIL ONLY THE CORRECT ONE REMAINS

CHECK YOUR RESPONSE

OTHER

Appendix D

Subjects' Characteristics and Scores

Appendix D

Subjects' Characteristics and Scores

Subject No.	Sex	Age at Pretest	SES	Race	Absences	IQ
Tutorial Ss:						
1	M	3-4	II	White	0	116
2	F	3-5	III	White	5	95
3	M	3-0	IV	Spanish-American	6	103
4	F	3-3	IV	White	4	131
5	M	3-3	IV	White	3	87
6	F	3-0	III	White	2	103
7	M	3-7	III	White	0	135
8	F	3-3	III	Spanish-American	1	82
9	M	3-11	IV	White	3	91
10	F	3-7	III	White	2	121
11	M	3-4	V	Black	0	115
12	F	3-5	III	White	0	117
25	M	4-5	I	White	3	121
26	F	4-0	II	White	0	127
27	M	4-2	V	White	1	108
28	F	4-8	IV	White	0	84
29	M	4-0	IV	White	1	104
30	F	4-6	III	White	2	120
31	M	4-9	II	White	3	125
32	F	4-6	I	White	1	119
33	M	4-6	III	White	0	100
34	F	4-4	III	White	1	113
35	M	4-5	IV	White	3	128
36	F	4-4	IV	White	6	86

Subjects' Characteristics and Scores (Continued)

Subject No.	Sex	Age at Pretest	SES	Race	Absences	IQ
Nontutorial S_s:						
13	M	3-8	I	White	-	89
14	F	3-1	V	White	-	89
15	M	3-1	III	White	-	97
16	F	3-2	IV	Black	-	100
17	M	3-10	IV	White	-	77
18	F	3-11	III	White	-	121
19	M	3-0	III	White	-	156
20	F	3-3	II	White	-	128
21	M	3-9	I	White	-	144
22	F	3-0	IV	Spanish-American	-	110
23	M	3-8	II	White	-	118
24	F	3-5	IV	White	-	110
37	M	4-9	I	White	-	123
38	F	4-9	III	White	-	114
39	M	4-3	III	White	-	112
40	F	4-7	IV	White	-	91
41	M	4-4	IV	White	-	94
42	F	4-8	IV	White	-	109
43	M	4-7	V	Black	-	95
44	F	4-4	III	Black	-	134
45	M	4-10	II	Black	-	121
46	F	4-10	III	White	-	117
47	M	4-5	IV	Black	-	106
48	F	4-2	I	White	-	136

Subjects' Characteristics and Scores (Continued)

KRISP Form A - Pretest

Subject No.	Mean Time	Errors	I-Score	E-Score
Tutorial S_s:				
1	2.32	20	1.39	.01
2	3.43	16	.88	.14
3	2.31	16	1.06	- .32
4	2.28	17	1.24	- .03
5	1.74	15	1.13	- .54
6	2.45	16	1.11	- .08
7	1.92	16	2.04	.47
8	1.78	18	1.44	- .06
9	3.13	20	1.23	1.23
10	2.90	12	1.18	.21
11	3.89	16	.67	.07
12	2.32	11	.68	- .57
25	3.61	8	.67	- .15
26	2.34	11	1.20	- .04
27	2.50	21	2.53	1.22
28	4.52	8	.88	.87
29	3.14	12	1.27	.24
30	3.62	5	.22	- .39
31	2.71	11	1.83	.44
32	3.48	5	.26	- .42
33	1.47	14	1.89	.12
34	2.45	12	1.29	.10
35	3.64	9	.79	- .02
36	2.86	14	1.41	.42

Subjects' Characteristics and Scores (Continued)

KRISP Form A - Pretest

Subject No.	Mean Time	Errors	I-Score	E-Score
Nontutorial S_s:				
13	3.28	16	1.74	.77
14	1.52	22	1.87	.25
15	2.84	20	1.26	.14
16	2.90	21	1.46	.48
17	1.71	18	2.33	.67
18	2.48	15	1.61	.44
19	3.71	13	.47	- .22
20	4.43	14	.47	.19
21	4.38	13	1.12	.64
22	2.71	22	1.59	.52
23	1.99	18	2.27	.73
24	3.26	13	.65	- .17
37	2.59	6	1.07	- .39
38	1.98	5	.96	- .35
39	3.63	7	.54	- .27
40	2.71	10	1.72	.80
41	1.46	18	2.39	.62
42	1.74	8	1.58	.17
43	3.66	14	2.06	1.18
44	3.37	5	.28	- .45
45	2.90	18	2.90	1.61
46	4.30	5	.36	.24
47	3.84	10	1.73	.15
48	2.81	9	.86	- .15

Subjects' Characteristics and Scores (Continued)

KRISP Form B - Posttest

Subject No.	Mean Time	Errors	I-Score	E-Score
Tutorial S_s:				
1	4.70	8	- .19	- .38
2	10.49	11	-1.20	1.31
3	8.46	11	- .88	.81
4	2.13	15	1.09	- .25
5	4.07	12	.80	- .21
6	4.53	0	- .82	-1.06
7	4.84	5	.02	- .25
8	5.15	14	.31	.36
9	6.68	4	- .50	.03
10	3.63	3	- .01	- .61
11	6.29	17	.15	.76
12	2.92	4	- .09	-1.06
25	2.87	1	- .04	-1.18
26	4.86	0	- .64	- .63
27	8.39	5	- .76	.56
28	5.28	6	.30	.68
29	5.49	3	- .37	- .38
30	3.04	2	.10	- .65
31	3.86	2	.10	- .68
32	3.48	3	.18	- .35
33	2.95	8	1.29	.03
34	2.83	4	.31	- .70
35	4.59	9	1.01	.63
36	4.99	12	.66	.73

Subjects' Characteristics and Scores (Continued)

KRISP Form B - Posttest

Subject No.	Mean Time	Errors	I-Score	E-Score
Nontutorial S_s:				
13	3.27	14	1.49	.52
14	1.56	20	1.67	.07
15	1.56	15	1.17	- .59
16	2.28	27	2.15	.87
17	1.80	18	2.31	.69
18	3.99	7	.35	- .07
19	3.16	17	.93	- .03
20	3.81	9	.16	- .41
21	3.78	7	.50	- .24
22	4.08	18	.91	.47
23	4.21	1	- .34	- .89
24	3.23	14	.66	- .18
37	2.39	6	1.13	- .44
38	2.92	2	.15	- .68
39	2.76	4	.36	- .84
40	4.24	1	- .39	- .54
41	1.95	12	1.53	- .02
42	3.31	5	.61	- .01
43	6.41	4	- .27	.32
44	2.01	7	.84	- .57
45	10.76	10	- .49	2.45
46	3.65	2	- .16	- .39
47	9.75	6	- .85	1.54
48	3.24	4	.21	- .59

Subjects' Characteristics and Scores (Continued)

Subject No.	Impulsiveness Net Change	Efficiency Net Change
Tutorial S_s:		
1	1.58	.39
2	2.08	-1.17
3	1.94	-1.13
4	.15	.22
5	.33	- .33
6	1.93	.98
7	2.02	.72
8	1.13	- .42
9	1.73	1.20
10	1.19	.82
11	.52	.83
12	.77	.49
25	.71	1.03
26	1.84	.59
27	3.29	.66
28	.55	.19
29	1.64	.60
30	.12	.26
31	1.73	1.12
32	.08	- .07
33	.60	.09
34	.98	.80
35	- .22	- .65
36	.75	- .31

Subjects' Characteristics and Scores (Continued)

Subject No.	Impulsiveness Net Change	Efficiency Net Change
Nontutorial S_s:		
13	.25	.25
14	.20	.18
15	.09	.73
16	- .69	- .39
17	.02	- .02
18	1.26	.51
19	- .46	- .19
20	.31	.60
21	.62	.88
22	.68	.05
23	2.61	1.62
24	- .01	.01
37	- .06	.05
38	.81	.33
39	.18	.57
40	2.11	1.34
41	.86	.64
42	.97	.18
43	2.33	.86
44	- .56	.12
45	3.39	- .84
46	.12	.23
47	2.58	-1.39
48	.65	.44

Appendix E

KRISP Normative Data

Appendix E

KRISP Normative Data*

Sex	Age	N	Time		Errors	
			Mean	S.D.	Mean	S.D.
Females						
1.	2:5 to 3:6	74	5.038	2.172	10.351	5.516
2.	3:7 to 4:6	112	4.840	2.009	5.759	4.511
3.	4:7 to 5:6	130	4.528	1.974	3.431	2.612
4.	5:7 to 6:8	98	4.193	1.783	2.480	1.991
Males						
1.	2:5 to 3:6	53	5.083	2.004	11.453	6.110
2.	3:7 to 4:6	107	5.460	2.258	5.916	4.026
3.	4:7 to 5:6	122	5.303	1.861	3.844	3.144
4.	5:7 to 6:8	107	4.461	1.739	3.178	2.670

*N = 900+

Appendix F

Means Comparisons: 2 X 2 X 2 Analysis of Variance

Appendix F

Means Comparisons: 2 x 2 x 2 Analysis of Variance

Group	Mean	Standard Deviation
Impulsiveness pretest:		
Males	1.517	0.687
Females	1.050	0.498
3-year-olds	1.287	0.521
4-year-olds	1.280	0.751
Tutorial	1.179	0.534
Nontutorial	1.388	0.725
Efficiency pretest:		
Males	0.350	0.576
Females	0.072	0.385
3-year-olds	0.207	0.436
4-year-olds	0.215	0.575
Tutorial	0.122	0.477
Nontutorial	0.300	0.526

Appendix G

Impulsiveness Adjusted Means Comparison: 2 X 2 X 2 Analysis of Covariance

Appendix G

Impulsiveness Adjusted Means Comparison: 2 x 2 x 2 Analysis of Covariance

Variate Y

Impulsiveness Posttest Scores

	Tutorial		Nontutorial		
	3	4	3	4	
	-.19	- .04	1.49	1.13	
	-.88	- .76	1.17	.36	
	.80	- .37	2.31	1.53	
Males	.02	.10	.93	- .27	Males
	-.50	1.29	.50	- .49	.3375
	.15	1.01	- .34	- .85	
	$\bar{X}$ = -.10	$\bar{X}$ = .205	$\bar{X}$ = 1.01	$\bar{X}$ = .325	
	-1.20	- .64	1.67	.15	
	1.09	.30	2.15	- .39	
	- .82	.10	.35	.61	
Females	.31	.18	.16	.84	Females
	- .01	.31	.91	- .16	.30625
	- .09	.66	- .66	.31	
	$\bar{X}$ = -.12	$\bar{X}$ = .152	$\bar{X}$ = .983	$\bar{X}$ = .210	
	- .11	.1785	.9965	.2225	.322

T = .03425 N = .6095

3's = .44325 4's = .2005

Covariate Z

Impulsiveness Pretest Scores

	Tutorial		Nontutorial		
	3	4	3	4	
Males	1.39	.67	1.74	1.07	Males 1.516
	1.06	2.53	1.26	.54	
	1.13	1.27	2.33	2.39	
	2.04	1.83	.47	2.06	
	1.23	1.89	1.12	2.29	
	.67	.79	2.27	1.73	
	$\bar{X}$ = 1.253	$\bar{X}$ = 1.497	$\bar{X}$ = 1.532	$\bar{X}$ = 1.782	
Females	.88	1.20	1.87	.96	Females 1.05
	1.24	.88	1.46	1.72	
	1.11	.22	1.61	1.58	
	1.44	.26	.47	.28	
	1.18	1.29	1.59	.36	
	.68	1.41	.65	.86	
	$\bar{X}$ = 1.088	$\bar{X}$ = .877	$\bar{X}$ = 1.275	$\bar{X}$ = .960	
	1.1705	1.187	1.4035	1.371	1.283
	T = 1.17875		N = 1.38725		
	3's = 1.287		4's = 1.279		

Covariate X

IQ Scores

	Tutorial		Nontutorial		
	3	4	3	4	
	116	121	89	123	
	103	108	97	112	
	87	104	77	94	
Males	135	125	156	95	Males
	91	100	144	121	111.25
	115	128	118	106	
	$\bar{X}$ = 108.0	$\bar{X}$ = 114.0	$\bar{X}$ = 114.0	$\bar{X}$ = 109.0	
	95	127	89	114	
	131	84	100	91	
	103	120	121	109	Females
Females	82	119	128	134	110.75
	121	113	110	117	
	117	86	110	136	
	$\bar{X}$ = 108.0	$\bar{X}$ = 108.0	$\bar{X}$ = 110.0	$\bar{X}$ = 117.0	
	$\bar{X}$ = 108.0	$\bar{X}$ = 111.0	$\bar{X}$ = 112.0	$\bar{X}$ = 112.5	110.87

T = 109.5 N = 112.25

3's = 110.0 4's = 111.75

111.

Impulsiveness - Adjusted Means

	Tutorial		Nontutorial		
	3	4	3	4	
Males	-.13146	.26201	1.07142	.27972	Males .37042
Females	-.17222	.07323	.97356	.22834	Females .27573
	-.15184	.16762	1.02249	.25403	.32496
	T = .00789		N = .63826		
	3's = .43533		4's = .21083		

Formula for Computing Adjusted Means:

$$\bar{Y}_{jkl} = \bar{Y}_{jkl} + .00963\ (\bar{X}_{jkl} - \bar{X}) + .12581\ (\bar{Z}_{jkl} - \bar{Z})$$

Where

$\bar{Y}_{jkl}$ = adjusted mean for cell jkl

$\bar{Y}$ = unadjusted mean for cell jkl

$\bar{X}_{jkl}$ = mean of first covariate for cell jkl

$\bar{X}$ = grand mean for first covariate

$\bar{Z}_{jkl}$ = mean of second covariate for cell jkl

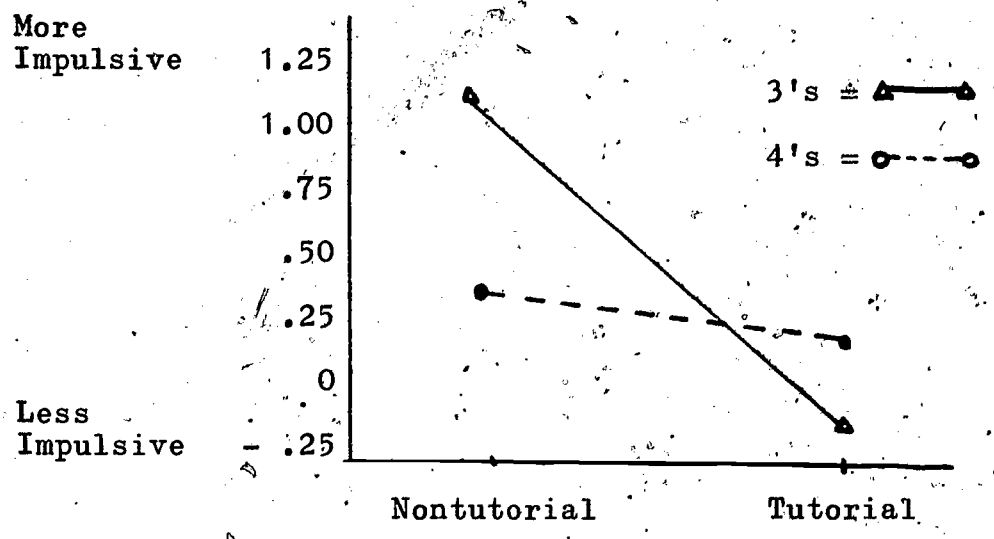
$\bar{X}$ = grand mean for second covariate

Appendix H

Interaction Effect of Age and Treatment

Appendix H

Interaction Effect of Age and Treatment*



*Significant, $p < .05$