8508785

Ciotti, Joseph Edmond

THE EFFECTS OF IMPULSIVITY ATTENUATION THROUGH TRAINING OF HAPTIC DIFFERENTIATION AND MATCHING STRATEGIES ON LOCUS OF CONTROL AND RISK TAKING

University of Hawaii PH.D. 1984

University
Microfilms
International 300 N. Zeeb Road, Ann Arbor, MI 48106

THE EFFECTS OF IMPULSIVITY ATTENUATION THROUGH TRAINING OF HAPTIC DIFFERENTIATION AND MATCHING STRATEGIES ON LOCUS OF CONTROL AND RISK TAKING

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN EDUCATIONAL PSYCHOLOGY

DECEMBER 1984

By

Joseph Edmond Ciotti

Dissertation Committee:

Harold I. Ayabe, Chairman
Mary E. Brandt
Lucius Butler
Morris K. Lai
Arthur W. Staats

ACKNOWLEDGEMENTS

Many people gave their support and encouragement throughout this study. I am especially thankful to the fifth graders who participated in the training and testing program, and to their teachers, Miss Yolanda Andrade and Mrs. Melinda Underkoffer (Maryknoll Grade School) and Mrs. Mary Reppun (Our Redeemer Lutheran Elementary School), who kindly cooperated by adjusting their own curricular plans to meet the needs and schedule of this investigation. I would also like to recognize the assistance afforded by the principals of both schools, Mr. James Gahler (Maryknoll Grade School) and Dr. Mark Silzer (Our Redeemer Lutheran Elementary School).

I am most appreciative of the guidance and encouragement which my committee chairman, Dr. Harold Ayabe, gave, not only during my work on this dissertation, but throughout my studies in the Educational Psychology program.

I also thank the other committee members for their special contributions: Dr. Morris Lai for his detailed consultations in statistical analysis, Dr. Lucius Butler for his enthusiastic teachings in audio-visual techniques, and Dr. Betsy Brandt for her thorough critiques and insights into the social implications of this study.

Finally, I owe my deepest gratitude to my wife, Kili, and two sons, Kapono and Nainoa. Their love and understanding supported me through the drudgery of routine, the pressure of deadlines, and the labor of creativity. They share in my struggles and accomplishments. My feelings are best summed up in the words of a popular song: "I can fly as high as an eagle...but you are the wind beneath my wings."

ABSTRACT

This study investigated the effects of haptic training of scanning strategies on attenuating impulsivity. Four major hypotheses were offered. **H1:** Ss trained in haptic differentiation scanning strategies will show greater impulsivity attenuation than Ss trained in haptic match-to-sample scanning strategies. **H2:** Ss identified prior to reflectivity training as internals on locus of control will show greater impulsivity attenuation than Ss identified as externals. **H3:** Locus of control is a function of cognitive tempo. Attenuation in impulsivity will result in a more internal locus of control. **H4:** Risk taking is a function of cognitive tempo. Attenuation in impulsivity will result in lower risk taking scores.

Seventy-five fifth-grade boys and girls were randomly assigned to one of 3 treatment groups. Groups DIFF and SAME were trained with discrimination tasks involving stimuli in the form of wooden geometric blocks. Only tactual manipulation of the stimuli was permitted. Group DIFF's task entailed identifying the one block from among 6 alternatives that was different from a standard block. Group SAME's task consisted of finding the one alternative out of 6 blocks that exactly matched the standard. The control group (Group CTRL) underwent no training.

All Ss were administered a computer-adapted version of Kagan's Matching Familiar Figures Test (a 12-item visual match-to-sample test), an investigator-constructed risk taking task (a computer operated, video arcade game involving pure chance), and two locus of control

scales (Nowicki-Strickland LOC Scale for Children and Reid-Ware Three Factor Internal-External Scale).

Results indicated that haptic training successfully attenuated impulsivity for Group DIFF, as measured by Salkind and Wright's Impulsivity Style index. Performance for Group DIFF was statistically different than groups SAME and CTRL ($p < .01$), as predicted by H1. The data did not support H2. Impulsivity attenuation was not differentially induced according to locus of control. Furthermore, locus of control was not found to be correlated with cognitive tempo. H3 and H4 were not confirmed. No effect was observed on either locus of control or risk taking as a result of impulsivity attenuation. Risk taking, however, was found to be positively correlated with Impulsivity Style ($r = .246$) and negatively correlated with Reid-Ware's Social Systems Control factor ($r = -.305$). A psychometric problem related to Kagan's MFFT distractor variants was also observed.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

CHAPTER I

INTRODUCTION

Statement and Significance of the Problem

Empirical evidence has long supported the contention that individuals possess different cognitive styles for processing information. When engaged in problem-solving tasks, individuals consistently select cognitive strategies from among their own personal pool of predispositions and preferences. The psychodynamics underlying these cognitive styles have been attributed to both congenital and acquired factors. Knowledge of how and why an individual arrives at a particular cognitive product is fundamental to any cognitive theory of learning. If such predispositions do indeed mediate learning outcomes, then the identification and articulation of their catalytic nature are essential to a fuller understanding of information processing.

Gagné (1967) was among the first theorists to recognize that differences in cognitive strategies reflect variations not only in mental ability, but also in the manner in which information is acquired and processed. Such differences constitute qualitative, as well as quantitative, variances in mental functioning. Ausburn and Ausburn (1978) have stressed the curricular importance of incorporating these mode preferences for learning within instructional designs. Expanding on surveys of the literature by Messick (1966) and Kogan (1971), Ausburn and Ausburn identified and described eleven major cognitive styles, each characterized by relative stability over time and by resistance to modification under training.

Among the most extensively studied of these styles is a construct alternatively labeled **cognitive tempo, conceptual tempo,** and **cognitive impulsivity.** The term tempo refers to the degree to which an individual incorporates response delay within a framework of problem-solving or hypothesis-testing strategies.

The most popular index of cognitive tempo is **reflection-impulsivity (R-I).** This measurement, which was formulated by Kagan, Rosman, Day, Albert, and Phillips (1964), assesses an individual's tendency to display slow or fast response times in problem-solving situations that involve high response uncertainty. Reflectivity is characterized by relatively long delays in responding coupled with few errors; impulsivity, by shorter delays with a higher incidence of response errors.

There is strong evidence to indicate (as presented in the Review of the Literature section of this dissertation) that Kagan's index of cognitive tempo may be measuring more than mere time delay. Experimental data, for instance, have supported the belief that reflectives do not simply spend more time than impulsives with identical problem-solving strategies. Reflective responders have been observed to exhibit qualitatively different cognitive strategies than their impulsive counterparts. Identification of these preferential strategies in problem solving has become a paramount concern in light of the demonstrated superiority in effectiveness and efficiency of reflective strategies over impulsives ones where at least fundamental academic tasks are involved.

Positive relationships between impulsivity and maladaptive academic and social behavior have been reported in numerous correlational studies. These findings have prompted a wide range of experimental designs directed at adjusting tempo toward a more reflective style. Attempts at modifying impulsivity have been met with qualified success (Duryea & Glover, 1982). Typically, error rates have been found to be more resilient and resistant to attenuation, while response latency has proven to be more malleable. Researchers have generally reported being successful in modifying impulsivity through direct instruction of efficient scanning techniques and training in attending to the distinctive features of the task at hand.

The potential ability to alter an individual's impulsivity level creates an added incentive for identifying both the underlying causes of cognitive tempo and any ramifications associated with its modification. Such knowledge would prove invaluable in the proper diagnosis, prescription, and intervention treatment of maladaptive and remedial learners. Despite the two decades of extensive research that have transpired since Kagan and his co-workers first isolated this cognitive style, the predominately correlational nature of these studies has left many of the predicted cause-effect relationships unconfirmed.

Among these unresolved issues is a clarification of the role which cognitive tempo plays in the formulation of an individual's locus of control and risk-taking style. Models of reflection-impulsivity suggest that variances in both factors should be at least partially accounted for by the style of tempo exhibited.

A strong case can be made for the existence of a causal relationship between locus of control and cognitive tempo. Individuals who assume a reflective posture in problem solving should receive frequent positive reinforcements as a result of the low rate of response errors associated with their style of tempo. Theory predicts that reflectives should develop a generalized expectancy for internal control of their reinforcements. Conversely, impulsives are expected to assume an external locus of control, perceiving outside agents, such as luck or fate, as the controlling source of their reinforcements.

Theoretical arguments have also been advanced linking the cautious outlook of low risk takers with a preference toward being reflective during a problem-solving task. The contemplative nature of reflectives is expected to inhibit a willingness toward high risk taking. These same arguments predict that those traits associated with impulsivity will foster a high risk-taking attitude.

The limited research thus far conducted in these two areas has yielded conflicting results. The most recent findings indicate the existence of moderate correlations for both relationships. New data suggests that the relationship between locus of control and cognitive tempo may be far more complex than originally hypothesized. Despite these latest positive results, the correlational nature of these investigations precludes any statement on the existence of causal relationships between cognitive tempo, locus of control, and risk taking.

The purpose of this study is to investigate the reported preference given by reflectives to differentiation strategies over match-to-sample strategies when engaged in problem-solving tasks involving high response uncertainty. A haptic training program involving instruction in either differentiation strategies or match-to-sample strategies was devised in an effort to induce impulsivity attenuation. Differential performance on Kagan's Matching Familiar Figures Test (MFFT) was expected to establish whether one strategy was superior to the other. This posttest only design was further aimed at exploring the causal role which cognitive tempo purportedly plays in the development of locus of control and risk taking. Both issues were addressed within the framework of Salkind and Wright's (1977) two-dimensional model for cognitive tempo, which integrates speed and accuracy on Kagan's MFFT into two orthogonal measures: Impulsivity Style and Efficiency.

This study took advantage of the statistical power offered by Salkind and Wright's model, which treats cognitive tempo as a continuous variable. Previous research analysis in cognitive tempo has been restricted to less sensitive statistical procedures due to the categorical nature of Kagan's R-I index. The results obtained from Salkind and Wright's model were compared with those obtained from Kagan's R-I index.

Review of the Literature

Kagan et al. (1964) first identified reflection-impulsivity as an index for measuring cognitive tempo. The **Matching Familiar Figures Test (MFFT)** which they constructed has become the standard instrument for R-I. The child's version of Kagan's MFFT, a visual match-to-sample test, consists of 12 items, each of which includes a standard stimulus (a picture of a familiar object) and typically six plausible variants, only one of which is identical to the standard (for a sample item see Figure 13, Appendix E). The standard and variants are continuously available to the subject, who must select the picture which matches the standard exactly. Two scores are recorded: 1.) **mean latency** (the average time to first response across all 12 test items) and 2.) **total errors** (the total number of errors committed on the test).

A negative correlation has been empirically found to exist between response time and response errors. Reflection-impulsivity is operationally defined on the yoked criteria of mean latency to first response and total errors. A double median split is first performed on the data. Subjects whose scores lie above the median on MFFT mean latency to first response and below the median on total errors are termed **reflective.** Those whose scores fall below the median on mean latency but above the median on total errors are called **impulsives.** Reflectives and impulsives generally comprise two-thirds of the sample. The remaining subjects falling within the counter-diagonal cells are classified as **slow-inaccurates** if their scores fall above the median on both mean latency to first response and total errors and as **fast-accurates** if their scores lie below the median on both mean

latency and total errors. Figure 1 graphically illustrates a typical scatterplot of mean latency versus total error on the MFFT.

This artificial dichotomization has been criticized by several authors (Ault, Mitchell, & Hartmann, 1976 and Messer, 1976). Potentially valuable discriminating data are inevitably lost as a result of this double median split. And, as a further consequence, researchers are led to categorize individuals in discrete groups, rather than along a continuum of cognitive styles. Statistical power is additionally lost by the standard policy of discarding slow-inaccurates and fast-accurates from follow-up studies.

Using data from nineteen studies, Ault et al. (1976) reported a median value of -.56 for the Pearson product-moment correlation between latency and error rates. Messer (1976) computed a median value of -.48 from the eighteen studies included in his summary. Messer also noted that the reflectivity-impulsivity indices recorded for the school-age children sampled were moderately stable and generalizable across tasks similar to the MFFT. Correlations between IQ and MFFT response time and errors were determined to average around .16 and -.32, respectively. Messer's review uncovered no overall sex difference for cognitive tempo. In those studies where sex differences were reported, girls were found to be slightly more reflective than boys.

Although a significant negative correlation exists between response latency and response errors for school-age children, no relationship apparently exists for preschoolers. Kagan and Messer (1975) reported that in a longitudinal study by Ward, while no

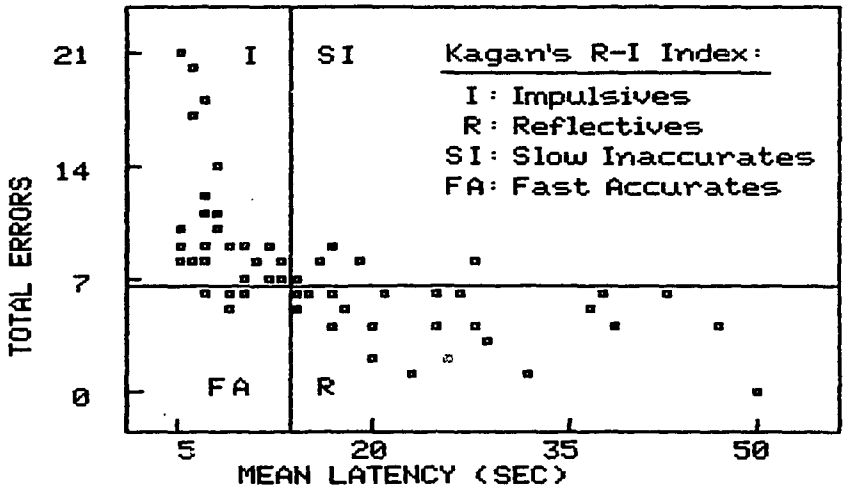

Fig. 1 Typical scatterplot of mean latency to first response against total errors on the MFFT for 10-year olds.

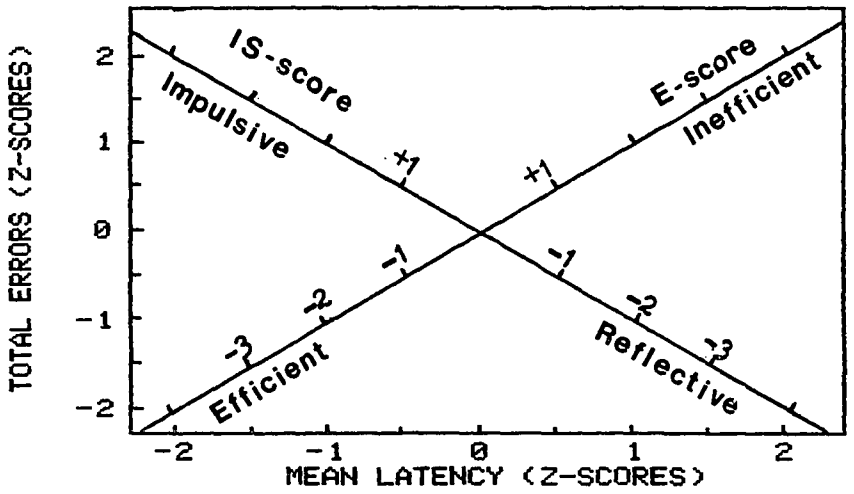

Fig. 2 Salkind and Wright's integrated model for Impulsivity Style and Efficiency.

correlation was found between response time and errors for a group of 4- and 5-year olds, a significant negative relationship emerged when these same children were retested at six years of age. Cairns (1978 a) also reported a decrease in MFFT errors between the ages of 5 and 7, although no corresponding increase was observed in latency scores.

The developmental nature of cognitive tempo has been addressed in fuller detail by Salkind and Nelson (1980). They compiled MFFT data on 2846 children, ages 5-12, from numerous investigators. Their pooled sample confirmed previous findings that reflectivity tends to increase with age. Prior to five years of age, children exhibit no correlation between response latency and errors. A significant negative correlation eventually emerges in school-age children, who tend to grow more reflective up through ten years old. Thereafter, their performance is characterized by a decrease in latency coupled with stabilization in error rates, which is suggestive of a shift toward more efficient information processing.

An important by-product of Salkind and Nelson's compilation of MFFT results has been the establishment of national norms for elementary school children (Salkind, 1978). This data bank serves to eliminate a common criticism of Kagan's R-I index, namely, that tempo categorization is sample dependent.

Salkind and Wright (1977) have proposed a two-dimensional model for cognitive tempo. The dual criteria of R-I (viz., speed and accuracy) are defined in terms of two constructs: **impulsivity style** and **efficiency.** The former differentiates reflective and impulsive individuals, while the latter serves to distinguish variations in

the level of efficiency as characterized by fast-accurates and slow-inaccurates.

Salkind and Wright's integrated model is illustrated in Figure 2 (see page 8). A new set of axes is obtained by rotating those of the original scatterplot. **Impulsivity Style** is defined as a dimension of individual differences ranging from impulsive to reflective. **Efficiency** is defined orthogonally to this dimension, ranging from fast-accurate to slow-inaccurate performances. Impulsivity Style (IS) and Efficiency (E) scores are computed from standardized total errors and mean latency scores:

$$IS_i = z_{ei} - z_{li} \quad \text{and} \quad E_i = z_{ei} + z_{li}$$

where z_{ei} = standard score for the ith individual's total errors
and z_{li} = standard score for the ith individual's mean latency.

Performance differences in information processing between reflective and impulsive children have been observed. Nuessle (1972) examined the relationship between R-I and proficiency of focusing on Levine's hypothesis-testing task. Focusing is assessed through the efficiency that results from the use or non-use of feedback provided during the problem-solving session. Results for fifth and ninth graders indicated that reflectives were more proficient focusers than impulsives. Nuessle concluded that the developmental differences observed in focusing are related to developmental differences in R-I. While no causal inferences could be drawn, Nuessle postulated that a reflective disposition may facilitate focusing by permitting higher efficiency in retrieving and recording information.

Weiner and Berzonsky (1975) examined the performance of reflective and impulsive children on Hagen's incidental learning task in order to assess the development of selective attention with respect to cognitive tempo. A negative correlation was found between central and incidental learning for sixth-grade reflective students, while a positive correlation was obtained for the impulsive group. The reflective subjects displayed less incidental learning and more central learning than the impulsive children, who showed an inability to use a selective strategy. Weiner and Berzonsky concluded that impulsive children were not adept at utilizing feedback to determine relevant and irrelevant components of a problem. Their findings served to confirmed a previous study by Hallahan, Kauffman, & Ball (1973), linking selective attention and cognitive tempo. Egeland & Higgins (1976) found that their impulsive subjects recalled less central and incidental information than their reflective counterparts. These results suggest that impulsives may possess a deficiency in the ability to encode information for storage.

Numerous other investigations have revealed that reflectives and impulsives use different strategies when faced with problems involving high response uncertainty. Visual scanning studies, in particular, have demonstrated that reflective search strategies are more extensive and effective than impulsive ones. Nelson (1968/1969), and later Goodman (1973/1974), observed that reflectives looked more often and longer at all MFFT stimuli than impulsives did. Siegelman (1969) confirmed this, reporting that impulsives ignored 2.5 times as many alternatives on the MFFT as reflectives.

Ault, Crawford, & Jeffrey (1972) found that reflectives and fast-accurates made proportionately greater number of comparisons between the MFFT standard and variants. Their fast-accurate subjects did not, however, eliminate all the incorrect variants prior to responding. In a subsequent study, Ault (1973) examined the problem-solving strategies behind cognitive tempo by using a 20-question game. Results indicated that impulsives asked less mature questions than reflectives and fast-accurates. Slow-inaccurates fell in between the other groups.

Drake (1970) reported that reflective subjects had inspected a larger area of the total visual field and had made about twice as many comparisons of corresponding design features. Only reflective adults always looked at all variants of an item before answering.

Zelniker, Jeffrey, Ault, & Parsons (1972) likewise observed that reflectives exhibited more eye-fixations and scanned more variants than impulsives on the MFFT. A training period followed during which their second-grade subjects were given a match-to-sample task where five of the variants were identical with the standard and only one differed. Such a discrimination task purportedly forces the subject to observe the variants more systematically, since a cursory search would likely leave the subject without an appropriate response. Zelniker and his co-workers reported that after ten training trials, the impulsives made fewer errors on an immediate MFF posttest than on the pretest.

Zelniker et al.'s results suggest that reflective scanning strategies may involve comparisons that focus on finding heterologous (or distinctive) features between the corresponding parts of the standard and variant. This type of strategy is more likely to result

in a conclusive determination of whether a given variant matches the standard. Comparisons that search for homologous (or matching) features are less efficient and more likely to result in an oversight. By inspecting the MFFT stimuli from a global perspective, impulsives may be more susceptible to overlooking differences between the standard and variants than reflectives are. This conclusion is substantiated by a previous study by Odom, McIntyre, & Neale (1971) and has been confirmed in later studies by Zelniker and Oppenheimer (1973) and Orbach (1977).

Reflective children have been observed to employ more thorough analytical problem-solving strategies than impulsives (Zelniker & Jeffrey, 1976; Hybertson, 1976; and Isakson & Isakson, 1978). This bias toward analytic versus global approach was confirmed by Mitchell and Ault (1979). They reported that, while their reflective subjects analyzed visual stimuli into component parts, their impulsive subjects engaged in a less effective global strategy. More recently, Loper, Hallahan, & McKinney (1982) failed to confirm these previous findings. They reported that both impulsive and reflective second and sixth graders were capable of offering either analytic or global responses. Furthermore, children of both cognitive styles were able to switch from a global pattern to an analytic one whenever they were reinforced for doing so.

Later, Siegel, Babich, & Kirasic (1974) examined visual recognition memory among reflective and impulsive children. They concluded that the primary basis for classification of R-I was that reflectives tended to engage in a more detailed visual feature

analysis of stimulus arrays. Borkowski, Peck, Reid, & Kurtz (1983) investigated the relationship between cognitive tempo and metamemory, which refers to introspective knowledge about the memory system. They reported that reflective second and third graders were better able to provide descriptions about how the mind works in solving memory problems than were impulsive children. Although no causal relationship could be concluded, their data suggested that cognitive tempo mediated metamemory which in turn mediated strategy transfer.

Kagan (1966) inquired into the psychodynamics of the reflection-impulsivity dimension. His study was based on the following assumptions: (1) response uncertainty is essential for the existence of a relationship between cognitive tempo and performance quality and (2) a child's tendency toward reflectivity or impulsivity is determined by the relative strengths of two standards (answer rapidly versus avoid errors). Reflectivity purportedly results when anxiety over making a possible error dominates over the desire for quick success. If the reverse is true, an impulsive disposition forms. Third-grade children were administered a serial learning task under various conditions designed to arouse anxiety over possible failure. Support for Kagan's anxiety hypothesis was obtained primarily from the results of reflective boys, who showed more disruption of memory on the task following anxiety arousal than did impulsives. Yando & Kagan (1970) argued such an anxiety hypothesis was supported by their findings that reflectives continued to exhibit longer delays than impulsives even when the number of alternatives on the MFFT ranged from as few as 2 to as many as 12.

Errickson, Wyne, & Routh (1973) investigated the effects of a response-cost procedure on cognitive tempo, which involves the punishment of incorrect responses and reinforcement of correct responses. Their findings supported Kagan's anxiety hypothesis that anxiety over error commission cultivates a more cautious and reflective approach to decision-making.

Messer (1970a), Reali & Hall (1970), and Weiner & Adams (1974) have all reported that both reflective and impulsive subjects exhibited increases in MFFT response times following the arousal of anxiety over error commission. Conversely, response times decreased following success on an intervening test item.

Ward (1968), however, found that impulsive kindergarteners increased their response latencies significantly more following a failure than did reflectives.

Block, Block, & Harrington (1974) criticized Kagan's anxiety hypothesis in light of these conflicting findings. They pointed out that, for interpretative relevance to exist between cognitive tempo and anxiety, reflective and impulsive children must differ conceptually in their responses to success and failure. Their research, involving preschoolers, indicated that impulsives, rather than reflectives, are susceptible to anxiety. They theorized that impulsives are generally fearful and inhibited. The uncertainty associated with the MFFT triggers anxiety in these individuals. Rapid responses are seen as a consequence of an urgency to escape the discomfort and pressure of the situation.

Kagan & Messer (1975) responded to this criticism by emphasizing that data based on preschoolers was unreliable, given the results from longitudinal studies which revealed no relation between MFFT total error and mean latency for this age group. They further proposed that different anxieties were responsible for arousing the two extremes of cognitive tempo: anxiety over performance versus anxiety over competence. Kagan and Messer postulated that reflectivity results whenever individuals become concerned about making an error on a task they believed they are capable of solving. Impulsives, on the other hand, are anxious over total incompetence in the test itself.

These observed differences in response times, which the psychodynamics of anxiety has been invoked to explain, can have direct consequences on the quality and diversity of strategies employed on the MFFT. The generalized experiences and reinforcements encountered as a result of the style of tempo assumed would be expected to influence the development of other cognitive traits. Among those traits that theorists most logically predict to be causally related to cognitive tempo are risk taking and locus of control.

Kogan and Wallach (1967) have demonstrated that individuals may be characterized as being inclined toward high, moderate, or low **risk taking** in decision-making performance. The fact that impulsives examine fewer variants before responding than reflectives suggests that impulsives are more prone to take risks in tasks involving high response uncertainty. Kagan (1965 a) postulated that reflectives were overly concerned with making mistakes and, thus, would tend to adopt much more cautious processing strategies than impulsives.

Eskra and Black (1971) were first to examine whether a relationship existed between caution and cognitive tempo. Although their findings failed to show any such relationship, Eskra and Black noted that the decision tasks used were uninvolving for many of the 8-year-old subjects and may not have aroused concern over the quality of their cognitive performance. In a subsequent study, Mann (1973) reported a systematic relationship between reflection-impulsivity and caution-haste in decision making for children age 6-8 years. Risk taking was evaluated on a battery of tests: toy decision, choice dilemmas, spelling decision, and a goal-setting game.

Kopfstein (1973) administered a standard risk-taking task involving a toggle-switch game. His fourth-grade subjects were presented a panel of ten switches, one of which was randomly designated a "danger" switch. A child gained game points by selecting one of the nine "safe" switches, but lost everything if the "danger" switch was chosen. The child could voluntarily stop at any point. Kopfstein found a small, nonsignificant positive correlation between impulsivity and risk-taking behavior, but also reported that more impulsive children stopped voluntarily than did reflective subjects.

More recently, Buchanan (1983) re-examined this risk-taking hypothesis with an Incomplete Figures Test based on a procedure devised by Spitz and Borland (1971). Third graders were shown 11 sets of eight incomplete line drawings of common objects in which each successive drawing in a set revealed progressively more of the object. After each stimulus was presented, the child was forced to guess the

object's identity by either making a high risk, outloud guess or a low risk, whisper guess. Only the outloud guess was game winning, scored, and received feedback. Buchanan reported that the reflective group made significantly fewer incorrect outloud guesses than the impulsive group ($p < .001$). Furthermore, reflectives made significantly more correct whisper guesses than impulsives ($p < .001$).

Risk-taking behavior is similar to that observed for **locus of control**, a construct devised by Rotter (1966). An **externally** controlled person is defined as one who holds that an outcome is contingent upon chance, luck, or fate, or is under the control of powerful others, or is unpredictable because of a complexity of external forces. An **internally** controlled individual interprets an event's outcome as contingent upon one's own behavior or relatively permanent characteristics. A relationship between locus of control and cognitive tempo has been formulated on the following logic. Impulsive individuals are expected to receive comparatively more negative feedback than reflective ones as a result of the formers' higher error rates. It is predicted that impulsives will grow to generalize that they are not in control of their own reinforcements and, thus, will assume an external locus of control. Conversely, reflectives are expected to develop a sense of internality with respect to their perceived control.

Most research findings in this area have proven inconclusive. Shipe (1971) reported a moderate correlation between reflectivity and internal locus of control for vocational school subject, but not for institutionalized boys. Reports of no significant differences were

published by Lesiak (1970), for third graders, Berzonsky (1974), for first and second graders, Finch, Nelson, Montgomery, & Stein (1974), for emotionally disturbed children, and Massari (1975), for black children enrolled in the first and second grade.

A later study by Finch, Kendall, Deardorff, Anderson, & Sitarz (1975) showed a significant correlation between reflection-impulsivity (R-I) and internality-externality (I-E). Externals were found to respond faster and make more errors than internals ($p < .05$). Ayabe (1979) discovered a curvilinear relationship between cognitive tempo and locus of control. Reflective third graders tended to be either internal or external, while similar impulsive subjects showed no such tendency. No explanation has been offered to account for such a curvilinear relationship.

Kogan (1983) has classified cognitive styles according to whether they index performance accuracy (such as, the measurements obtained from field dependence-independence tasks), reflect a value judgment on desirability (with one polarity of the style being preferred over the other), or are neutral on value judgment while also devoid of accuracy implications. Although some investigators, such as Zelniker & Jeffrey (1976), contend that cognitive tempo is value-free (with reflectivity being the preferred mode of operation for tasks involving detailed analysis and impulsivity being preferred when global processing is required), most researchers refer to cognitive tempo as value-laden.

The findings of numerous studies indicate that reflectives are superior to impulsives in performance on a variety of academic tasks, such as, **reading** (Kagan 1965a, 1965b, 1966), **arithmetic achievement**

(Cathcart & Liedtke, 1969), **inductive reasoning** (Kagan, Pearson, & Welch, 1966), **information processing** (Nuessle, 1972; Ault, 1973; Hallahan et al., 1973; Siegel, Kirasic, & Kilburg, 1973; Weiner & Berzonsky, 1975; and Egeland & Higgins, 1976), **memory** (Kagan, 1966; Siegel et al., 1974; and Borkowski et al., 1983), **perceptual and discrimination learning** (Drake, 1970; Odom et al., 1971; and Massari & Schack, 1972), **moral judgment** (Rotenberg, 1980); and **general school performance** (Messer, 1970).

In light of this overwhelming data indicating the inferiority of an impulsive decision-making style, several investigators have explored the possibility of modifying cognitive tempo. In general, the attempts at attenuating impulsivity have been successful in lengthening response latency and, to a lesser extent, reducing the number of response errors. One highly defined program for modifying cognitive structure has been developed by Feuerstein (1980). Feuerstein claims that impulsivity represents an impairment in cognitive functioning at the input level, resulting from a lack of mediated learning experiences. The Feuerstein's Instrumental Enrichment (FIE) program is aimed at attenuating impulsivity by presenting tasks directed at gathering all existing information, necessitating the inclusion of all data provided in order to solve a problem, and introducing reflective thinking. The tasks included in the instruments demand enumeration, comparison, and summation of objects and events.

In a review of the literature on impulsivity attenuation, Digate, Epstein, Cullinan, & Switzky (1978) have classified the experimental modification procedures into six categories: **required delay** (Ayabe, 1972 and Inagaki & Hatano, 1979), **direct instruction** (Ayabe, 1969 and Heider, 1971), **differentiation training** (Zelniker & Oppenheimer, 1973 and Orbach, 1977), **self-verbalization** (Meichenbaum & Goodman, 1971 and Bender, 1976), **modeling** (Ridberg, Parke, & Hetherington, 1971 and Denny, 1972), and **reinforcement** (Briggs & Weinberg, 1973 and Hemry, 1973). A more recent and novel attempt at modifying impulsivity was reported by Young (1982/1983), who succeeded in attenuating impulsivity by involving second graders in Logo computer programming.

Direct instruction in reflective scanning techniques and differentiation training have proven to be among the most consistently successful of treatments in altering cognitive tempo. Several investigators trained their subjects in visual match-to-sample discrimination techniques (Nelson, 1969; Albert, 1969/1970; and Egeland, 1974). Egeland reported that his second-grade subjects continued to exhibit the induced attenuation over a period of two months. Butter (1979) trained impulsive third- and fourth-grade boys with both haptical and visual scanning methods. While both techniques succeeded in modifying impulsivity, haptic training alone transferred across modality, suggesting that haptic training may constitute a more effective procedure for modifying impulsivity than visual scanning.

Basing their work on the findings of Zelniker et al. (1972), who demonstrated that differentiation training was effective in improving performance on the MFF test, Zelniker & Oppenheimer (1973) compared

the effects of visual match-to-sample training with differentiation training. In the match-to-sample group, subjects were instructed to select from a set of stimuli those figures that were exactly the same as the standard, whereas in the differentiation training group, subjects were required to find those variants that were different than the standard. Zelniker & Oppenheimer reported that differentiation training promoted learning of distinctive feature in their impulsive kindergarteners. The match-to-sample group did not show the same statistically significant trend. Orbach (1977) confirmed the conclusion that subjects taught to differentiate the distinctive features of a stimulus array make fewer response errors than subjects trained in other scanning techniques.

Hypotheses

Previous research studies have frequently treated cognitive tempo as an organismic variable. The established capability of modifying impulsivity presents an opportunity to investigate causal relationships between cognitive tempo and other psychological constructs, such as, locus of control and risk taking.

Four major hypotheses are offered which center on postulated causes and effects of impulsivity attenuation. For purposes of this study, **impulsivity attenuation** is defined as displacement toward more reflective scores as measured by Salkind and Wright's Impulsivity Style index. The more traditional method of referencing cognitive tempo, Kagan's categorical index of R-I, will be utilized for comparison purposes.

A. Hypothesis 1: Differentiation vs. Match-to-Sample Scanning.

Butter's (1979) previously cited findings have indicated that haptic match-to-sample training is not only as effect as visual match-to-sample training in improving performance on Kagan's visual MFFT, but also superior when the subsequent discrimination task involves haptic stimuli.

Furthermore, research findings on visual scanning have shown that impulsivity attenuation can be more effectively achieved through visual differentiation training than through visual match-to-sample training (Zelniker & Oppenheimer, 1973). Pick (1965) demonstrated that, when memory was not required on a discrimination task (such as would be the case for the MFFT), training in the detection of distinctive features proved superior to schema learning on improvement

of performance in discrimination. If differentiation scanning strategies are indeed more effective than match-to-sample strategies in discrimination tasks, then this superiority should hold up across sense modalities. Rudel and Teuber (1964) demonstrated that crossmodal learning (tactual-visual) was not only possible in a shape discrimination task, but also superior to intramodal learning (tactual-tactual).

It seems reasonable to assume, then, that haptic training of differentiation strategies should induce greater improvement in a subsequent visual discrimination task (specifically, Kagan's MFFT) than haptic training of match-to-sample strategies.

H1: Subjects (Ss) trained in haptic differentiation scanning techniques will show greater impulsivity attenuation than Ss trained in haptic match-to-sample scanning strategies.

B. **Hypothesis 2: Differential Impulsivity Attenuation.**

Research findings indicate that locus of control plays a mediating role in determining whether a person will become involved in the pursuit of achievement (Lefcourt, 1976). Disbelief in the contingency between one's effort and outcomes may preclude an individual's striving to achieve. Several researchers have reported a correlation between locus of control and academic achievement (Crandall, Katkovsky, & Crandall, 1965; Lesiak, 1970; Shipe, 1971; Messer, 1972; and Nowicki & Strickland, 1973). Messer further demonstrated that internal fourth-grade Ss had higher grades and

achievement test scores than their external peers even when IQ and cognitive tempo were partialled out. These findings suggest that, when confronted with some achievement-oriented training, internals will tend to score higher than externals on a test designed to measure the effects of that training.

H2: Ss identified prior to reflectivity training as internals on locus of control will show greater impulsivity attenuation than Ss identified as externals.

C. **Hypothesis 3: Locus of control = f(cognitive tempo).**

Ayabe & Nitahara-Pang (1981) succeeded in changing the locus of control scores for a group of college students who received mnemonic training and praise. A control group which did not undergo memory training was used as a comparison. The treatment group received positive feedback on the results of a posttest, while the control group was given negative feedback. The treatment group showed higher internal scores than the control group on a locus of control scale administered immediately afterward. Findings from a follow-up study by Ayabe, Freese, Kim, Arakaki, & Kameoka (1983) indicated that the feedback used may not have played as influential a role in modifying locus of control as the mnemonic training.

While Ayabe and Nitahara-Pang's study does demonstrate that locus of control is malleable, the training technique that was used may not necessarily have been the immediate cause for the observed trend toward more internality. Research previously cited has established a relationship between cognitive tempo and metamemory (Borkowski et al.,

1983). Reflectives exhibit a deeper understanding of memory systems. It is postulated that the mnemonic training delivered in the study by Ayabe & Nitahara-Pang may inadvertently have trained these Ss to be more reflective. This, in turn, may have mediated the observed change in locus of control.

H3: Locus of control is a function of cognitive tempo. Attenuation in impulsivity will result in a more internal locus of control.

D. **Hypothesis 4: Risk Taking = f(cognitive tempo).**

Kagan (1965 a) proposed that reflective children adopt much more cautious decision-making strategies than their impulsive peers. A cautious lookout is viewed as a consequence of the great concern over error commission which reflectives are purported to possess. Observations of children at play also indicated that impulsive children are more likely to engage in activity involving high risk situations. Kagan noted that reflective children exhibit a strong tendency to avoid peer group interaction. Buchanan (1983) reported that his third-grade impulsive Ss took higher risks on a guessing task than his reflective Ss. His findings give support for the existence of a relationship between cognitive tempo and risk taking.

It is hypothesized that risk taking is a function of cognitive tempo. As a consequence, training Ss to be more reflective will result in shifting their risk taking outlook toward the more cautious end of the risk taking continuuum.

H4: Risk taking is a function of cognitive tempo. Attenuation in impulsivity will result in lower risk taking scores.

CHAPTER II

METHOD

Subjects

Seventy-five fifth-grade boys and girls participated in this study on a strictly voluntary basis. No remuneration or compensation was offered or given. Participation in the study, however, did necessitate the release of students from class time, which was undoubtedly viewed as a reward by the volunteers. The Ss were pooled from two private elementary schools located approximately a mile apart in Honolulu, Hawaii. Enrollment in both schools was open to children living on the island of Oahu. Social economic status averaged middle to upper middle class for both school populations.

Twenty-three of the Ss attended a Lutheran elementary school, where they were enrolled in a self-contained class. The remaining fifty-two Ss attended a Catholic parochial school, where two fifth-grade sections were offered (27 students were enrolled in one class and 25 in the other). These two classes were intact most of the day, except for reading and mathematics.

The pooled sample was comprised of 42 girls and 33 boys, whose median age was 10-4 years with a range of 9-10 years to 11-6 years. All Ss were trained and tested on their own school grounds.

Instruments

Kagan's Matching Familiar Figures Test (MFFT). This visual discrimination instrument, which was constructed by Kagan et al. (1964), contains two practice and twelve test items. Each item

consists of a set of line drawings of familiar objects, such as, a tree (see Figure 13, Appendix E). A standard and six similar looking alternatives are illustrated on facing pages. The S must select the alternative that exactly matches the standard.

Kagan's MFFT was selected as a posttest instrument. Each of the test items was photocopied, laminated, and affixed to art board. The standard and six variants were mounted on facing leafs, which were hinged together by plastic tape to form a test folder for each item. A set of 14 separate folders were produced (2 practice and 12 test items).

Kagan (1965) reported a one-year test-retest reliability of 0.62 for the MFFT. A survey of the literature by Ault et al. (1976) showed that the test-retest reliabilities for error scores range from 0.23 to 0.43 over intertest periods from 3 weeks to 2.5 years. Average internal consistency reliability coefficients (alpha) were reported as 0.89 for mean latency and 0.52 for total errors.

Nowicki-Strickland Locus of Control (LOC) Scale for Children. This paper-and-pencil questionnaire consists of 40 yes/no items which survey a child's personal belief in the factors that control the outcomes of certain events. Sample questions include: "Are some kids just born lucky?" and "Most of the time, do you feel that you can change what might happen tomorrow by what you do today?" The higher the score, the more external the orientation.

This instrument was used in its entirety and in the same format as a pretest and a posttest. An interval of 13 days separated the two

test administrations. Ss filled in their answers on optical scan forms for both tests.

Nowicki & Strickland (1973) reported estimates of internal consistency of .63 (grades 3 to 5) and .68 (for grades 6 through 8). Test-retest reliability for an intertest period of six weeks ranged from .63 (for third grade) to .71 (for tenth grade). More recently, Halpin & Ottinger (1983) obtained alpha coefficient estimates that ranged from .49 for grade 3 to .67 for grade 6 and an internal consistency reliability of .58 across all grades. Test-retest reliabilities over a four-week intertest interval were reported as ranging from .19 (grade 3) to .75 (grade 6).

Reid & Ware's Three-Factor Internal-External Scale. This instrument focuses upon the multidimensionality which locus of control measures (Lefcourt, 1976). The Reid-Ware Scale is a 45-item forced choice questionnaire, which includes 13 filler items. Reid and Ware (1973, 1974) report that this instrument assesses locus of control under three factors: **Self-Control** (SC), **Social Systems Control** (SSC), and **Fatalism** (F). Sample questions include: "(A) Even when there was nothing forcing me, I have found that I will sometimes do things I really did not want to do. (B) I always feel in control of what I am doing." and "(A) The average man can have an influence in government decisions. (B) This world is run by a few people in power and there is not much the little guy can do about it." and "Many of the unhappy things in people's lives are at least partly due to bad luck. (B) People's misfortunes result from the mistakes they make."

The Reid-Ware LOC scale was used only as a posttest in this study. The higher the score, the more external the individual on each of the sub-factors.

Reid & Ware (1974) reported alpha coefficients of 0.71, 0.76, and 0.76 for the 8-item Self-Control dimension, 12-item SSC dimension, and 12-item Fatalism dimension, respectively. The intercorrelations between these I-E dimensions were: SC-SSC ($r = .30$), SC-F ($r = .27$), and SSC-F ($r = .39$).

Risk Taking Task. The Risk Taking Task is an investigator-constructed instrument designed to measure the level of risk an individual is willing to take in a purely chance-oriented situation. The task (called **Rescue the Ewoks**) is in the form of a computer video-arcade game. An individual is presented with a panel of ten switches, one of which is designated the "danger" switch. The location of this switch, which is randomly chosen by the computer, is unknown to the S. Selection of the "danger" switch results in losing the game. Selection of any of the 9 remaining "safe" switches results in game winning points. Scoring is double or nothing each time a switch is chosen. The S can stop voluntarily at any time in the game by pressing a "quit" button.

In order to make the task interesting, the characters of the game were picked from the popular motion picture epic: **Star Wars**[1]. Ss were told that 9 Ewoks were captured and held prisoner on board the Death Star. They could rescue these Ewoks by pressing the switches on the

---

[1]Star Wars is a registered trademark of Lucasfilm, Ltd.

panel in front of them. One of the ten switches, however, released Darth Vader, ending the game (called a "Mission") in failure, with the resulting loss of all points won on that mission. A mission was successfully completed if all 9 Ewoks were rescued or if the S elected to escape with all the Ewoks rescued up to that point by pressing a button marked "Escape."

Ss received continuous updates on the risk level facing them aurally (buzzing sound effect), visually (flashing light saber), and verbally (danger level message). A video gameboard, controlled by a microcomputer, provided the necessary feedback on this and other activities occurring throughout the mission (see Figures 16 through 22, Appendix K).

The Risk Taking Task consisted of four complete missions. Only the first and third missions were scored. Although the S believed that a "danger" switch existed for all missions, none in fact existed for these two. This enabled the experimenter to determine the maximum level of risk a S was willing to take without being subjected to stopping involuntarily. The raw score for each of these two missions consisted of the maximum number of switches attempted. The higher the risk score, the higher the risk taking outlook; the lower the risk score, the more cautious the outlook. Missions 2 and 4 were designed as dummy trials to disguise the deception involved in Missions 1 and 3. Darth Vader was programmed to appear every time on the second rescue attempt for Mission 2. On the last mission, Darth Vader was programmed to appear at random only after the fifth rescue attempt was made.

The Risk Taking Task devised for this investigation differed from Slovic's (1966) ten toggle-switch activity, reported in a cognitive tempo study by Kopfstein (1973), in several major respects. Kopfstein's task: a.) involved a single trial per S, as opposed to two scored and two dummy trials for this study's Risk Taking Task; b.) forced Ss to stop involuntarily if the "danger" switch was picked, thereby biasing the risk taking scores toward lower values than actual; c.) used monetary reinforcements (2 pennies won per "safe" switch selected), while this task used game points and Ewoks rescued (double or nothing) as tokens; and d.) involved an electromechanical light-buzzer system, as opposed to the computer video game format of this task.

The Risk Taking Task used in this investigation was administered as a posttest only. Reliability, as based on the split half method for the two scored items (Missions 1 and 3), was computed to be 0.84. A validity test conducted for this study evaluated the scores based on the Risk Taking Task with those for academic/social risk taking as rated by a teacher. A quadratic relationship was observed between the Risk Taking Task and teacher-rated scores ($R = .50$). Individuals who took the highest risks on the Risk Taking Task were rated by their teacher as assuming risk taking postures that were either highly cautious or highly risky in academic/social settings. This curvilinear relationship indicates that the Risk Taking Task may be measuring a highly complex level of risk taking.

Apparatus

Haptic Training Blocks and Screen. The haptic training sessions, described in a later section of this dissertation, involved the manipulation of wooden blocks hidden behind a screen. Two sets of stimuli were constructed: a.) one set for training in differentiation, where the object was to tactually find the block that was different from a standard, and b.) one set for training in match-to-sample discrimination, where the object was to tactually find the block that exactly matched a standard.

The wooden blocks were cut out of 1/4-inch masonite. Tempered masonite was used to reduce the expected ware-and-tear from the perspiration of handling. The blocks were 10-sided geometric figures generated according to a techniques developed by Lawrence and LaBerge (1955) and were similar to those used in a previously cited study by Butter (1979). Ten coordinates were randomly selected by computer and plotted on a 5 x 5 grid (1 inch per square). The 10 computer-generated points were then connected with straight lines by hand to form an enclosed geometric pattern.

The blocks were mounted on masonite trays, measuring 24-inches by 12-inches. Two sets of trays were constructed. One set consisted of trays supporting 1 standard and 6 variants, only one of which was shaped different from the standard. This set was to be used by training Group DIFF (referred to in a later section of this dissertation). A second set of trays consisted of a standard and 6 variants, only one of which exactly matched the standard. This set was to be used by training Group SAME (also referred to in a subsequent

section of this dissertation). Each tray was coded with the label of the appropriate group for ease of identification by the experimenter.

The variants that were designed to match the standard were constructed by sawing a stack of blocks together. Those variants designed to be different from the standard were constructed by randomly selecting two of the standard's corner points and shifting them approximately 3/4 of an inch in a direction randomly chosen by computer. The blocks were permanently mounted on 3/4-inch square pegs which were affixed to the masonite tray (see Figures 9 through 12, Appendix C). The variants were arranged in two rows on the left of the tray. The back row consisted on 2-inch high pegs, while the front row consisted of 1-1/4 inch high pegs. The standard was mounted on a 1-5/8 inch high peg between these two rows on the extreme right of the tray.

Nine trays of blocks were constructed for each of the two training groups. Eight of the trays were used during the two training sessions. The ninth tray was used in a review session prior to testing.

A screen, constructed from tempered masonite, stood 18-inches tall, 24-inches wide, and 12-inches deep (see Figure 8, Appendix B). A tray of blocks could be inserted behind the screen. The standard was always positioned on the right-hand side of the S. The S could inspect the blocks by placing his/her hands through an opening 6-inches high at the bottom of the screen. A black cloth curtain covered the opening to preclude visual inspection of the blocks by the S. An experimenter sat oppposite the S and had full view of the haptic activity occurring behind the backless screen.

A diagram of the block arrangement was mounted on the front of the screen facing the S. A sign reading either "Think DIFFERENT" or "Think SAME" (depending upon the training group) was suspended by hooks to the right of the diagram.

Since two experimenters were enlisted to administer the haptic training, four screens were constructed--two per trainer.

MFFT Response Panel Box. A rectangular panel box, which was constructed from pressed board, formed the housing for 6 electronic switches that permitted a S's response to be inputted into a microcomputer (see Figure 14, Appendix F). The box measured 15 inches long x 11-1/2 inches deep. The top panel, upon which the test item folders were to be placed, sloped up at a 9 degree angle from the horizon (with the front edge measuring 2-1/2 inches high and the back edge 4-inches high). An extension 3-1/2 inches deep and 7-inches high formed a back support for the MFFT item folders. A 1/2-inch dowel was attached to the back support by two treaded screws and wing nuts, which formed an adjustable backrest upon which the standard's panel could lean. This adjustability feature was designed for ease of viewing and reduction of glare. The angle between the folder leafs could be adjusted from a minimum of 95 degrees to a maximum of 135 degrees. The angle was set at 105 degrees for this study.

A numeric keypad for an Apple IIe microcomputer was modified to form 6 input switches. The switches were arranged in two rows of 3 and positioned 1-inch from the front and back edges of the top panel. The switches in each row were mounted 3-inches apart in order to line up with their corresponding variant pictures. Each switch had a standard

computer key cap numbered 1 on the top left through 6 on the bottom right.

Two such response panel boxes were constructed for this study.

MFFT Item Folders. The MFFT items were removed from their original spiral manual and presented on separate cardboard folders designed specifically for the MFFT response panel box (see Figure 14, Appendix F). Each MFFT item was photocopied on white paper, trimmed down to 7-1/2 inches x 11-inches, and laminated in clear plastic. Each standard and its corresponding array of 6 variants were centered and mounted with spray adhesive onto separate white art board panels, measuring 9-3/4 inches x 15-inches. The matching panels were then hinged together with white plastic tape and intentionally off-centered 1/2 inch lengthwise to create an overhang for ease of flipping once the folder was positioned on the response panel box. This arrangement formed a test item folder with a standard and array of variants facing each other on opposite pages. A slot 1-3/4 inch x 8-1/2 inches was cut at the center of the hinged edge to permit access for the top three buttons of the response panel box. A label was placed on the outside cover of each folder to enable the experimenter to identify the item. Fourteen such folders were constructed for each MFFT response panel box (2 practice folders with 12 test items).

Risk Task Control Panel. A rectangular box with dimensions identical to those of the MFFT response panel box was constructed from pressed board to form a control panel of 11 switches for the Risk Taking Task (see Figure 15, Appendix J). The control panel was

designed without the back support system used with the MFFT box. A laminated template was affixed to the top of the control panel. The eleven input switches that were arranged on the top of the control panel were rewired from a numeric keypad for an Apple IIe microcomputer. A single switch, labeled "Escape," was mounted on the right-hand edge. The remaining ten switches, labeled 1 through 0, were arranged in two rows to the left of the "Escape" button. The odd numbered keys were positioned 2-1/2 inches apart along the top edge, with the even numbered keys directly below them along the bottom edge. This arrangement matched that of the gameboard displayed on a video terminal.

One control panel was constructed for this study.

Microcomputer Software and Hardware. Investigator-written computer software directed the operation of both the Risk Taking Task and the MFFT. Feedback, measurements, and data storage were all under software control for both activities.

An Apple IIe (64K) microcomputer with floppy disk drive was used with each task. Feedback for the MFFT was displayed on a 12-inch green screen monitor, which was placed directly behind the response panel box. This monitor rested on a 12-inch high stand such that the bottom of the screen stood 1-inch above the top of the opened item folder. A 12-inch color monitor was hooked up to the microcomputer for the Risk Taking Task. This monitor was placed directly behind the control panel on a stand 9-inches high.

A Thunderclock was inserted into one of the rear slots of the Apple IIe in order to record response time for the MFFT. The MFFT response panel box and the risk taking control panel were each linked to an Apple IIe through the numeric keypad port.

Experimenters

Two adult experimenters (Es), one male and one female, were given instructions on how to administer the haptic training program. In order to eliminate any trainer effects, each S was trained by both Es, one during the first training session, the other during the second session.

Ss were randomly assigned to one of two adult female Es who administered the MFFT. Both Es were teachers who had worked together in the same classroom.

One adult female E administered the Risk Taking Task to all Ss.

Except for instructions on the computer-related operations of the MFFT and Risk Taking Task, the last three mentioned Es were kept blind about the nature of the tests they were administering.

The locus of control questionnaires were administered in class by the homeroom teachers (all female) of the respective fifth graders.

Design

The 75 fifth-grade volunteers were randomly assigned to one of three treatment groups. The only assignment constraint was to counterbalance treatment groups with 25 Ss each.

Two treatment groups underwent training in reflective strategies. One of these groups was presented with **differentiation** training where

the objective was to identify the one stimulus out of six that was **different** from the standard. This group is hereafter called **Group DIFF.** The second training group was presented with a **match-to-sample** task where the objective was to identify the one stimulus out of six that was the **same** as the standard. This group is hereafter called **Group SAME.** The third group underwent no training and served as a **control** group (**Group CTRL**).

The effects of reflectivity training were examined with a posttest only design. This was viewed as an improvement over Butter's (1979) pre/posttest design. Butter's design left open the effects of pretesting as a threat to internal validity (Campbell and Stanley, 1963). Butter's study was also threatened by the effects of statistical regression, since only those Ss identified as impulsive on the pretest were selected for reflectivity training. This study avoid this problem by admitting Ss without regard to cognitive tempo.

The experimental variables in general were arranged in a 3 x 2 (treatment group x gender) factorial design. The dependent variables included: total errors, mean latency, total test time, Impulsivity Style, and Efficiency for the MFFT; locus of control scores for the Nowicki-Strickland and Reid-Ware LOC scales; and risk scores for the investigator-constructed Risk Taking Task.

Procedure

Pretest LOC. The Nowicki-Strickland LOC Scale for Children was administered as a pretest to all 75 fifth graders who volunteered as Ss in this study. This 40-item questionnaire was administered orally in class by the students' homeroom teacher. Each teacher was asked to

read each question, without inflection, at a moderate pace for a fifth grader. The teacher was permitted to repeat a question if necessary. Full instructions for administering this pretest may be found in Appendix G. The Ss responded by blackening in the appropriate answer box on an optical scanning form.

Haptic Training Session. The 75 Ss were randomly assigned by computer to one of three treatment groups, with 25 Ss per group. One group (**Group CTRL**) served as a control and received no training during this session. The other two groups were trained by haptic scanning techniques in reflective search strategies. **Group DIFF** was trained to search for differences between two stimuli, while **Group SAME** was instructed on how to find two stimuli that were exactly the same.

Two training sessions were scheduled, each lasting 20 minutes. The first training session took place 7 days after the pretest was administered. The second training session was scheduled 4 days later. Each E trained two Ss at a time during the 20-minute period. The Ss switched Es for the second training session in order to avoid trainer-related effects.

Each S sat in front of a screen and was given explicit discrimination instructions particular to his/her group (see Appendix I for the complete set of instructions). **Group DIFF** was presented with a standard block and 6 variants, only one of which was **different** from the standard. **Group SAME** was presented with a standard block and 6 variants, only one of which was exactly the **same**.

The Ss were permitted to explore the blocks only by touch. They were required to keep one hand on the standard and one hand on a

variant at all times while inspecting the blocks. After inserting the first tray of blocks behind the screen, the E guided the S's right hand onto the standard block (called the "Target"). The S's left hand was next guided onto Block #1 (the 6 variant blocks were numbered 1 through 6, from Block #1 on the S's lower right clockwise to Block #6 on the S's upper right). The Ss were instructed to keep only their right hand on the Target block and their left hand on one of the 6 variant blocks. This procedure of simultaneous palpation was selected from research reported by Cairns (1978 b). Cairns found that impulsive Ss who explored simultaneously with both hands committed fewer haptic discrimination errors than impulsive Ss who explored under successive conditions, that is, by using one hand at a time.

Two common search strategies were presented to both training groups. These strategies were based on the findings of those researchers listed below in parentheses. Their findings have been previously discussed in the Review of the Literature section of this dissertation. The two common strategies presented were:

1. Compare each corner and edge of the Target block with the corresponding corner and edge of each variant block. (Drake, 1970 and Ault et al., 1972).

2. Explore all 6 variant blocks at least once before giving an answer. In order not to miss a block, inspect the 6 variants systematically by starting with Block #1 and moving clockwise to Block #6. (Goodman, 1973/1974; Nelson, 1968/1969; Siegelman, 1969; and Zelniker et al., 1972).

In addition, each training group received directions specific to its purpose. Group DIFF was instructed to concentrate on finding a corner or edge of a variant block that was different from that of the standard. Group SAME was trained to search for corners and edges that exactly matched the standard's.

The Ss changed Es for the second training session during which time the identical directions and procedures as for the first training session were given. The trainers provided frequent feedback during both training sessions. At no time did the trainers refer to time as a factor in solving the task at hand.

Review/Testing Session. Three days after completion of the second training session, all 75 Ss were administered a battery of tests and inventories: MFFT, Risk Taking Task, Nowicki-Strickland LOC, and Reid-Ware LOC. All Ss followed the same sequence of testing, except that the Ss in both training groups were provided with a 1-2 minute review of the haptic training they had previously undergone. These Ss were asked to verbalize the search strategies they had been taught. They then were presented with a set of review blocks appropriate to their group. As they explored these blocks, an E observed whether the Ss were properly applying the reflective strategies they had learned.

Administration of MFFT. All 75 Ss were individually administered the MFFT by microcomputer under the direction of an E (see Appendix D for instructions). The E placed a test item folder on top of the MFFT response panel box. The S was told to flip the top page of the folder when he/she hears the computer beep (an action caused when the E

pressed any key on the computer). The clock for timing the response latency for each item began with the sound of this beep, although neither S nor E was made aware of this.

With the folder open, the S could view the standard and 6 alternatives simultaneously. The S was instructed to find the one alternative that exactly matched the standard. A grid of 6 numbered boxes, which corresponded to the positions of the 6 variants, was displayed on the video screen in front of the S. Above it was a verbal label of the standard presently being inspected. This grid provided feedback for the S. Once an answer was found, the S was instructed to press the key on the response panel box that corresponded to it. If the answer was correct, the video screen would display the message: "YES" in the proper grid box and "THAT'S THE CORRECT ANSWER!!!" at the bottom of the screen. If the response was incorrect, the video message would read: "NO" in the grid box selected and "No, that is not the right one. Find the one that is just like the top picture" at the bottom of the screen. The E would verbally reinforce this message by pointing to the standard's picture on the top page of the folder. The S was allowed a maximum of six tries on each item. If the correct solution was not obtained on the sixth attempt, the computer would indicate the location of the correct answer by displaying the message: "The correct answer was in Box # --." The clock timing the total item time was stopped once the key to the correct solution was pressed or the sixth attempt completed. Thereupon, the E removed the folder and replaced it with the next test item.

Two practice items were first given to insure that the S understood the test directions. At no time during the test did the E refer to time or accuracy as a factor in scoring the test. The E, in fact, did not know what data was being collected. The computer recorded on disk the following data for each of the 12 test items: total errors committed, latency to first response, total time to complete the item, variant position of all responses made (including whether the sixth response, if reached, was corrected or not).

Following the MFFT, each S was asked three questions concerning the strategies he/she relied on when completing this task:

1. How often did you search for parts of the picture that looked the SAME? (Possible answers: always / most of the time / about half the time / very little / never)

2. How often did you search for parts of the picture that looked DIFFERENT? (Possible answers: always / most of the time / about half the time / very little / never)

3. Before you answered each question, how many of the bottom pictures did you usually check first? (Possible answers: 1 / 2 / 3 / 4 / 5 / 6)

Administration of Risk Taking Task. Upon completion of the MFFT, each S was individually administered the investigator-constructed Risk Taking Task. The S was seated directly in front of the risk task control panel and approximately 18 inches away from the color monitor. The complete directions for this risk taking task may be found in Appendix I.

After the S was informed that he/she was going to play a video game called "Rescue the Ewoks," a picture of an Ewok village (Figure 16, Appendix K) appeared on the video screen, followed by the theme song from "Star Wars." The S was presented a storyline that told of 9 Ewoks who had been captured and shipped to prisons on board the Death Star. The object of the game was to rescue as many Ewoks as the S felt he/she safely could without getting caught.

Once the gameboard (Figure 17, Appendix K) appeared on the monitor, the E outlined the rules of the game for the S. Two practice missions followed. During Practice Mission 1, the S was directed to press any rescue button on the control panel. The first two attempts always resulted in a successful rescue, signalled by the appearance of an Ewok at center screen (see Figure 18). A silhouette of the Ewok also replaced the jail cell's number on the screen's gameboard. This reminded the S of the jail cells he/she had already selected. The computer was also programmed to deactivate all keys pressed during a given mission. This prevented the same key from being accidentally pressed more than once during a mission. The E pointed out that each time an Ewok was rescued, the score displayed on the gameboard doubled. The S was next familiarized with the different danger signals that warned of the increasing chance of picking Darth Vader's cell. These included a buzzing sound effect, a flashing light saber, and a verbal message displayed at center screen (see Figure 19).

On the third rescue attempt of Practice Mission 1, the computer was programmed to display Darth Vader's picture at center screen (Figure 20) regardless of the rescue key pressed. This illustrated

what would occur if the S selected the "danger" key. The E emphasized that the S had lost all the points he/she had won on that mission up until then. Darth Vader's picture was replaced by the message "YOU LOSE," signalling the end of that particular mission (Figure 21).

On the second practice mission the S was given instructions on how he/she could escape at any time during a mission with all the Ewoks rescued and points won. The S was first directed to press any rescue key. Regardless of the key pressed, an Ewok would appear at center screen. The S was next directed to press the key marked "Escape" on the right of the control panel. An Ewok hut appeared at center screen (Figure 22). As many Ewoks as were rescued on that mission were next seen to move across the screen into the hut. This marked the end of a successful mission.

When the E was satisfied that the S understood the directions, the S was told that he/she was now ready to go on 4 missions. The S was further told that at the beginning of each mission Darth Vader would be re-hidden behind one of the 10 jail cells and the 9 captured Ewoks would be placed behind the other 9 cells.

Unknown to the S and E, the computer was programmed so that Darth Vader would never appear on Missions 1 and 3.

The E was informed that Darth Vader would always appear on the second rescue attempt of Mission 2. When this occurred, the E was instructed to remind the S of the option of using the "Escape" key. This was the only interaction between the E and S during the Risk Taking Task, outside of the 2 practice missions.

Also unknown to the S and E, the computer program was written so that Darth Vader would appear at random only after the fifth rescue attempt was made on the fourth and last mission.

After the fourth mission, the gameboard disappeared from the screen and was replaced by a score board summarizing the number of Ewoks rescued and total points won on all 4 missions.

The computer program recorded the maximum number of keys pressed on missions 1, 3, and 4. This data was stored on a floppy diskette at the end of the game.

Administration of LOC. The Nowicki-Strickland LOC Scale for Children was administered as a posttest immediately after all Ss in the same homeroom had completed the MFFT and Risk Taking Task. The same directions as for the pretest were used (see Appendix G). Once again the homeroom teacher orally read the questions to the entire class. The teacher was permitted to repeat the question if necessary.

Immediately afterward, the homeroom teacher administered the Reid-Ware LOC Scale (see Appendix H for administration instructions). This questionnaire was also read aloud before the entire class. The Ss responded to both LOC questionnaires by blackening in the appropriate box on separate optical scanning forms designed especially for elementary school children.

CHAPTER III

RESULTS

None of the 75 Ss who volunteered to participate in this study dropped out. All Ss completed all phases appropriate to their treatment group and engaged in each activity according to its prescribed schedule. Thus, mortality and missing data were not factors of concern in analyzing the data.

Although females outnumbered males 42 to 33, the random assignment of Ss to the three treatment groups insured an unbiased distribution of gender among the groups. A chi-square test of independence for group by sex yielded a nonsignificant result (chi-square = 0.771, df = 2, n.s.). The .05 level of significance was used to evaluate all statistical results in this study.

The following research issues were successively addressed through a variety of data analysis techniques:

1.) With the control group as a reference, was haptic training of reflective strategies successful in attenuating impulsivity within the two training groups? (H1)

2.) Was the degree of induced impulsivity attenuation dependent upon locus of control? (H2)

3.) Given the conflicting correlational findings of previous investigators, to what degree were the principal cognitive constructs of this study intercorrelated (viz., cognitive tempo, locus of control, and risk taking)?

4.) What effects did the induced impulsivity attenuation, if any, have on locus of control and risk taking? (H3 & H4)

Also investigated was a psychometric anomaly, as originally reported by Kojima (1976), in the item analysis of Kagan's MFFT.

Data analyses were conducted on an Apple IIe microcomputer, using the Human Systems Dynamics statistical software series: STATS PLUS, ANOVA II, and REGRESS II.

Results Related to Hypothesis 1

Impulsivity Attenuation

Six parameters were examined in establishing the level of impulsivity attenuation that had occurred, if any, as a result of haptic training: MFFT total error, MFFT mean latency to first response, MFFT total test time, Kagan's R-I index, and Salkind and Wright's indices of Impulsivity Style and Efficiency (hereafter, simply referred to as Salkind's indices). Variances in performance on the MFFT among the three treatment groups were initially analyzed with the conventional measures of MFFT total error scores and mean latency. These two measures, along with total test time, afforded an inspection of performance differences among the groups on single dimension parameters.

Since Kagan's construct of reflection-impulsivity is based on the yoked criteria of total errors and mean latency, his categorical index of cognitive tempo was next examined to see if any relationship uncovered from the previously examined uni-dimensional indices continued to exist under the joint constraints of R-I. This analysis was followed up with statistical tests employing Salkind's indices of Impulsivity Style and Efficiency. The continuous nature of these

measures permitted more powerful checks on the effects of training on impulsivity attenuation.

In order to explore the possibility of differential effects which gender might cause on the dependent variables, as reported by some investigators, two-way factorial analyses of variance (treatment group x sex) were performed on all parameters, except Kagan's index. In the latter case, a median test and chi-square analysis were conducted. Although a more conservative statistical approach to analyzing the MFFT data would have been to use MANOVA techniques, univariate ANOVAs were utilized exclusively for several reasons. Since cognitive tempo is defined on the joint constraints of error and latency, determination of the success of impulsivity attenuation was to be based solely on changes in Salkind's Impulsivity Style index. Success or failure in altering error or latency alone was incidental to this aspects of the study. The results of univariate effects were used basically for comparison purposes with previous studies. Since the literature abounds in univariate ANOVA treatments of these separate parameters, it was deemed more useful to apply the same analysis procedures.

Single Dimension Indices. The Pearson product moment correlation between total error scores and mean latency to first response across all groups was $r = -.56$ ($df = 73$, $p < .01$). This moderate negative correlation was typical of previously reported values and in line with the norms tabulated by Salkind (1978) for 10-year olds ($r = -.58$, $N = 227$). No significant difference was found for the correlation between total errors and total test time ($r = -.18$, $df = 73$, n.s.). As

would be expected, mean latency to first response and total test time were highly correlated ($r = .89$, $df = 73$, $p < 0.01$). Reliabilities, computed with the split-half odd-even method, were .67 for total errors, .94 for mean latency, and .82 for total test time.

Table 1 presents the mean and standard deviation of these three uni-dimensional variables (total error, mean latency, and total test time) for each treatment group, as well as their composite scores across all three groups.

In order to determine whether the sample examined in this study was typical of the general norming population with respect to MFFT total error and mean latency scores, t-tests for the difference between means for independent samples were performed. The results indicated that the means for total errors between the control group and the norming population were significantly different ($t = 2.27$, $df = 250$, $p < .05$). The mean latency scores between the control group and the norming population were not found to be significantly different ($t = 1.29$, $df = 250$, n.s.). The low total error scores exhibited by the control group are indicative of a higher that normal presence of reflective subjects in this study. Such a condition would serve to produce a floor effect in attenuating impulsivity; and, thus, make obtaining significant findings in this regard more difficult.

As a corollary to Hypothesis 1, it was expected that the haptic training groups (DIFF and SAME) would commit fewer total errors on the MFFT than the control group; and that Group DIFF would commit fewer errors than Group SAME. The three groups were expected to follow this same ranking order (DIFF-SAME-CTRL) according to mean latency scores,

TABLE 1

MEAN SCORES AND STANDARD DEVIATIONS FOR
TREATMENT GROUPS, COMBINED GROUPS, AND NATIONAL NORMS

	Treatment Group				
Index	Different	Same	Control	Combined	Norm
TE	3.5 (3.8)	5.9 (6.1)	5.0 (3.8)	4.8 (4.7)	7.3 (4.9)
ML	28.3 (12.0)	23.4 (7.6)	20.0 (8.1)	23.9 (9.9)	17.2 (10.6)
TT	390.0 (128.6)	356.5 (82.8)	313.4 (96.5)	353.3 (107.7)	--
N	25	25	25	75	227

Standard Deviations listed in parentheses below Mean Scores

TE = Total Test Time ML = Mean Latency TT = Total Time

Norms for 10-year olds, extracted from Salkind (1978).

TABLE 2

ANALYSIS OF VARIANCE FOR MFFT TOTAL ERRORS

Source	Sum of Squares	df	Mean Square	F	p
Group	113.424	2	56.712	2.656	.075
Sex	12.579	1	12.579	.589	
Group x Sex	101.484	2	50.742	2.377	.098
Error	1473.084	69	21.349		
Total	1700.571	74			

with the training groups exhibiting longer response times than the control group.

Table 2 summarizes the results of a factorial ANOVA (group x sex) on the total error variable. An unweighted means solution for unequal n was applied. No significant main or interaction effect was detected. The high, but nonsignificant F-ratio for between-groups ($F = 2.656$, $df = 2/69$, $p = .075$) was suggestive of the actions of a floor effect on error scores.

When the mean latency scores on the MFFT were examined across the three treatment groups (Table 3), a significant main effect was obtained for between-groups ($F = 5.519$, $df = 2/69$, $p = .006$). Neither the sex main effect nor the group x sex interaction reached significance.

Scheffe's method was used as a post hoc multiple comparison test to identify the areas of significance for the between-groups effect. As predicted, Group DIFF was found to have significantly higher mean latency scores than the control group ($F = 11.06$, $df = 3/73$, $p < .01$). Although the three groups ranked as expected along this variable (Figure 3, page 55), with Group DIFF taking longer than Group SAME to respond on the first try of each MFFT item and with Group SAME exhibiting longer latencies than Group CTRL, no significant difference was found for the remaining comparisons.

As would be expected from the high correlation between mean latency and total test time, the training groups were also observed to spend longer total test times than the control group. Table 4 summarizes the results of an ANOVA for MFFT total time. The main

TABLE 3

ANALYSIS OF VARIANCE FOR MFFT MEAN LATENCY

Source	Sum of Squares	df	Mean Square	F	p
Group	948.520	2	474.260	5.519	.006
Sex	138.987	1	138.987	1.617	.205
Group x Sex	312.519	2	156.259	1.818	.168
Error	5929.296	69	85.932		
Total	7329.322	74			

TABLE 4

ANALYSIS OF VARIANCE FOR MFFT TOTAL TIME

Source	Sum of Squares	df	Mean Square	F	p
Group	82602.718	2	41301.359	3.945	.023
Sex	41661.838	1	41661.838	3.980	.047
Group x Sex	19174.746	2	9587.373	.916	
Error	722296.508	69	10468.065		
Total	865735.810	74			

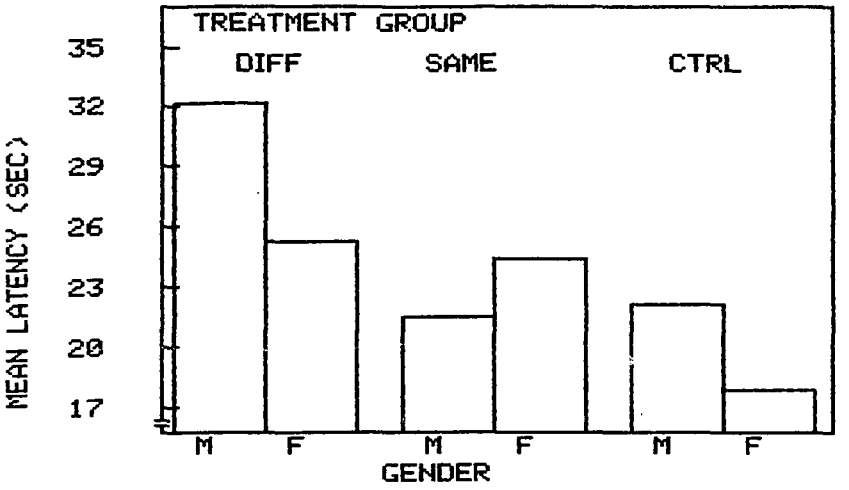

Fig. 3 Mean values of MFFT mean latency scores for groups and gender.

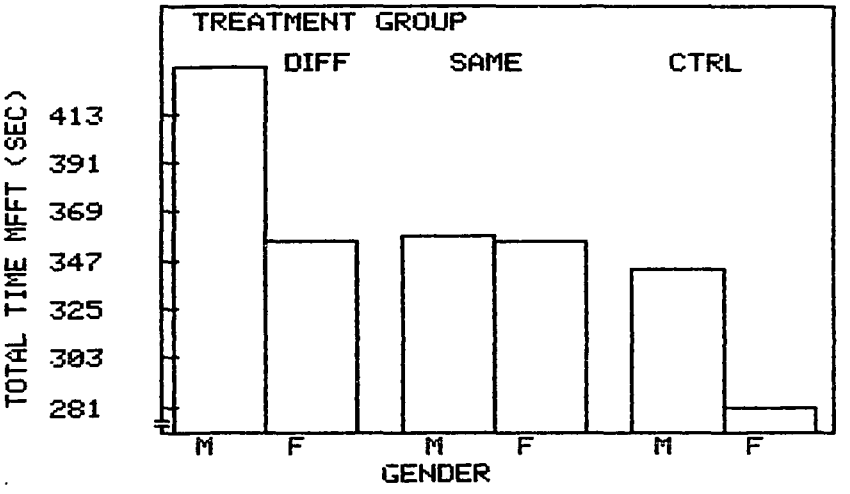

Fig. 4 Mean values of MFFT total test time for groups and gender.

effect associated with between groups continued to be significant ($F = 3.945$, $df = 2/69$, $p = .023$). A subsequent multiple comparison test with Scheffe's method revealed that the significant difference also existed only between Group DIFF and Group CTRL. Figure 4 graphically illustrates this finding.

An additional main effect for between-sex was found to be significant when total time was used as the criterion ($F = 3.980$, $df = 1/69$, $p = .047$). Bartlett's test for homogeneity of variances was carried out in light of the unequal number of males and females in this study. The corrected Bartlett's statistic obtained was not statistically significant for variances of total time scores for males and females in each of the three treatment groups ($B = 3.229$, $df = 5$, n.s.). This allowed the acceptance of the ANOVA findings that female subjects spent significantly less time (mean total time = 330.7 sec) completing the MFFT than did male subjects (mean total time = 378.6 sec).

The analyses of these three single-dimension variables were indicative of an attenuation of impulsivity in at least the group involved with difference training (Group DIFF).

Kagan's Categorical Index. As previously stated in this dissertation, Kagan et al. (1964) defined cognitive tempo as a categorical variable according to a double median split technique. In order to test if impulsivity attenuation had indeed occurred in at least Group DIFF, the MFFT variables (total errors and mean latency) were taken jointly as prescribed by Kagan.

Table 5 shows the median scores on both measures for all three treatment groups, as well as for the combined groups. The medians Salkind (1978) reported for his 10-year-old norming population (N = 227) were 6.68 for total errors and 13.67 for mean latency to first response. Comparison of the data in Table 5 with that of the norming population further indicates that the samples used in this study were more reflective than the general 10-year-old population across the 48 contiguous states. This would serve to mask impulsivity attenuation through a floor effect.

Both the total error and mean latency scores were in the predicted direction for all three treatment groups. Figure 5 (page 59) graphically illustrates the differential placement of a double median split using total error and mean latency median values for these three groups, as well as for Salkind's norming population. An above normal tendency toward reflectivity for all three samples in this study is suggested by the scatterplot.

A median test for each criterion (total errors and mean latency) was conducted to determine whether these differences were significant. The resulting chi-square value, with Yates correction applied, was nonsignificant for both the median of the total errors (chi-square = 2.273, df = 2, p = .322) and the median of the mean latency scores (chi-square = 2.894, df = 2, p = .234).

A double median split based on the median values for the control group was used to classify all Ss into one of Kagan's four cognitive tempo groups (R = reflective, I = impulsive, FA = fast accurate, and SI = slow inaccurate). Table 6 shows the contingency table for

TABLE 5

MEDIAN SCORES FOR MFFT TOTAL ERRORS AND MEAN LATENCY FOR TREATMENT GROUPS, COMBINED GROUPS, AND NATIONAL NORMS

Index	Treatment Group Different	Same	Control	Combined	Norm
Errors	2.7	3.9	4.7	3.8	6.68
Latency	27.8	24.1	17.6	24.1	13.67
N	25	25	25	75	227

TABLE 6

CONTINGENCY TABLE FOR TREATMENT GROUP VERSUS KAGAN'S COGNITIVE TEMPO CLASSIFICATION

Treatment Group	R-I Classification R	I	FA	SI	Margin Totals
Different	16	6	0	3	25
Same	16	6	1	2	25
Control	9	9	3	4	25
Totals	41	21	4	9	75

R = Reflective
I = Impulsive
FA = Fast Accurate
SI = Slow Inaccurate

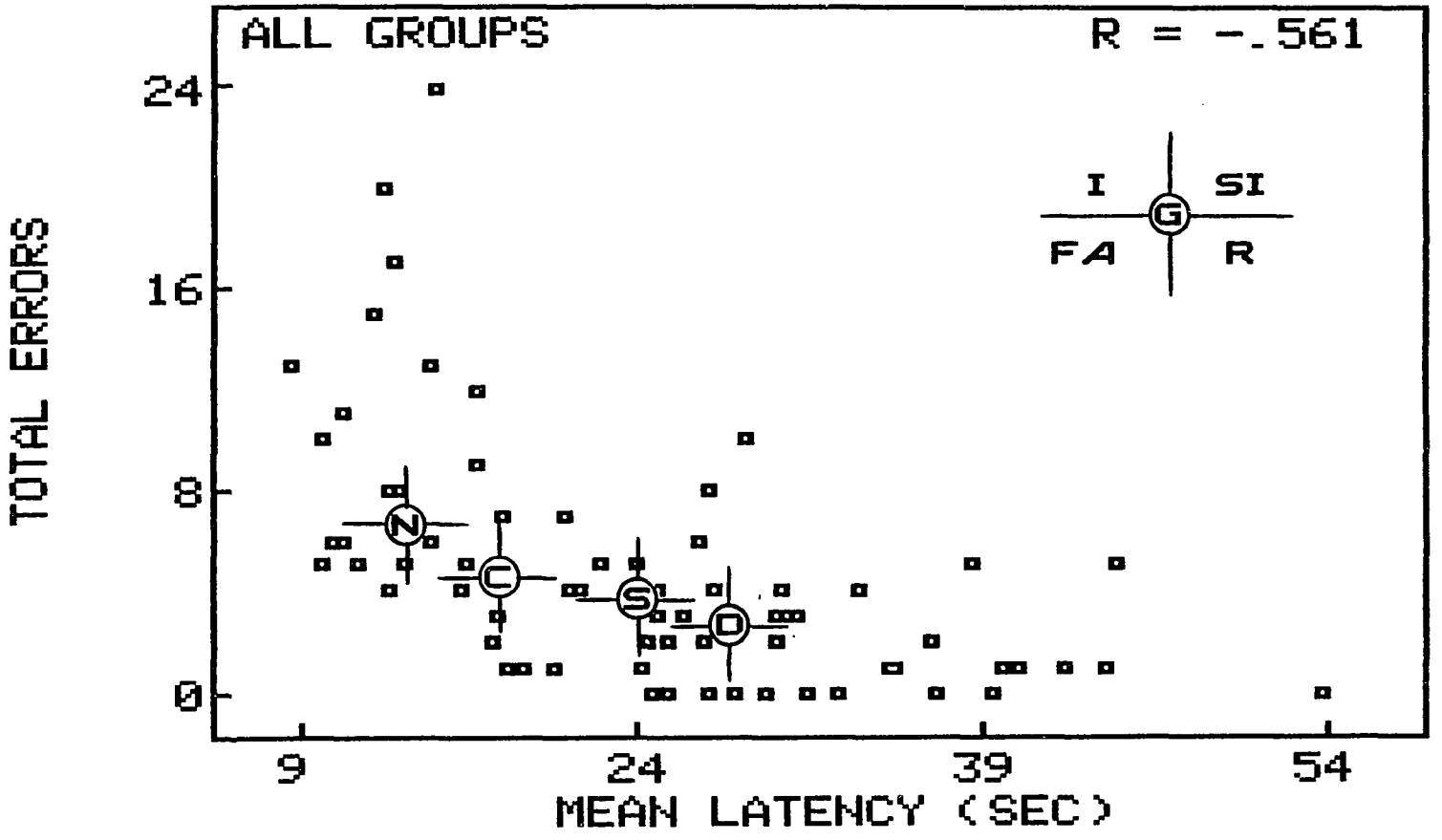

Fig. 5 Scatterplot for mean latency and total error scores (double median split indicated for all three treatment groups and Salkind's norm).

treatment group x R-I classification. A chi-square test, with Yates's correction, uncovered no significant difference (chi-square = 3.968, df = 6, p = .659).

Since the categorical nature of Kagan's index in conjunction with the possible existence of a floor-effect could mask out the presence of impulsivity attenuation, Salkind's continuous indices of impulsivity style and efficiency were next examined.

Salkind's Continuous Indices (H1). As stated previously in the review of the literature, Salkind and Wright (1977) have outlined procedures for calculating two continuous indices from the MFFT total error and mean latency scores. Standard scores are first computed for each individual:

z_{ei} = standard score for the ith individual's total errors

and

z_{li} = standard score for the ith individual's mean latency.

Salkind's indices are next calculated as follows:

Impulsivity Style (IS): $IS_i = z_{ei} - z_{li}$

Efficiency (E): $E_i = z_{ei} + z_{li}$

Impulsivity Style scores become lower on Salkind's scale as reflectivity increases. Similarly, Efficiency scores become lower as efficiency increases. Hypothesis 1 predicted that, as a result of the haptic training program, groups DIFF and SAME would exhibit lower IS scores than the control group. No prediction was offered for Efficiency scores.

Table 7 is a tabulation of the correlation matrix for Impulsivity Style, Efficiency, and selected MFFT parameters. For comparison purposes, two sets of IS and E scores were computed based on the mean error and latency values of the control group and the norming population (see Table 1). The Pearson product moment correlations between IS and E were:

$r_{IS-E} = -0.053$ for the control-based scores, and

$r_{IS-E} = 0.070$ for the norm-based scores.

As expected from their orthogonal nature, as devised by Salkind & Wright (1977), these values were not significantly different from zero, df = 73. The correlation between IS control-based and norm-based scores was significant ($r = 1.00$, df = 73, $p < .01$), as was the correlation between E control-based and norm-based scores ($r = 0.515$, df = 73, $p < .01$). As a result of the perfect correlation for IS scores between the control-based and norm-based group, only the control-based IS scores were examined.

Table 8 summarizes the results of a factorial ANOVA (treatment group x sex) for the control-based Impulsivity Style scores. An unweighted means solution was applied for unequal n. The main effect for between-groups was found to be significant ($F = 4.229$, df = 2/69, $p = .018$). Neither the sex main effect nor the interaction effect was significant.

Scheffe's method of multiple comparisons revealed that the significant difference for between-groups was due to significant differences between Groups DIFF and SAME ($F = 6.56$, df = 3/73, $p < .05$) and between Groups DIFF and CTRL ($F = 6.39$, df = 3/73,

TABLE 7

CORRELATION MATRIX FOR SELECTED MFFT PARAMETERS

	IS/C	IS/N	E/C	E/N	Error	Latency
IS/N	1.000					
E/C	-.053	-.052				
E/N	.070	.071	.515			
Error	.886	.886	.327	.356		
Latency	-.882	-.881	.427	.237	-.561	
TotTime	-.601	-.600	.603	.434	-.182	.887

IS/C = Impulsivity Style Control-Based
IS/N = Impulsivity Style Norm-Based
E/C = Efficiency Control-Based
E/N = Efficiency Norm-Based
Error = Total MFFT Errors
Latency = Mean MFFT Latency to first response
TotTime = Total Time to complete MFFT

TABLE 8

ANALYSIS OF VARIANCE FOR IMPULSIVITY STYLE (CONTROL-BASED)

Source	Sum of Squares	df	Mean Square	F	p
Group	36.705	2	18.353	4.229	.018
Sex	.278	1	.278	.064	
Group x Sex	23.411	2	11.705	2.697	.072
Error	299.438	69	4.340		
Total	359.832	74			

$p < .05$). No significant difference was obtained between Groups SAME and CTRL ($F = 0$, $df = 3/73$, n.s.). Figure 6 graphically illustrates the difference between the Impulsivity Style means of these three groups.

Results of a two-way ANOVA for the control-based Efficiency scores are given in Table 9 (page 65). While the group x sex interaction was not found to be significant, both main effects were. The between-groups effect was significant ($F = 4.321$ $df = 2/69$, $p = .016$). Scheffe's method indicated a significant difference only between Groups SAME and CTRL ($F = 7.24$, $df = 3/73$, $p < .05$).

The between-sex main effect was also found to be significant ($F = 5.528$, $df = 1/69$, $p = .020$). Bartlett's test of homogeneity indicated that the variances for Efficiency scores of males and females in all groups could be treated as homogeneous. Bartlett's corrected B was computed as 7.398 ($df = 5$, n.s.). The significance in the between-sex scores could, thus, be interpreted as a superiority of females over males with regard to efficiency on the MFFT. Figure 7 graphically illustrates this relationship.

The superiority of females over males continued to hold when Efficiency scores were based on the means of Salkind's norming population. Table 10 (page 65) outlines the salient findings of the ANOVA for these norm-based Efficiency scores. Between-sex means were significantly different ($F = 4.299$, $df = 1/69$, $p = .039$). Bartlett's corrected B remained statistically nonsignificant ($B = 10.602$, $df = 5$, n.s.).

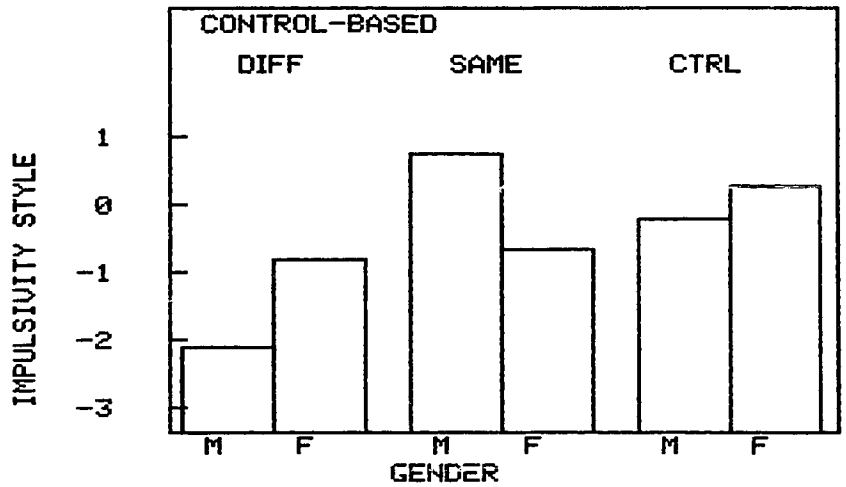

Fig. 6 Impulsivity Style means for treatment groups and gender.

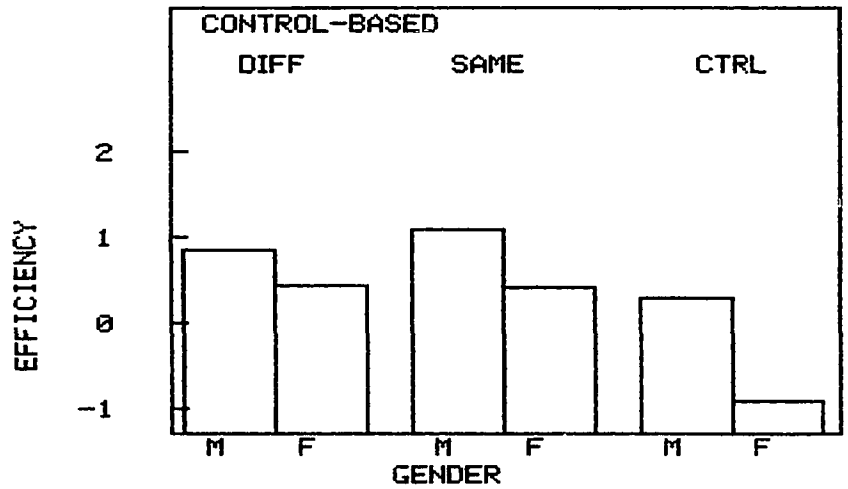

Fig. 7 Efficiency means for treatment groups and gender.

TABLE 9

ANALYSIS OF VARIANCE FOR EFFICIENCY (CONTROL-BASED)

Source	Sum of Squares	df	Mean Square	F	p
Group	17.078	2	8.539	4.321	.016
Sex	10.924	1	10.924	5.528	.020
Group x Sex	1.996	2	.998	.505	
Error	136.320	69	1.976		
Total	166.318	74			

TABLE 10

ANALYSIS OF VARIANCE FOR EFFICIENCY (NORM-BASED)

Source	Sum of Squares	df	Mean Square	F	p
Group	.621	2	.310	.165	
Sex	8.061	1	8.061	4.299	.039
Group x Sex	2.254	2	1.127	.601	
Error	129.383	69	1.875		
Total	140.319	74			

When Efficiency scores were compared to the norming population, however, the between-groups difference was no longer found to be significant ($F = .165$, $df = 2/69$, n.s.). Thus, while the training groups (DIFF and SAME) exhibited less efficiency on the MFFT than did the control, when compared to the norms this difference disappeared.

In sum, the haptic training strategies for Group DIFF were successful in attenuating impulsivity. No statistically significant attenuation effect was discovered for Group SAME. Evidently, attention deployment on feature differences is superior to that on feature similarities. Although no significant difference was obtained for Group SAME, its Impulsivity Style score was in the expected direction in comparison to the control group. While the possibility remains that Group SAME did not experience impulsivity attenuation, the lack of statistical significance might also be attributed to the possible existence of a floor effect. Salkind's index of Impulsivity Style was in general consistent with the findings from the single dimension parameters and, as anticipated, proved to be more sensitive to changes in cognitive tempo than Kagan's categorical index.

The fact that Groups DIFF and SAME exhibited significantly lower Efficiency scores than the control group may be due to a common strategy taught in both training groups--that of inspecting all items before a response was allowed.

Results Related to Hypothesis 2

Locus of Control Feedback (H2)

Hypothesis 2 predicted that Ss with more internal locus of control scores would attain greater impulsivity attenuation than those

with more external scores. The achievement-orientation associated with internals was expected to beneficially aid in the attenuation training process. Consequentially, knowledge of locus of control score, together with treatment group membership, was expected to increase the predictability of Impulsivity Style scores.

The Nowicki-Strickland Locus of Control Scale for Children was administered as a pretest one week before the training process began. The higher the score, the more external the individual. Normative data extracted from Lefcourt (1976) yielded a mean score of 17.65 ($df = 4.20$, $N = 81$) for fifth grade boys and girls. The mean pretest score for all fifth graders in this study was 15.40 (s.d. = 4.26, $N = 75$). A t-test indicated that these two means were significantly different ($t = 3.32$, $df = 154$, $p < .01$). The sample under study appeared to exhibit a more internal disposition on locus of control than the norm for fifth graders. Given the type of schools from which the samples were selected (both private), this difference was not totally unexpected.

A multiple regression analysis was performed to test the validity of Hypothesis 2. The pretest Nowicki-Strickland locus of control score, treatment group membership, and sex were used as predictor variables. The control-based Impulsivity Style served as the criterion variable. Table 11 summarizes the findings of the regression analysis. The results failed to support Hypothesis 3. Group membership continued to be the sole reliable indicator of Impulsivity Style.

TABLE 11

MULTIPLE REGRESSION ANALYSIS FOR CONTROL-BASED IMPULSIVITY STYLE WITH NOWICKI-STRICKLAND Pre-LOC, TREATMENT GROUP, AND GENDER AS PREDICTOR VARIABLES

Source	Sum of Squares	df	Mean Square	F	p
Regress	26.6309	3	8.8770	1.934	.131
Residual	325.9391	71	4.5907		
Total	352.5700	74			

Multiple Correlation (R) = .2748 Standard Error = 2.1426

Variable	Coefficient	T	S.E.	p
Pre-LOC	.021824	.370	.0589	
Group	.708832	2.327	.3046	.022
Sex	.228606	.456	.5009	
Constant	-2.642251			

TABLE 12

CORRELATION MATRIX FOR NOWICKI-STRICKLAND PRE/POSTTESTS (Pre-LOC/Post-LOC) AND SELECTED MFFT PARAMETERS

	Error	Latency	TotTime	IS/C	E/C	Pre-LOC
Latency	-.561					
TotTime	-.182	.887				
IS/C	.886	-.882	-.601			
E/C	.327	.427	.603	-.053		
Pre-LOC	.040	-.068	-.023	.061	-.082	
Post-LOC	.025	.039	.045	-.007	.097	.704

Note. See Table 7 for abbreviations.

Correlational Results

Inter-Construct Correlations

Before exploring any possible causal effects resulting from this impulsivity attenuation, it was deemed necessary to first establish whether the principal constructs in this study (viz., cognitive tempo, locus of control, and risk taking) were intercorrelated. As stated in the review of the literature, previous correlational studies have yielded conflicting findings.

LOC versus Cognitive Tempo. The Nowicki-Strickland Locus of Control Scale for Children was re-administered after the completion of the haptic training sessions. The Pearson product moment correlation between pretest and posttest was statistically significant ($r = .704$, $df = 73$, $p < .01$). The test-retest reliability obtained for this study is comparable with that reported in previous investigations.

The correlation matrix for the MFFT indices and both the pre- and posttest Nowicki-Strickland Locus of Control (hereafter called Pre-LOC and Post-LOC, respectively) is given in Table 12. No significant correlation was obtained between either LOC and any of the MFFT parameters. These findings are at variance with those of Shipe (1971) and Finch et al. (1975). They do, however, support reports of nonsignificance by Lesiak (1970), Berzonsky (1974), Finch et al. (1974), and Massari (1975).

Since Ayabe (1979) reported a curvilinear (quadratic) relationship between MFFT mean latency scores and the Nowicki-Strickland LOC for third graders, a polynomial regression analysis of the second degree was conducted between Post-LOC and control-based

Impulsivity Style. The results summarized in Table 13 failed to confirm any curvilinear relation ($F = 0.009$, $df = 2/72$, n.s.). Similar polynomial regression analyses between Post-LOC and MFFT mean latency and between Post-LOC and total errors, likewise, did not reveal a curvilinear relationship.

The failure to establish the existence of a correlation between LOC and MFFT scores all but precluded the possibility of finding a causal relationship between impulsivity attenuation and LOC, thus, calling into question the validity of Hypothesis 3.

Risk Taking versus Cognitive Tempo. Two raw scores were obtained from the Risk Taking Task--those for Missions 1 and 3. Missions 2 and 4 were designed to disguise the fact that no "danger" switch actually existed for Missions 1 and 3. The mean raw scores for Missions 1 and 3 for all Ss were 5.3 (s.d = 2.63) and 5.9 (s.d. = 2.67), respectively. The Pearson product moment correlation between the raw scores of Missions 1 and 3 was significantly different from zero ($r = .725$, $df = 73$, $p < .01$). This yielded, by way of the Spearman-Brown Prophecy Formula, a reliability of .841 for the combined two missions, which attests to the high reliability of the instrument.

The risk raw score (rrs) for each mission was converted into a cumulative risk (CR) score, defined as follows:

$$CR = \sum_{n=1}^{rrs} \frac{1}{11 - n}$$

where rrs = the risk raw score, that is, the maximum number of

TABLE 13

POLYNOMIAL (QUADRATIC) REGRESSION ANALYSIS FOR
CONTROL-BASED IMPULSIVITY STYLE AND NOWICKI-STRICKLAND Post-LOC

Source	Sum of Squares	df	Mean Square	F	p
Regress	.4951	2	.2475	.009	---
Residual	2059.2916	72	28.6013		
Total	2059.7866	74			

Multiple Correlation (R) = .0155 Standard Error = 5.3480

Variable	Coefficient	T	S.E.	p
Linear	-.01787	-.063	.2848	---
Quadratic	-.01105	-.116	.0952	---
Constant	15.4322			

TABLE 14

POLYNOMIAL (QUADRATIC) REGRESSION ANALYSIS FOR
CUMULATIVE RISK SCORES AND TEACHER-RATED RISK TAKING SCORES

Source	Sum of Squares	df	Mean Square	F	p
Regress	3.9783	2	1.9891	5.940	.006
Residual	11.3858	34	.3349		
Total	15.3641	36			

Multiple Correlation (R) = .5089 Standard Error = .5787

Variable	Coefficient	T	S.E.	p
Linear	-.99846	-2.968	.3364	.005
Quadratic	.07094	2.672	.0265	.011
Constant	4.2168			

rescue switches which the S pressed before quiting or completing a mission.

(For example, if a S quit after pressing 4 switches, then rrs = 4, and the cumulative risk score would be:

$$CR = 1/10 + 1/9 + 1/8 + 1/7 = 0.479).$$

The rationale behind this scale is that the amount of risk involved on each successive trial increases non-linearly. The total amount of risk taken on any given mission is an accumulation of each of these individual risks.

A mean CR was calculated from the two raw scores for each S and is hereafter labeled **RISK.** The mean value for the two risk raw scores, hereafter labeled **rs**, was also computed for each individual for comparison purposes. The lower the value of either RISK or rs, the more cautious the individual.

In an effort to understand the type of risk taking being measured by this study's Risk Taking Task, one of the fifth-grade homeroom teachers at the Catholic parochial school was asked to rate the level of academic/social risk taking (including classroom and playground activities) exhibited by those participants with whom she had previous personal contact. Thirty-seven children were rated on a 9-point scale: ranging from 1 for most cautious to 9 for highest risk behavior.

Examination of the scatterplot for teacher-rating versus cumulative risk scores indicated the probable existence of a curvilinear relationship between the two variables. A polynomial (quadratic) regression analysis for teacher-rating and cumulative risk scores was conducted as a follow-up. Table 14 summarizes the findings.

The multiple correlation ($R = .5089$) for a quadratic relationship was statistically significant ($F = 5.94$, $df = 2/34$, $p = .006$). The data indicated that Ss who received the highest cumulative risk taking scores on the Risk Taking Task were rated by the teacher as either the highest risk takers or the most cautious risk takers in academic/social activities. This finding suggests that the Risk Taking Task does index risk taking behavior, although in a more complex manner than expected.

The correlation matrix between selected MFFT parametric scores and the mean cumulative risk scores is tabulated in Table 15. The mean raw score is listed for comparison. Significant correlations were obtained between RISK and MFFT total error ($r = .293$, $df = 73$, $p < .02$) and between RISK and control-based Impulsivity Style ($r = .246$, $df = 73$, $p < .05$). Greater risk taking is associated with more total errors on the MFFT and a more impulsive cognitive tempo.

A similar risk taking task was devised by Kopfstein (1973). The fourth graders in his study were presented with a one trial, 10-switch task in which the "danger" switch could be selected by chance anytime during the trial. Kopfstein reported a small, nonsignificant positive correlation between these two cognitive styles. He further observed that more impulsive children stopped voluntarily than did reflective ones. Since Mission 4 of this present study was designed somewhat like Kopfstein's single trial (the "danger" switch could be selected by chance after the fifth trial), an analysis of the number of Ss from each of Kagan's R-I categories who voluntarily stopped was made. The obtained chi-square value of 2.44 ($df = 3$) was nonsignificant.

TABLE 15

CORRELATION MATRIX FOR MEAN RAW RISK (rs), MEAN CUMULATIVE RISK (RISK), AND MFFT PARAMETERS

	Error	Latency	TotTime	IS/C	E/C	rs
Latency	-.561					
TotTime	-.182	.887				
IS/C	.886	-.882	-.601			
E/C	.327	.427	.603	-.053		
rs	.267	-.119	.007	.219	.214	
RISK	.293	-.140	-.001	.246	.209	.973

Note. See Table 7 for abbreviations.

TABLE 16

CORRELATION MATRIX FOR NOWICKI-STRICKLAND Pre-LOC & Post-LOC, REID-WARE'S 3 FACTORS, AND RISK TAKING

	Pre-LOC	Post-LOC	SELF	SOCIAL	FATE	rs
Post-LOC	.704					
SELF	.137	.118				
SOCIAL	.126	206	-.084			
FATE	.288	.317	.123	.072		
rs	-.076	-.114	-.072	-.313	-.122	
RISK	-.090	-.117	-.079	-.305	-.100	.973

Reflectives, impulsives, fast accurates, and slow inaccurates quit equally voluntarily on that trial.

LOC versus Risk Taking. Two locus of control scales were compared with the results of the Risk Taking Task. Besides the Nowicki-Strickland LOC Scale, which was designed especially for children, the Reid-Ware LOC Scale was administered immediately following the MFFT and Risk Taking Task. The Reid-Ware LOC involves three factors: Self-Control, Social Systems Control, and Fatalism. This instrument was originally intended for college students, and as such, is above the reading ability of fifth graders. In order to minimize this difficulty, while keeping the instrument intact so as to take advantage of the sub-test scores, the Reid-Ware LOC Scale was administered orally, as was the Nowicki-Strickland LOC. Higher scores on both LOC scales indicate more external dispositions.

Table 16 is a tabulation of the intercorrelations between the Nowicki-Strickland posttest score, the Reid-Ware sub-test scores, and the cumulative risk and mean raw scores. Inspection of the table shows that the Nowicki-Strickland LOC was significantly correlated only to Fatalism on the Reid-Ware LOC instrument ($r = .317$, $df = 73$, $p < .02$). As was expected, due to the purported independent nature of the three Reid-Ware sub-factors, no significant difference was obtained for these between factor sub-scores (SC-SSC: $r = -.084$; SC-F: $r = .123$; and SSC-F: $r = .072$, $df = 73$, n.s.).

No significant correlation was obtained between the Nowicki-Strickland LOC posttest and risk taking scores. When the Reid-Ware LOC was compared with the cumulative RISK scores, however, a significant

correlation emerged for the Social Systems Control factor ($r = -.305$, $df = 73$, $p < .01$). This negative relationship indicates that individuals who are cautious are more likely to be external on Social Systems Control than high risk takers. This suggests that risk taking is associated with the amount of external pressure individuals sense from others in their environment.

In sum, significant correlations were observed between risk taking and MFFT error performance and risk taking and Impulsivity Style. Neither a linear nor a quadratic correlation was obtained between any of the MFFT parameters and locus of control.

Risk taking was found to be correlated with the Social Systems Control factor on the Reid-Ware LOC Scale. Scores on the Nowicki-Strickland LOC Scales were significantly correlated only with the Reid-Ware Fatalism sub-test scores.

Results Related to Hypotheses 3 and 4

Causal Relationships

Since impulsivity attenuation was successfully induced in at least Group DIFF, it was appropriate to examine the remaining two hypotheses involving cause-effect relationships. Hypothesis 3 predicted that impulsivity attenuation would cause a drop in LOC scores toward more internality. Hypothesis 4 predicted a movement toward more cautious risk taking as a result of impulsivity attenuation. Findings cited in the foregoing section suggest that Hypothesis 3 would not be confirmed, since no correlation was observed between Impulsivity Style and locus of control. The significant

correlation between risk taking and Impulsivity Style left open the possibility of confirming Hypothesis 4. The low degree of correlation ($r = .246$) indicated that anything but a strong effect would very likely be masked out.

Attenuation Effect on LOC (H3). Hypothesis 3 postulated that the inducement of impulsivity attenuation would have a causal effect on LOC scores. A Lindquist Type III ANOVA (group x sex x time) for LOC scores was conducted to test this prediction. A significant interaction between group membership and the repeated factor (time of LOC administration) would serve to confirm this hypothesis.

Table 17 summarizes findings from this split-plot factorial 32.2 ANOVA. No significant interaction was obtained between group membership and time of administration ($F = .943$, $df = 2/69$, n.s.). Hypothesis 3 was not supported. This negative result was anticipated after having failed to obtain a significant correlation between LOC and Impulsivity Style.

None of the main effects (group, sex, and time) was found to be statistically significant. The nonsignificant F-ratio for the repeated factor (time of LOC administration) demonstrated that the Nowicki-Strickland LOC scores remained stable over an administration time of 13 days ($F = .008$, $df = 1/69$, n.s.)

When two-way ANOVAs (group x sex) were performed on the three Reid-Ware sub-factors, none of the between-groups main effects was found to be significant as they would be if Hypothesis 3 were true. The between-group F-ratios for Self Control, Social Systems Control, and Fatalism were .418, .117, and .084, respectively ($df = 2/69$,

TABLE 17

REPEATED ANOVA FOR NOWICKI-STRICKLAND LOC

Source	Sum of Squares	df	Mean Square	F
Group	6.043	2	3.021	.112
Sex	.080	1	.080	.003
Group x Sex	4.242	2	2.121	.078
Error-Between	1868.178	69	27.075	
Time	.165	1	.165	.008
Group x Time	39.439	2	19.719	.943
Sex x Time	4.447	1	4.447	.213
Group x Sex x Time	36.280	2	18.140	.868
Error-Within	1442.115	69	20.900	

TABLE 18

ANALYSIS OF VARIANCE FOR CUMULATIVE RISK SCORES

Source	Sum of Squares	df	Mean Square	F	p
Group	.025	2	.012	.032	
Sex	.480	1	.480	1.290	.258
Group x Sex	.537	2	.269	.723	
Error	25.693	69	.372		
Total	26.735	74			

n.s.). Furthermore, neither the between-sex main effect nor the group x sex interaction was found to be statistically significant.

Thus, impulsivity attenuation did not significantly change LOC, whether locus of control was gauged by the Nowicki-Strickland or Reid-Ware LOC Scale.

Attenuation Effects on Risk Taking (H4). It was further predicted, under Hypothesis 4, that inducement of impulsivity attenuation would result in more cautious outlooks on a risk taking task. A two-way factorial ANOVA (group x sex) was performed for cumulative risk scores. A statisically significant main effect on the between-group factor would serve to confirm Hypothesis 4.

Table 18 gives the principal findings of that analysis. Neither interaction nor main effects were observed to be significant. The F-ratio for the between-group factor was nonsignificant at .032 (df = 2/69, n.s.). Hypothesis 4 was not confirmed. The lack of a significant between-sex main effect (F = 1.290, df = 1/69, n.s.), furthermore, indicated that no preferential risk taking style existed between males and females.

In sum, neither Hypothesis 3 nor 4 was supported by the findings. While impulsivity attenuation was successfully induced for at least Group DIFF, the resultant change in cognitive tempo was not observed to have affected either locus of control or risk taking styles.

Additional Results

Psychometric Anomaly on MFFT

Kojima (1976) first pointed out that the location of the correct variants may account for some of the error variance of the MFFT errors in second-grade Ss. Variant 2 (the alternative directly below the standard) and variant 3 (immediately to the right of variant 2) were chosen more often than the other variants. Furthermore, impulsive Ss were more likely to select these variants than their reflective peers. Variants 5 and 6 were observed to result in the least amount of miscues. Similar findings were reported for third- and fifth-grade Ss. Kojima suggested as the simplest explanation that children possess a differential preference for some variant positions.

Although this study was not originally designed to investigate this finding, the data collected permitted a cursory look into the claim. A goodness-of-fit analysis for the frequency with which the incorrect variant positions were chosen yielded a significant chi-square value of 37.05 ($df = 5$, $p < .001$). Assuming uniform expectation across all variant positions, it was found that variant 2 was selected disproportionately more often than expected, as was variant 1. Variants 5 and 6 were selected disproportionately less often than expected. These results are consistent with Kojima's.

While Kojima's explanation of position preference has a parsimonious quality to it, other explanations are also plausible. Differential ability in discriminating the heterologous features of the distractor variants might be responsible for some of the reported error variance in the MFFT scores. While the magnitude and quality of

the dissimilarity could be inspected, attempts were made only to examine the quality of the heterologous feature. A survey of the distrator variants in the MFFT showed that dissimilarities could be classified into three categories (distortion, proportional scaling, and orientation), with each variant exhibiting one dominant discrimination category. **Distortion** was defined as any change in shape, resulting from, for example, bending a line. **Proportional Scaling** was defined as any change in size in which the enlargement or reduction was kept true to scale. **Orientation** was defined as any change in position of an element of the picture. This could be accomplished, for example, by linear displacement, rotation, or mirror-reflection.

Copies of the MFFT were given to 4 raters with fine arts background. They were asked to classify each of the 5 distractor variants for all 12 test items into one of the 3 previously identified categories. They were further asked to identify any additional category that might pertain to these pictures. Of the 60 distractor pictures inspected, the raters were in 100% agreement with the classification of 45 of them. There was 75% agreement among raters for the remaining 15. Two distractors appeared to exhibit dual dominance for two of the raters. No other category was identified. In all cases, the mode was chosen as the major classification of the distractor variant. Table 19 summarizes the resulting classification. Examination of this table shows that the type of dissimilarity dominance at each variant position is not uniformly distributed, and bears a striking resembles to that of variant position preference. Distortion occupied

TABLE 19

POSITION OF VARIANTS ON MFFT FOR CORRECT RESPONSE AND DISTRACTORS (ACCORDING TO DISSIMILARITY TYPE)

Item	Correct Response	Dissimilarity Type		
		Distortion	Scaling	Orientation
1	1	2,3	4	5,6
2	6	1,2,5	3	4
3	3	1,2	4	5,6
4	1	2,3	4	5,6
5	2	1,3	4	5,6
6	6	1,2,5	3	4
7	3	1,2	4	5,6
8	5	1,2	3	4,6
9	4	1,2	3	5,6
10	5	1,2	3	4,6
11	2	1,3	4	5,6
12	4	1,2,6	3	5

a highly disproportionate frequency at variant positions 1 and 2, proportional scaling at positions 3 and 4, and orientation at positions 5 and 6.

The percentage of errors each S committed for distractors involving dissimilarities of distortion, proportional scaling, and orientation were compared against total errors and mean latency on the MFFT test. Results showed significant correlations between total error and proportional scaling oversights ($r = .250$, $df = 73$, $p < .05$) and between mean latency and distortion oversights ($r = -.263$, $df = 73$, $p < .05$). Thus, Ss who exhibited high total errors made a greater proportion of their mistakes with distractors involving proportional scaling than did Ss with lower total error scores. Furthermore, Ss exhibiting short mean latency committed a greater proportion of their errors with distractors involving distortion than did Ss with longer latency scores. Only orientation failed to discriminate among the Ss.

While these findings are interesting, the fact that the type of dissimilarity dominance is not uniformly distributed among the variant positions makes any definitive conclusion impossible.

CHAPTER IV

DISCUSSION

The results of the data analyses confirmed the prediction of Hypothesis 1 that training in differentiation search strategies is superior to training in match-to-sample search strategies in inducing impulsivity attenuation. The data, however, did not support Hypothesis 2, which contented that the degree of attenuation in impulsivity is dependent upon an individual's locus of control. The results, furthermore, failed to confirm Hypotheses 3 and 4, which postulated that locus of control and risk taking, respectively, are functions of cognitive tempo. Before expounding on the theoretical and practical implications of these major findings, some discussion of the important role which haptic training played in this experimental study is deserved.

Haptic Training

From a research point of view, haptic training possesses two major advantages over visual training:

a.) Haptic exploration facilitates for the experimenter direct observation of the type and quality of activity each S is engaged in when attending to the task at hand. Visible confirmation can be readily made as to whether the S is correctly following the instructions given during the training sessions.

b.) Haptic training also permits the presentation of selected search strategies independently of visual cues. As such, training of the reflective strategies involved in this study (viz., inspection of

all variants before answering; comparison of corresponding elements for the standard and each variant; and concentration on identifying either sameness or difference between elements) could be conducted without influencing changes in the S's visual motor skills. Training with visual stimuli has the potential of confounding sought-after effects through incidental improvements in such areas as visual recognition memory. This is of particular concern since Siegel et al. (1974) reported that a significant component in determining cognitive tempo is ability in visual feature analysis. The reflective Ss used in their study were reported to perform better than the impulsives only when the MFFT standard and distractor variants differed on one elemental feature. When more discriminating features were incorporated in the test items, this advantage disappeared.

From a research perspective, haptic training affords an ideal procedure for studying changes in performance in visual discrimination tasks, while simultaneously avoiding any contamination associated with visual training techniques.

Discussion Related to HYPOTHESIS 1

Differentiation vs Match-to-Sample Induced Attenuation

In order to ascertain whether the Ss in groups DIFF and SAME recalled the strategies they learned in the haptic training sessions and applied them to the MFFT, two informal checks were made. Immediately prior to testing, each S in the training groups was presented with a set of haptic blocks for review. After each S

verbalized the directions given during the training sessions, observations were made to check whether these strategies were applied haptically. All 50 Ss in groups DIFF and SAME demonstrated complete retention of the common and specific strategies presented in their training sessions. Immediately following the MFFT, all 75 Ss were asked to give a self-report of the strategies they employed on the MFFT. Analysis of this survey indicated that the Ss in groups DIFF and SAME inspected more variants than those in the control group. Furthermore, Group DIFF indicated a greater tendency than either groups SAME or CTRL to look for differences between the stimuli. Groups SAME and CTRL, conversely, indicated a greater tendency than Group DIFF to look for matches between the stimuli. Experimental confirmation of these claims (by monitoring of eye movement, for instance) remains for future research.

The findings of this study re-confirm those of other investigators that performance on visual discrimination tasks can be improved through prior haptic manipulation of stimuli (Kerpelman, 1967 and Butter, 1979). Wolfgang (1971) has proposed that this cross modal transfer results from the increased active participation Ss experience when engaged in tactual tasks, as opposed to visual ones.

The results of this investigation showed that, when haptic training incorporated differentiation as a search strategy (Group DIFF), impulsivity attenuation was achieved at a statistically significant level. As hypothesized, Group DIFF exhibited significantly lower, and thus, more reflective, Impulsivity Style scores than groups SAME and CTRL. Those Ss who were haptically trained to search for

matches between the stimuli (Group SAME) did not exhibit a statistically different level of cognitive tempo from the control group (Group CTRL). The nonsignificant attenuation observed, however, was in the predicted direction. Hypothesis 1 was, thus, partially confirmed.

This finding of superiority of differentiation training over match-to-sample training is consonant with the contention that attention given to identifying distinctive features on a match-to-sample discrimination task (like Kagan's MFFT) is fundamentally different strategically from attention aimed at finding matches between the task's stimuli. Individuals who attack such discrimination tasks by searching for distinctive features appear to espouse a strategy involving a process of elimination. On the other hand, those individuals whose attention focuses on finding matching elements between the stimuli appear to hold the elimination process of secondary importance. Their goal seems to be that of achieving immediate solution to the problem. Both strategies involve distinctive tradeoffs. A differentiation strategy, which involves narrowing down the possible alternatives, necessarily consumes more time, yet is less risky and more likely to result in success than a match-to-sample strategy, which is susceptible to errors of oversight. In fact, individuals identified as fast-accurates on Kagan's R-I index, or as efficient on Salkind's scale, may be employing both strategies to their advantage. After applying a differentiation strategy to eliminate several alternatives on the MFFT, fast-accurates may eventually switch over to a match-to-sample strategy when they sense

the risk is worth taking. Alternating strategies in such a manner would be expected to yield more efficient scores than either strategy employed alone.

This study's finding that differentiation training was superior to match-to-sample training in inducing impulsivity attenuation supports the work of Gibson and Gibson (1955), Pick (1965), and Odom et al. (1971). Under conditions of simultaneous comparisons, such as those involved in the MFFT, improvements in discrimination are better accomplished through distinctive feature learning rather than prototypic learning, where matching of sensory inputs to prototypes is involved.

This finding is particularly impressive in light of the fact that Group SAME had a distinctive advantage over Group DIFF on the MFFT. The haptic match-to-sample task can be viewed as a direct tactual analogy of the MFFT visual match-to-sample task. This would have indirectly given Ss in Group SAME more experience than those in Group DIFF with the format of the MFFT. Despite this advantage, Group DIFF exhibited significantly greater impulsivity attenuation than Group SAME. This finding based on haptic training re-confirms the visual training reports of other researchers (Odom et al., 1971; Zelniker et al., 1972; Zelniker & Oppenheimer, 1973; and Orbach, 1977). Scanning which involves a conscious search for distinctive features between the standard and a given variant is more likely to result in a definitive and successful conclusion as to whether the two stimuli match. Scanning which involves a search for matching features is more susceptible to result in oversight.

When compared to the norms compiled by Salkind (1978), the sample of this study was significantly skewed to the reflective end of the cognitive tempo continuum. As Duryea and Glover (1982) warn, a floor effect may prevent the detection of measurable effects with reflective Ss, since their error rate is already very low. This floor effect may have been responsible for the absence of a statistically significant effect on MFFT total errors. Salkind and Norman (1980) have suggested that the standard MFFT may contain too little response uncertainty for children 10 years of age and older. This appears consistent with the fact that nine of the 75 Ss committed no errors on any of the 12 items of the MFFT administered.

Research with a population more heterogeneously distributed across cognitive tempo would be required to determine if such a floor effect was indeed responsible. Greater statistical power can be further attained by using the MFF20, devised by Cairns and Cammock (1978). This version of the MFFT was psychometrically developed from several forms of Kagan's instrument. The end product was a more reliable test (split-half correlations reported over 2 weeks were .91 for latency and .89 for errors) which was suitable for children 7-11 years old. The present study used Kagan's MFFT in order to compare results with the norms cited by Salkind (1978). Future research involving populations skewed toward reflectivity should fair better using the MFF20.

When impulsivity attenuation was gauged by Kagan's categorical index, no significant difference was observed between the 3 treatment groups, although movement of both training groups was in the predicted

direction. The categorical nature of Kagan's index, as critiqued by Ault et al. (1976), is prone toward sacrificing valuable information. Analyses in this study attest to the superiority of Salkind's continuous index of Impulsivity Style over Kagan's double median split. Future research in cognitive styles should take advantage of the greater statistical sensitivity offered by Salkind's index.

Haptic training was successful in increasing the mean latency of Group DIFF over that of Group CTRL. Although no statistical difference was observed between groups SAME and CTRL, movement was in the predicted direction. This same relationship held true when total test time was examined. Thus, it is possible to lengthen the latency of a sample even when that sample is skewed toward reflectivity.

As discussed earlier, the same result was not found for total errors. If, as proposed, a floor effect existed only for total MFFT errors, then a increase in latency should result in lower efficiency for the trained groups. This finding was observed for Salkind's Efficiency index. The loss in efficiency was, thus, probably an artifact due to a floor effect on total errors. The difference in Efficiency scores was statistically significant only between groups SAME and CTRL. This may be explained from the fact that Group DIFF actually did achieve lower error scores than Group CTRL, although the mean was not statistically significant. Group SAME, on the other hand, exhibited a slight increase in total errors, which compounded their increase in latency, and may have resulted in their observed shift toward greater inefficiency.

Sex differences in cognitive tempo were observed only for total test time and Efficiency (both control- and norm-based). Boys on the average took 14% longer to complete the MFFT than did girls of the same age. Since no statistical difference was found between genders for total error scores, it was not surprising to find that girls were more efficient on the MFFT than boys. This finding suggests as a possibility that boys may be less willing than girls to risk making errors when skill conditions are present. For, under this condition, lower efficiency for boys would be expected to result in the presence of a floor effect for errors.

Discussion Related to Hypotheses 2 and 3

Locus of Control

Analysis of the Nowicki-Strickland pretest indicated that the sample in this study was significantly skewed toward the internal side of the LOC scale. No linear or curvilinear correlation was detected between locus of control and cognitive tempo. A definitive statement on the absence of such a correlation is not possible, however, since the sample exhibited a restricted range in both LOC and cognitive tempo. Such a condition could mask out low correlation effects. A more heterogeneous sample on both locus of control and cognitive tempo would be needed for more conclusive evidence.

The results of the data analysis did not support Hypothesis 2, which predicted that impulsivity attenuation would exhibit a differential effect according to the locus of control of the S. This suggests that a history of prior achievement, as is found more often

with internal-oriented individuals than with externals, may not be necessary in effecting changes in cognitive tempo. Educators should, therefore, not expect externally oriented students to resist reflectivity training any more than internally controlled students.

Hypothesis 3 contended that locus of control was a function of cognitive tempo, and, as a result, would be affected by impulsivity attenuation. This prediction was not supported by the results of this study. The findings suggest that researchers and educators involved in attenuating impulsivity need not be concerned over the possibility of inadvertently altering the locus of control of their Ss.

Finally, no sex difference was observed for any of the comparisons involving locus of control measures.

Discussion Related to Hypothesis 4

Risk Taking

The Risk Taking Task was found to have high internal consistency ($r = .84$). The type of risk taking measured by the Risk Taking Task appears to be complex, as indicated by the statistically significant quadratic relationship it holds with teacher-rated risk taking in academic/social settings ($R = .50$). Individuals who were rated as either extremely cautious or risky by their teacher were observed to be the highest risk takers on the Risk Taking Task. It seems plausible that children who assume highly cautious stances in activities involving their peers may revert to the opposite extreme by taking unrealistic chances when faced with pure chance situations that

are one-on-one. It is as if those children who are highly cautious in group situations use the Risk Taking Task (which may be viewed as computer versus individual) to release their pent-up risk taking energy. Additional research into the complex nature of risk taking which the Risk Taking Task appears to be measuring would prove valuable.

As predicted, risk taking was found to be associated with cognitive tempo. High risk taking, as indexed by the mean cumulative risk score, is positively correlated with total error ($r = .293$); higher risk takers being associated with commission of more total errors on the MFFT. A positive correlation between the mean cumulative risk score and Salkind's Impulsivity Style index was also observed ($r = .246$). As expected, individuals who exhibit a reflective cognitive style are more prone to be conservative on risk taking than those who are identified as impulsive. Both findings are consistent with the contention that reflective individuals are more concerned than impulsives with their performance on the MFFT. This concern might be mediated by or translated into various risk levels associated with error commission.

The directionality of this relationship was examined by comparing the risk scores of those Ss who underwent training in impulsivity attenuation with those of the control group. Analysis of the data failed to detect differences in the risk scores between these groups, suggesting that cognitive tempo does not moderate risk taking. Hypothesis 4 was, thus, not supported. An alternate conclusion is that the signal from such a cause-effect relationship may be too weak to

have been detected in this study. The magnitude of the noise would be expectedly high, given the low, although statistically significant, correlation between these two constructs. Further study with Ss more heterogeneously spread across cognitive tempo than the present would be necessary to resolve any such signal, should it exist, from the noise level. The possibility, of course, still remains that risk taking is the causal agent for cognitive tempo. At present, however, this causal issue remains unresolved.

An implication of this negative finding is that researchers and educators alike who are involved in modifying cognitive tempo need not worry about the ramifications of indirectly altering an individual's risk taking style as a side-effect of impulsivity attenuation.

A surprising finding was that risk taking, as indexed by the mean cumulative risk score, is **negatively** correlated with the Social Systems Control factor of the Reid-Ware LOC Scale ($r = -.305$). This indicates that children identified as internal (based on Social Systems Control) were higher risk takers than those identified as external. This is in direct contradiction to what has been predicted in the literature, viz., that internals would be more conservative risk takers, while externals would be higher risk takers.

This result may be explained in terms of an incongruency between the personality and situational aspects of LOC as expounded by Karabenick and Addy (1979). Situation control is present whenever skill or chance factors are viewed as the primary determinates of the outcome. Karabenick and Addy suggest that differential effects occur depending upon whether the personality-situation dimensions are

congruent or not. Congruency here refers to the matching up of personality with situation--persons with generalized internal control beliefs with skill situations and persons with external control beliefs with chance conditions. Combinations are termed incongruent when internals are placed in chance situations and/or externals are involved with skills tasks.

Karabenick and Addy reasoned that, if internals are more concerned with their performance on skill-oriented tasks, while externals are more concerned when chance is involved, then congruency should foster more realistic risk taking by internals in skill situations and by externals in chance situations. Conversely, when personality-situation conditions are incongruent, less realistic risk taking should occur for both internals and externals.

Since the Risk Taking Task in this study involved pure chance, internals would have been subjected to an incongruent condition, while externals would have been exposed to a congruent situation. The results of this study support Karabenick and Addy's model in that higher risk taking was observed for internals and greater cautiousness for externals. Although the Reid-Ware Social Systems Control factor was the only locus of control index found to be significantly correlated with risk taking, a negative direction was observed for the correlation between risk taking and the other two Reid-Ware sub-factors (Self Control and Fatalism). This negative relationship further turned up when scores on the Nowicki-Strickland LOC Scale (both pre- and posttest) were correlated with risk taking scores. As a whole, internals exhibited a trend toward higher risk taking than

externals did in a pure chance situation, regardless of the LOC instrument used.

This finding is of value to researchers involved in risk taking studies. The observed effects may be dependent upon an interaction between the locus of control of the Ss and the situation (skill or chance) presented.

Of special interest to this investigator was the large amount of time Ss were observed to spend while deciding which switch to press next. Although they were working on a task involving pure chance, it appeared as if they believed they could somehow outguess the computer and increase the odds of making the correct decision. This suggested that the fifth graders may not believe or understand that probability in a pure chance situation is fixed. Further study of how the chance conditions in this Risk Taking Task are perceived by children across age levels would be valuable from a developmental point of view.

No statistically significant sex difference was observed for this study's Risk Taking Task. The results indicate that, when chance (as opposed to skill) is involved in risk taking, males and females behave similarly.

Future research might focus in on re-writing the Reid-Ware LOC Scale for elementary school children. The sub-factors involved in this Scale appear to offer interesting areas of investigation where locus of control and risk taking are concerned.

The results based on cumulative risk index devised for this study's Risk Taking Task appeared in line with those based on the mean risk raw scores. Further research is needed to determine if this index

is more sensitive than raw score values at higher risk levels (conditions where considerably more than 10 switches are involved).

Additional Discussion

Psychometric Anomaly

The results of an item analysis of the MFFT supported the findings of Kojima (1976) concerning a psychometric problem with Kagan's instrument. Variant position 2 was selected more frequently than expected under the assumption of uniform selection. Distractor position 1 also showed this same high selection tendency. Variant positions 5 and 6 were chosen less often than expected. Kojima suggested that this phenomenon might be due to a preference for the position directly under the standard, viz., position 2.

Another alternative explanation, which was explored in this study, involved the placement of distractors according to dissimilarity type (that is, the predominant perceptual element that distinguished the standard from the distractor). Analysis showed that dissimilarities in distortion were disproportionately located at variant positions 1 and 2. Positions 3 and 4 were found to be the predominant locations for distractors employing proportional scaling as discriminating features, while positions 5 and 6 were the most common locations for orientation type distractors.

Analysis indicated that a relationship existed between the type of dissimilarity and an individual's Impulsivity Style index. Impulsives made a greater percentage of their error with distortion and scaling distractors than did reflectives. Only orientation

distractors did not differentiate among the Impulsivity Style scores. This suggests that impulsives may possess different visual perception ability than reflectives. Such a conclusion would be consonant with the findings of Siegel et al. (1974), Hartley (1976), and Adejumo (1979). However, since the dissimilarity types are not randomly distributed among the MFFT variant positions, any statement drawn from the findings would remain inconclusive. Future research should explore the effects of dissimilarity types on cognitive tempo by reconstructing the MFFT to adhere to more sound psychometric standards.

Microcomputers in Psychological Research

Special recognition must be made to the valuable role which microcomputers offer in psychological research. Complex activity (such as that involved in manipulating this study's Risk Taking Task) can be performed. Such interactive activity would otherwise be too difficult, or even impossible, to conduct manually.

Advantages in data collect are also obvious. Besides increasing testing efficiency, microcomputers aid in reducing recording error. Furthermore, Ss can be kept more blind to the nature of the study at hand, since data is not visibly collected. This capability is particularly valuable for the MFFT, which is designed to assess a S's preference for either speed or accuracy. The presence of a stopwatch and tally sheet has the potential of interferring with such observations. In addition, the Es can also be kept more blind to the purpose of the experiment. In this study, for instance, the Es involved in both the MFFT and Risk Taking Task were unaware of the

exact nature of the test they were conducting and of the type of data being collected.

Researchers will eventually be faced with an intriguing concern over data reduction as microcomputers gain popularity in psychological research. The capability of analyzing data concurrently with data collection presents the potential scenario where the sample size is relegated to computer control--subjects, for example, being continuously added to the study until the desired criteria are met. Microcomputer technology will introduce a new concept to experimental research: the principal of **triple blind** studies, where not only the Ss and Es are in the blind, but also the computer.

Summary of the Findings

In sum, the following major conclusions were drawn from the data analyses:

1. Impulsivity attenuation is attainable through haptic training of reflective search strategies. Differentiation training is superior to match-to-sample training in inducing impulsivity attenuation.

2. Individual placement on the locus of control scale did not differentially effect the degree of impulsivity attenuation attained among trained Ss.

3. Locus of control bears no correlation (either linear or curvilinear) with cognitive tempo.

4. Risk taking was found to be correlated with Salkind's Impulsivity Style index and MFFT total error scores. Risk taking was also observed to be negatively correlated with locus of control as measured by Reid-Ware's Social Systems Control.

5. Impulsivity attenuation does not result in changes in either locus of control or risk taking.

6. The MFFT has an inherent psychometric flaw. Distractor alternatives are not randomly distributed with respect to dissimilarity type among the 6 variant positions. This renders indeterminate the reason for the disproportionate selection of certain distractor variant positions.

CHAPTER V

SUMMARY

The purpose of this investigation was to examine the effects that haptic training of scanning strategies would have in inducing impulsivity attenuation. It was postulated that scanning strategies based on distinctive feature searches were superior in discrimination tasks to those employing prototypic (or match-to-sample) searches. It was also hypothesized that a feedback system existed between cognitive tempo and locus of control. Individuals who were internally oriented were expected to exhibit greater impulsivity attenuation than externally oriented individuals. This study further investigated the impact that any such induced attenuation in impulsivity would have on an individual's risk taking outlook and locus of control.

Seventy-five fifth-grade boys and girls were randomly assigned to one of 3 treatment groups: Group DIFF, Group SAME, and Group CTRL. Groups DIFF and SAME were trained with haptic scanning techniques during two twenty-minute sessions. Both training groups were presented with discrimination tasks involving stimuli in the form of wooden geometric blocks. Only tactual manipulation of the stimuli was permitted. The Ss in both training groups were instructed in ways of systematically attacking the task at hand. The Ss in Group DIFF were further trained to search for features between the stimuli that were different. Their task entailed identifying the one block from among 6 alternatives that was different from a given standard block. The Ss in

Group SAME were trained to search for features between the stimuli that were the same. Their task consisted of finding the one alternative out of 6 blocks that exactly matched a given standard. The control group underwent no training during this period.

Prior to training, all Ss were administered the Nowicki-Strickland Locus of Control Scale. Data from this instrument was used to determine whether locus of control had a differential effect on impulsivity attenuation.

The level of impulsivity attenuation induced during the training sessions was measured with Kagan's MFFT, which is a 12-item visual match-to-sample instrument. Administration of the MFFT deviated from its traditional format in that feedback and data collection were under the control of a microcomputer. The test items remained, otherwise, unaltered. Three performance measures were obtained from this instrument: total errors, mean latency to first response, and total time to complete the test. Analyzed singly, each of these variables acted only as an indicator of the amount of impulsivity attenuation achieved.

Since reflectivity-impulsivity was operationally defined by Kagan on a double median split (total errors and mean latency), it was deemed appropriate that impulsivity attenuation be gauged on this joint constraint. According to Kagan's categorical scheme, a reflective child is defined as one who scores below the median in errors and above the median in latency. An impulsive child is defined as one who scores above the median in errors and below the median in

latency. An individual scoring below the median on total errors and mean latency is called a fast accurate, while one scoring above the median on both criteria is termed a slow inaccurate.

Salkind's Impulsivity Style index for cognitive tempo was also examined as a possible alternative to Kagan's index. Salkind's index is continuous in nature, being defined as the difference between the standardized scores for errors and latency. Results based on Kagan's categorical index of cognitive tempo were compared with those based on Salkind's Impulsivity Style. Salkind's continuous scale was expected to be more sensitive to changes in cognitive tempo. Salkind's Efficiency index, defined as the sum of the standardized scores for errors and latency, was also examined.

All Ss were individually administered an investigator-constructed risk task. The format of the task followed that of a video arcade game. The computer controlled game, called "Rescue the Ewoks," presented the Ss with a double or nothing situation. The risk involved was purely chance in nature. Two risk taking raw scores were obtained and averaged together for each S. A cumulative RISK index was also defined from these raw scores.

Following the risk task, the Ss were administered in a group situation two locus of control scales: Nowicki-Strickland LOC Scale for Children and the Reid-Ware 3 Factor Internal-External Scale (with sub-factors for Self Control, Social Systems Control, and Fatalism). These questionnaires, like the pretest LOC, were scored by optical scanner.

The following results were obtained from the data analyses:

1. Haptic training resulted in statistically significant increases in latencies to first response and total test time only for Group DIFF. The females Ss were found to spend less time completing the MFFT than the male Ss. No significant improvement in error scores was obtained for either training group.

2. Analysis with Kagan's categorical index failed to detect any statistically significant attenuation in impulsivity. The statistically nonsignificant shifts exhibited by both groups SAME and DIFF were in the predicted direction. When compared to the norm, the sample in this study was found to be significantly more reflective. This suggested the presence of a floor effect on total errors.

3. Analysis with Salkind's Impulsivity Style index indicated that haptic training of reflective search strategies can induce impulsivity attenuation. The Impulsivity Style index of Group DIFF was found to be significantly more reflective than either Groups SAME or CTRL. This indicated that differentiation training was superior to match-to-sample training, as predicted. The lack of agreement between the findings based on Salkind's Impulsivity Style index and those based on Kagan's categorical index may be attributed to the presence of a floor effect on errors. The greater statistical sensitivity of Salkind's index would be expected to make possible the detection of weaker signals than Kagan's index could resolve.

4. When referenced to the control group, analysis with Salkind's Efficiency index indicated that Group SAME had become significantly

more inefficient after training than Group CTRL. This difference, which may have resulted from a floor effect on error scores, disappeared when the Efficiency score was based on the norm. The females Ss were statistically more efficient on the MFFT than the male Ss regardless of which group was used as the reference.

5. Results from the pretest LOC failed to establish any differential effects on impulsivity attenuation with respect to locus of control.

6. The induced impulsivity attenuation achieved in this study did not affect the status of the S's locus of control. The findings, thus, did not support the claim that locus of control is causally related to cognitive tempo.

7. The induced impulsivity attenuation achieved in this study did not affect the S's risk taking outlook. The findings, thus, did not support the claim that risk taking is causally related to cognitive tempo.

8. No correlation (either linear or curvilinear) was observed to exist between locus of control and cognitive tempo, as measured on any of the indices.

9. Risk taking was found to be positively correlated with Impulsivity Style. High risk takers in chance situations were associated with more impulsive cognitive styles.

10. Risk taking and locus of control were found to be negatively correlated for the Reid-Ware's Social Systems Control sub-factor. This indicated that high risk taking was associated with an internal orientation on the Social Systems Control scale. This finding was

consonant with Karabenick and Addy's (1979) model of incongruency between personality and situational aspects of locus of control.

11. The psychometric problem first reported by Kojima (1976) concerning Kagan's MFFT was confirmed. The distractor at variant position 2 was chosen statistically more often than would be expected under random selection. The same held true for variant position 1. The distractors at variant positions 5 and 6 were selected less often than expected. When the MFFT distractors were classified by their distinctive features, 3 major categories were obtained: distortion, proportional scaling, and orientation. The distortion distractors were found to be located predominantly at variant positions 1 and 2. The proportional scaling distractors were located predominately at positions 3 and 4, while the orientation distractors were found most often at positions 5 and 6.

In summation, impulsivity attenuation can be successfully achieved through a training program that emphasizes both systematic search techniques and attention to the distinctive features between stimuli. The degree of induced impulsivity attenuation is not dependent upon locus of control. Furthermore, no causal ramification exists for either risk taking or locus of control as a result of inducing attenuation in impulsivity.

APPENDICES

APPENDIX A

Haptic Training Instructions

1. E begins the training session by saying:

My name's ... I'll be working with you today with some wooden blocks that I'm going to place behind the screen in front of you. You'll be able to feel the shape of the blocks by placing your hands underneath the black curtain. The screen and curtain are there so you can't see the blocks. You'll only be able to touch the blocks with your hands.

2. E acquaints S with the materials involved with the task, then places a tray of blocks behind the screen and says:

Let's start now by putting your right hand under the curtain. I'll guide it onto the block at the far right.

[E places S's right hand on the standard block.]

This block is called the TARGET block. Keep your right hand on it.

Now, place your left hand under the curtain. To the left of the TARGET block are 6 other blocks arranged in 2 rows: 3 blocks on the bottom and 3 blocks on the top.

[E guides S's left hand to each of the 6 blocks, starting from BLOCK 1 and going clockwise to BLOCK 6.]

We'll call these BLOCKs 1, 2, 3, 4, 5, 6.

[E repeats the guiding process above.]

A picture of how the blocks are arranged is posted on the front of your screen.

3. E informs S of the object of the task.

Your job is to compare the shape of the TARGET block with the shape of the other 6 BLOCKs.

Only one of these 6 BLOCKs is shaped [DIFFERENT THAN (Group DIFF) / EXACTLY THE SAME AS (Group SAME)] the TARGET block. The other 5 blocks are shaped [EXACTLY LIKE (Group DIFF) / SLIGHTLY DIFFERENT THAN (Group SAME)] the TARGET block.

You must find the BLOCK that is [DIFFERENT THAN (Group DIFF) / EXACTLY THE SAME AS (Group SAME)] the TARGET block. You're only allowed to touch the blocks.

4. E presents the scanning strategies for the haptic training sessions.

Since most of us are used to identifying things with our eyes rather with our hands, you might find this a bit hard to do at first.

But, I'll be teaching you some rules as we go along that will help you become very good at it. If you follow these rules, you'll find the problem much easier to solve.

(1) Always feel the TARGET with your right hand.

(2) Always feel the other 6 BLOCKs with your left hand.

(3) Always start with BLOCK 1 and continue examining the other BLOCKs in a clockwise direction, moving from 1 to 2 to 3 and so forth up to BLOCK 6.

[E guides S's left hand over the 6 BLOCKs.]

(4) Compare all the corners and edges of the BLOCK you're examining with the corners and edges of the TARGET block before you move on to the next BLOCK. Always check each corner in a clockwise

direction, starting from the bottom right and moving around the entire block.

[E guides S's left hand around the corners of BLOCK 1 and S's right hand around the corners of the TARGET block.]

(5) Always concentrate on finding a corner or edge that feels [DIFFERENT THAN (Group DIFF) / EXACTLY THE SAME AS (Group SAME)] the TARGET block. The sign in front of you reminds you to:

THINK DIFFERENT (Group DIFF)

THINK SAME (Group SAME).

(6) Even though you think you've found the correct BLOCK, examine all the other BLOCKs before you tell me what your answer is. You can always go back to review any or all the BLOCKs before you say your answer.

Appendix B

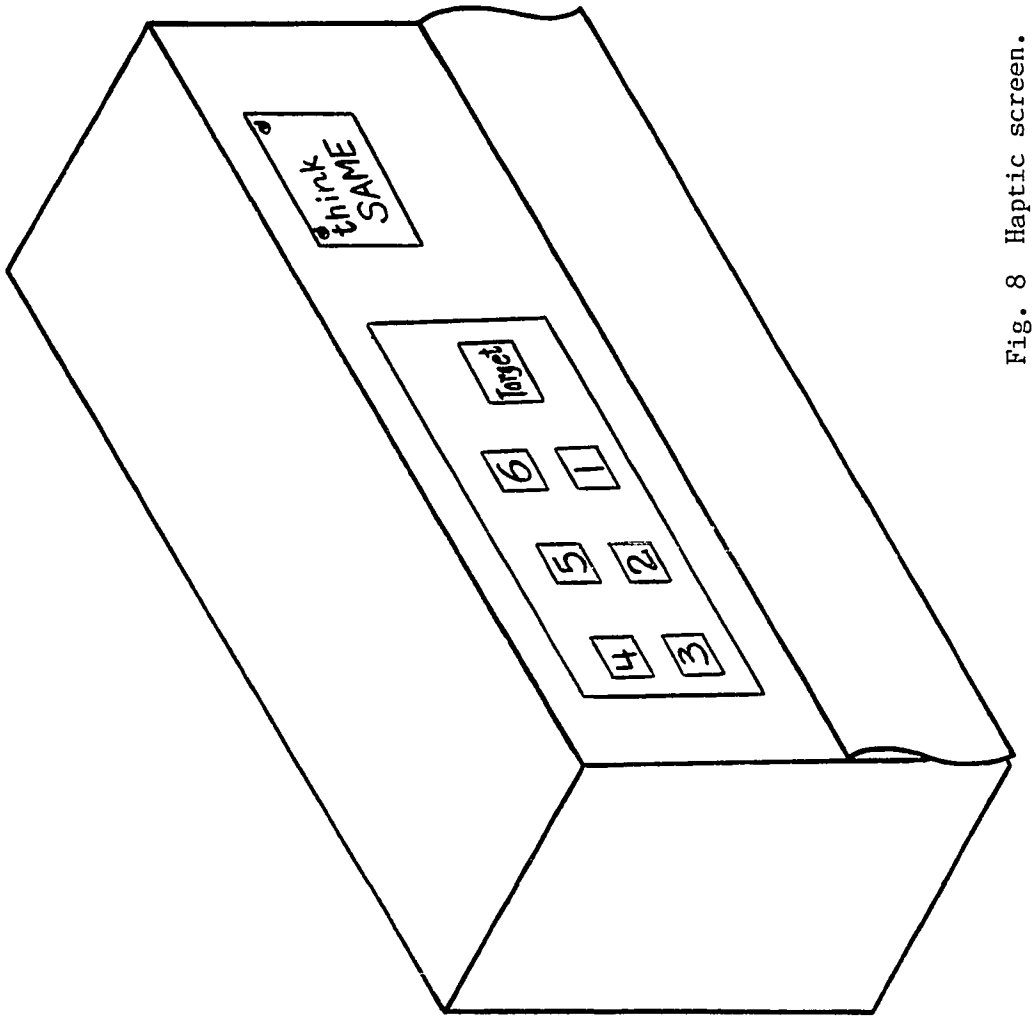

Fig. 8 Haptic screen.

Appendix C

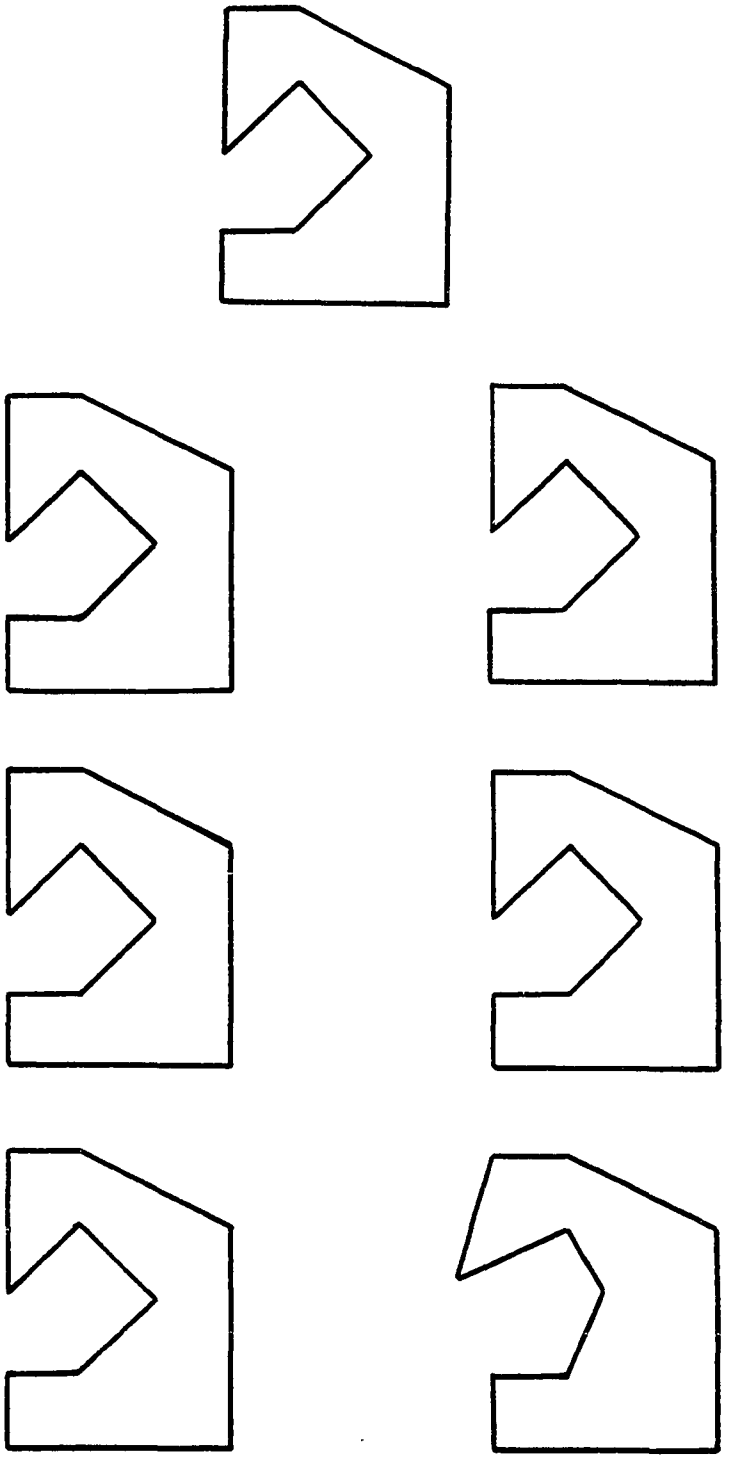

Fig. 9 Sample block tray for Group DIFF's regular training session.

Appendix C (continued)

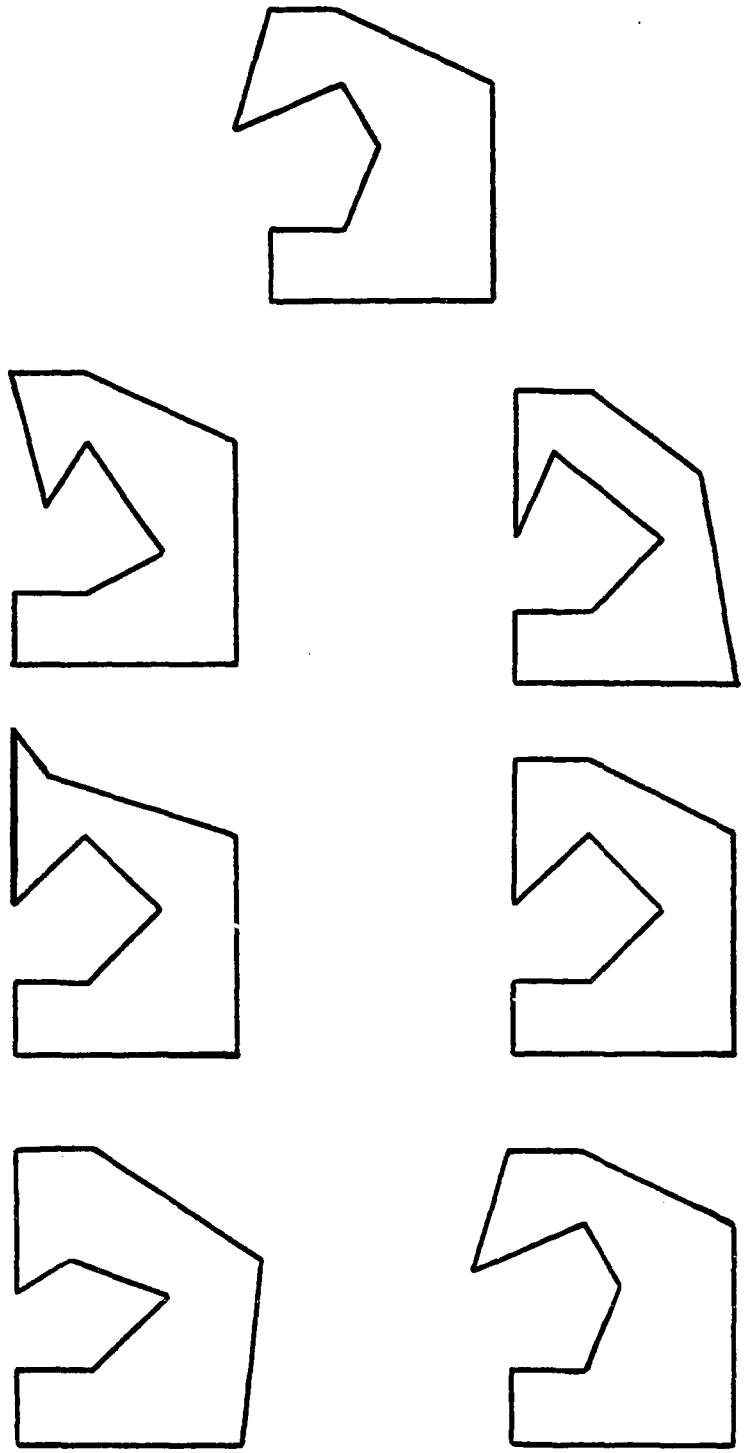

Fig. 10 Sample block tray for Group SAME's regular training session.

Appendix C (continued)

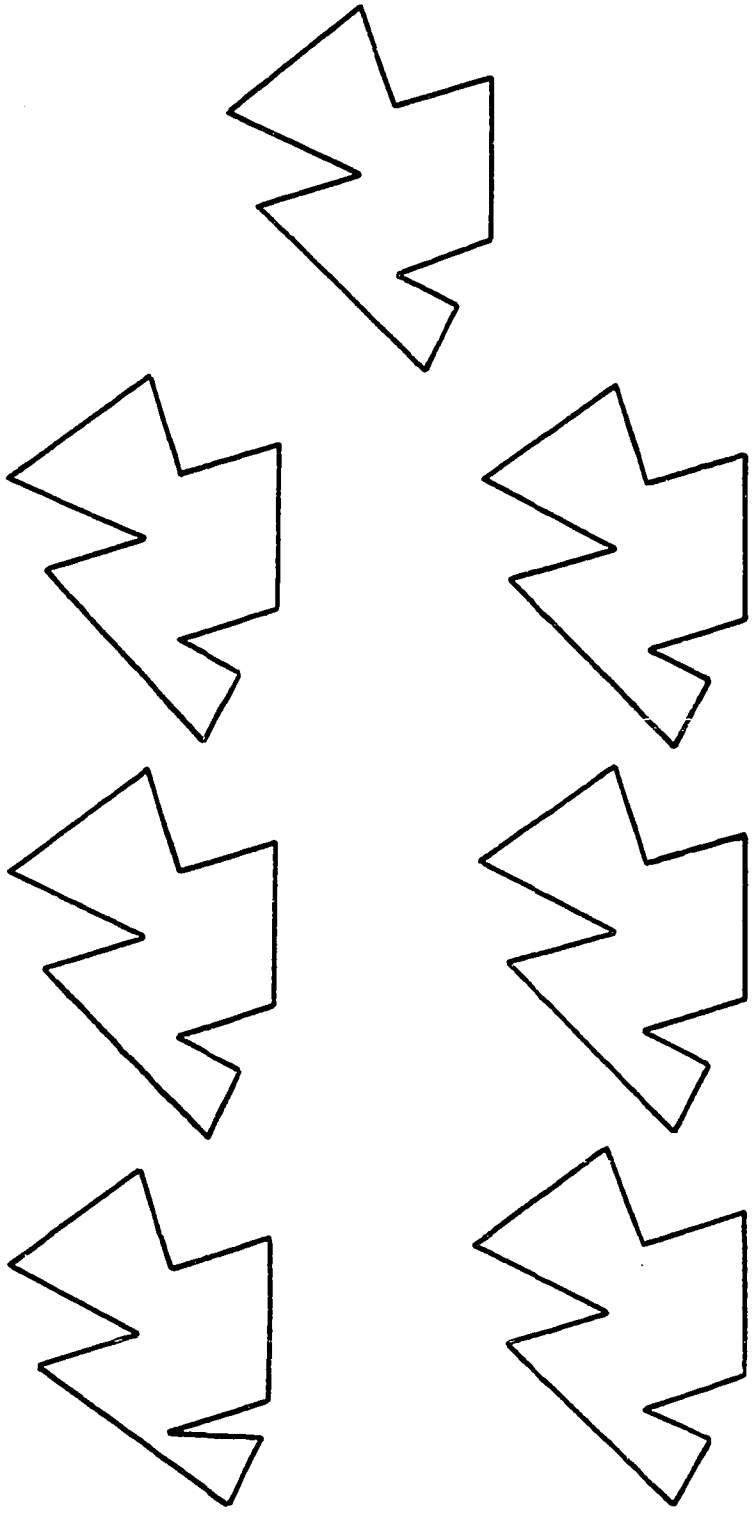

Fig. 11. Review block tray for Group DIFF.

Appendix C (continued)

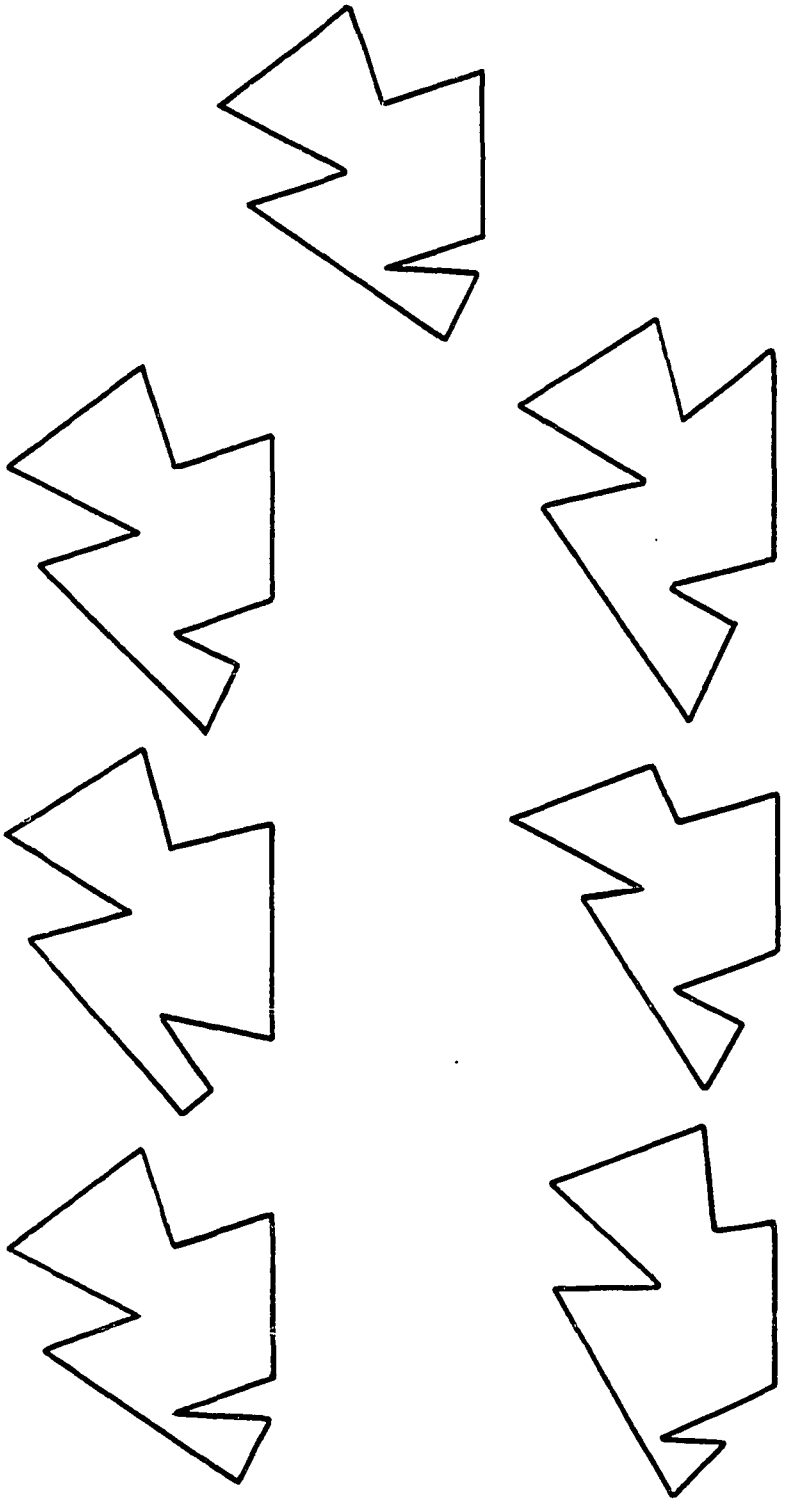

Fig. 12. Review block tray for Group SAME.

APPENDIX D

Instructions for Administering Kagan's Matching Familiar Figures Test

1. E seats the S in front of the MFFT response panel box, then introduces the task by saying:

Hi. My name's .... I'll be helping you with a simple matching problem.

I'm going to show you a picture of something you know and then some pictures that looks like it.

2. E places Practice Item 1's folder on the panel and says:

I'm placing a set of pictures on the panel in front of you. When you here a beep, flip the page like this.

[E demonstrates this procedure.]

You will have to press the button next to the picture on the bottom page (point) that is just like the one on the top page (point). The screen will show you if your answer is correct or not.

Let's do some for practice.

3. E shows the two practice items and helps the child find the correct answer if necessary.

Now we are going to do some that are a little bit harder. When you hear the beep, flip the page. You will see a picture on the top and six pictures on the bottom. Find the one that is just like the one on top, then press the button next to it. The screen will show if your answer is correct or not.

If the S is correct, the E praises the child; if incorrect, the E say:

"No, that is not the right one. Find the one that is just like the top picture."

A maximum of 6 responses is allowed for each item. If the S commits 6 errors for a given item, the computer will terminate that item by displaying the location of the correct picture.

Appendix E

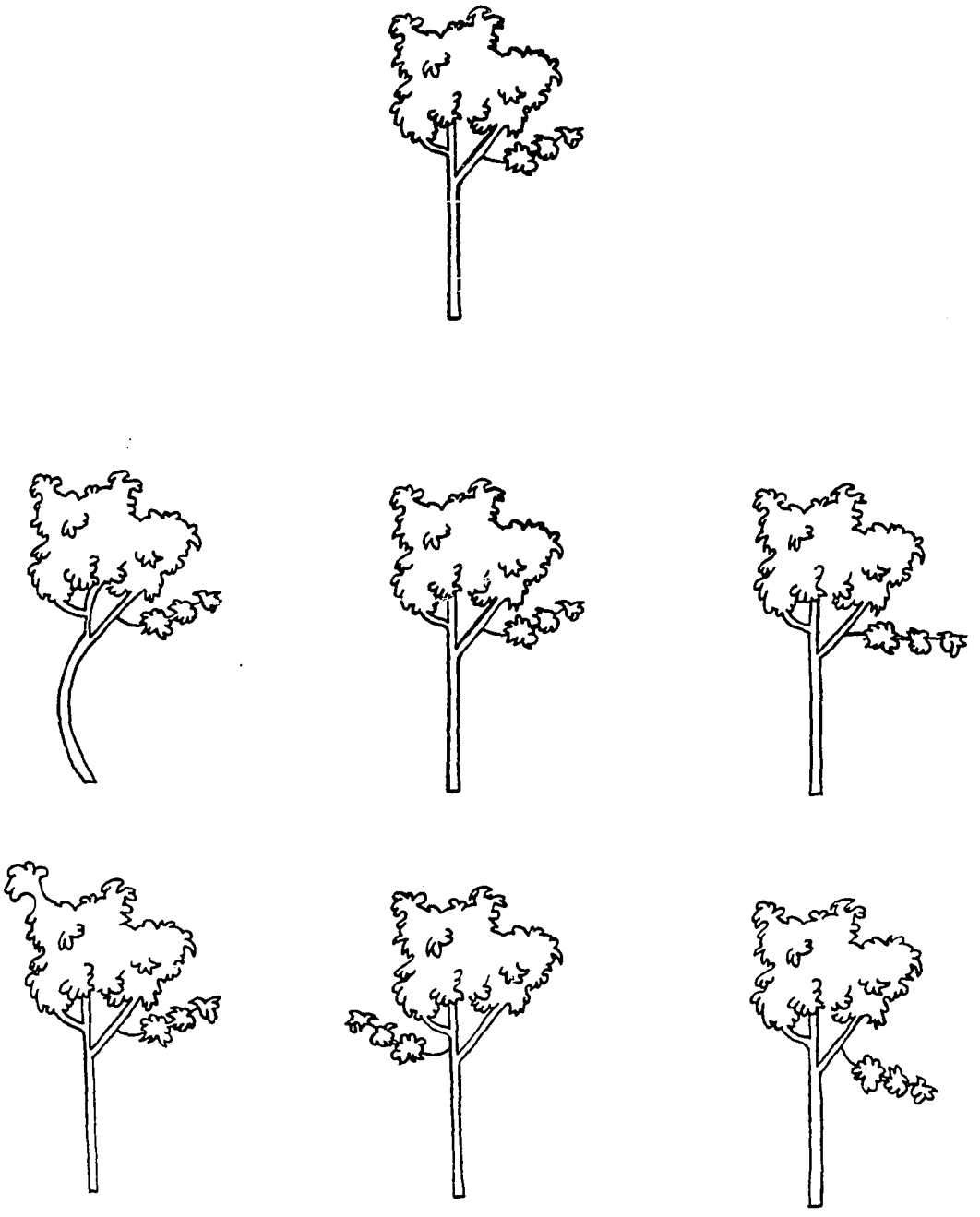

Fig. 13 Sample MFFT item.

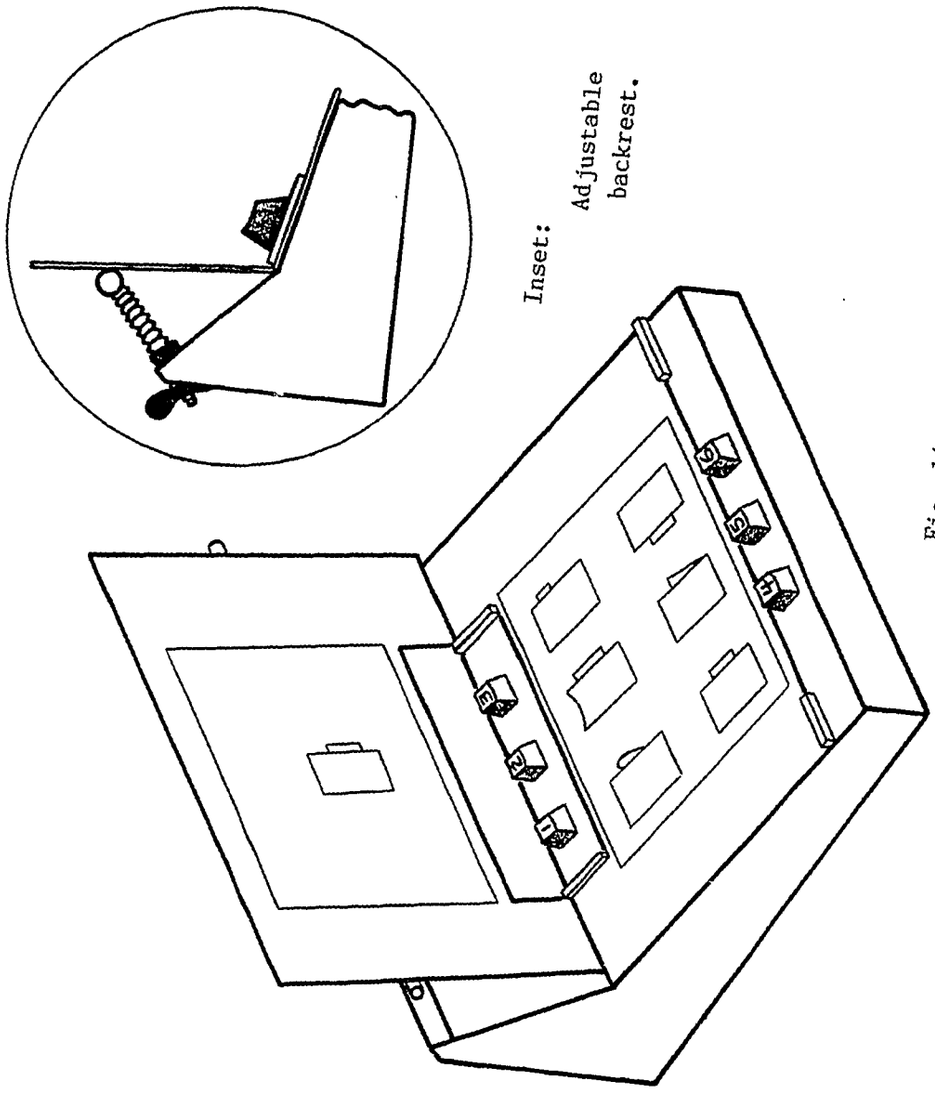

Fig. 14 MFFT response panel box.

APPENDIX G

Instructions for Administering

Nowicki-Strickland Locus of Control Scale for Children

A. Materials Enclosed.

1. One copy of the Nowicki-Strickland LOC Scale for the teacher administering the questionnaire.
2. Answer Sheets [Scan-Tron Form 882] (one sheet per student).

B. Directions.

1. Distribute one answer sheet per student.
2. Instruct students to use #2 pencil.
3. Have the students PRINT their name at top of form. All other information listed at the top is NOT filled in.
4. Turn the answer sheet lengthwise so that the word KEY is at the top of the page.
5. Read the following instructions when everyone is ready:

I WILL BE READING ALOUD 40 QUESTIONS THAT ASK YOU WHETHER YOU BELIEVE CERTAIN THINGS ARE TRUE OR NOT.

THIS IS NOT A TEST. THERE ARE NO CORRECT ANSWERS. ALL ANSWERS ARE EITHER YES OR NO. FILL IN THE BOX MARKED [a] FOR YES. OR FILL IN THE BOX MARKED [b] FOR NO. KEEP ALL PENCIL MARKS INSIDE THE BOXES. IF YOU CHANGE AN ANSWER, MAKE SURE YOU COMPLETELY ERASE YOUR FIRST MARK.

YOU MUST ANSWER ALL QUESTIONS. IF YOU ARE UNSURE ABOUT AN ANSWER, MARK DOWN THE FIRST THING THAT COMES TO MIND.

6. Read each question at a moderate pace for 5th graders without inflecting your voice. You may repeat the question if necessary.
7. When through, have the students check that their name is on the answer sheet and that only one mark is made for each of the 40 questions.

APPENDIX H

Instructions for Administering

Reid-Ware Three Factor Internal-External Scale

This questionnaire is administered in the classrom by the teacher in essentially the same manner that the Nowicki-Strickland LOC Scale for Children was given.

A. Materials Enclosed.

1. One copy of the questionnaire (for the teacher).
2. Answer Sheets [Scan-Tron Form 882] (one sheet per student).

B. Directions.

1. Distribute one answer sheet per student.
2. Use #2 pencil only.
3. Students PRINT their name at the top of the form. No other information is needed.
4. Turn form so that the word KEY is at the top.
5. Read the following instructions when everyone is ready.

I WILL BE READING ALOUD 45 STATEMENTS CONCERNING THINGS YOU BELIEVE IN. EACH STATEMENT IS MADE UP OF TWO POSSIBLE ANSWER LABELED A AND B. YOU ARE TO CHOOSE THE ANSWER WHICH YOU MORE STRONGLY BELIEVE IS TRUE FOR YOURSELF. BE SURE TO SELECT THE ONE YOU ACTUALLY BELIEVE TO BE MORE TRUE, RATHER THAN THE ONE YOU THINK YOU SHOULD CHOOSE OR THE ONE YOU WOULD LIKE TO BE TRUE.

IF YOU CHOOSE THE FIRST ANSWER, FILL IN THE BOX MARKED [a] ON YOUR ANSWER SHEET. FILL IN THE BOX MARKED [b] IF YOU BELIEVE THE SECOND ANSWER IS CLOSER TO WHAT YOU BELIEVE IN.

YOU MUST ANSWER ALL QUESTIONS. IF YOU ARE UNSURE ABOUT AN ANSWER, MARK DOWN THE FIRST THING THAT COMES TO MIND.

6. Read each question at a moderate pace for 5th graders without inflecting your voice. You may repeat the statement.

7. When through, have the students check that their name is on the answer sheet and that only one mark is made for each of the 45 statements.

APPENDIX I

Instructions for Administering

Risk Taking Task: Rescue the Ewoks

1. Seat the child in front of the Risk Taking Task's control panel and say:

Hi, my name's ..... We're going to play a simple video game called: Rescue the Ewoks. The object of the game is to rescue as many Ewoks imprisoned on board the Darth Star as you can without getting caught.

2. Ask for the child's test ID card. Type out:

a.) First name

b.) Last name

c.) 3-digit code number

3. When the message: **Any corrections? (Y/N)** appears, type in the appropriate response.

4. After you type **N** to the preceding question, a picture of an Ewok village will appear on the screen. As the picture is being drawn, say:

Let's see how the game is played.

5. Once the Star Wars theme song ends, two Ewok eyes appear to shift back and forth in the darkness of the large Ewok hut. When this animation stops, press the **SPACE BAR.**

6. The storyline appears as subtitles at the bottom of the screen. Press the SPACE BAR to display each new storyline.

A long time ago .....

..... in a galaxy far, far away .....

There lived 150 Ewoks in the

peaceful forests of Endor.

Imperial Stormtroopers invaded their

village and took 9 Ewoks prisoner.

The captured Ewoks were shipped to

prisons aboard the orbiting Death Star.

Your mission is to rescue as many

Ewoks as you feel you safely can.

But, beware of Darth Vader .....

for a trap has been set for you!

7. When the Gameboard appears on the screen, say:

First, let's try 2 practice missions to learn the rules of the game.

On the video screen in front of you, you see 10 prison cells numbered 1 through 0. The captured Ewoks are hidden in 9 of these cells. There's only one Ewok in each cell. In the tenth cell is Darth Vader.

In front of you is a control panel of rescue buttons. Each button unlocks the jail cell with its matching number. Each time you find an Ewok your score doubles. However, if Darth Vader appears, you lose all your points as well as all the Ewoks you've rescued on that mission.

You can stopped at any time and escape with all the points you won on that mission, as well as with all your rescued Ewoks by pressing the ESCAPE button.

8. Next say: **Let's try it now. Press any numbered rescue button on your control panel.**

[An Ewok picture appears at center screen. The score doubles and is displayed in the Score Window at the right of the screen. The number of the selected jail cell disappears and is replaced by an Ewok silouhette.]

After the Ewok picture appears, say:

There. You rescued an Ewok. Notice that your score doubled to 2.

9. Repeat this rescue procedure by saying:

Let's try another rescue button.

[An Ewok picture appears again at center screen. Note that if a previously pressed rescue button is pressed, nothing will happen. The computer does not respond to a button selection until after the ? symbol appears between the words: **RESCUE or ESCAPE.** Advise the student to wait until the ? appears before making another selection.]

After the Ewok picture appears, say:

You've rescued a second Ewok. Your score doubled again to 4.

10. Make the student aware of the danger level indicators by say:

Each time you rescue an Ewok, you come closer to meeting up with Darth Vader. To warn you of your current danger level, you will:

a.) see a DANGER LEVEL warning sign flash at center screen, and

b.) hear the light saber buzz, while its beam pulsates up and down;.

The beams blade will be longer when it stops flashing. The length of the blade indicates the amount of danger you'll face if you try another rescue button.

11. Next say:

Let's press another rescue button.

[A picture of Darth Vader always appears on the third rescue attempt of PRACTICE 1. This gives the experimenter an opportunity to explain the double or nothing aspect of the game.]

Say:

This shows you what happens when you pick the jail cell where Darth Vader is hidding. All the Ewoks you've rescued in that mission are recaptured and your score for that mission drops to ZERO.

REMEMBER THAT YOU CAN ALWAYS STOP AT ANY TIME IN THE MISSION BY PRESSING THE ESCAPE BUTTON INSTEAD OF A RESCUE BUTTON. By doing so, you can make sure you don't lose any points for that mission.

12. Next say:

Let's try one more practice mission (P2) to see how the ESCAPE button works.

It's important to remember that each time we begin a new mission, all 9 Ewoks and Darth Vader are re-hidden in the jail cells again.

Press any rescue button now.

[An Ewok picture appears again at center screen.]

You've rescued one Ewok so far on this mission. If at any time in your mission you decide to stop, just press the ESCAPE button. Let's try it now.

[After the ESCAPE button is pressed, the message: 1 EWOK RESCUED appears at center screen. An Ewok hut soon appears below it. An Ewok (one for each rescued Ewok on that mission) walks across screen into that hut.]

13. Ask if there are any questions. If there are none, say:

Let's start the game now. You'll go on 4 missions. At the beginning of each mission Darth Vader will be re-hidden behind one of the 10 jail cells and the 9 captured Ewoks behind the other cells.

Are you ready? Okay, you can begin.

14. Allow the student to play the game undisturbed throughout the 4 missions except for Mission 2 as noted below.

NOTE: Darth Vader **ALWAYS** appears on the **SECOND** rescue attempt of Mission 2. Remind the student of the option that's available by using the ESCAPE button by saying:

Remember. You can always stop and escape with all your rescued Ewoks and all the points you won on a mission by pressing the ESCAPE button.

15. After Mission 4 is finished, the gameboard disappears and is replaced by a scoreboard with the following information:

RESCUE the EWOKS

MISSION LEADER: [Student's FIRST name]

MISSIONS FLOWN: 4

EWOKS RESCUED: [Total Ewoks rescued on all 4 missions]

TOTAL POINTS: [Total points won on all 4 missions]

16. At the bottom of the screen, the following message will appear:

Another player? (Y/N)

Press the appropriate key.

Appendix J

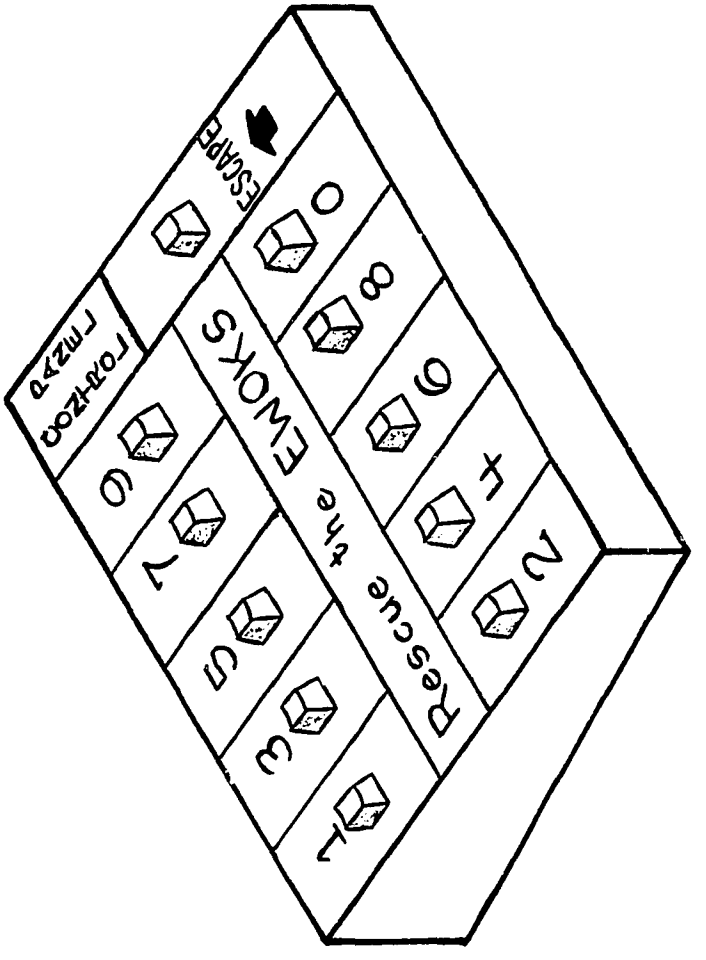

Fig. 15 Risk taking control panel.

Appendix K

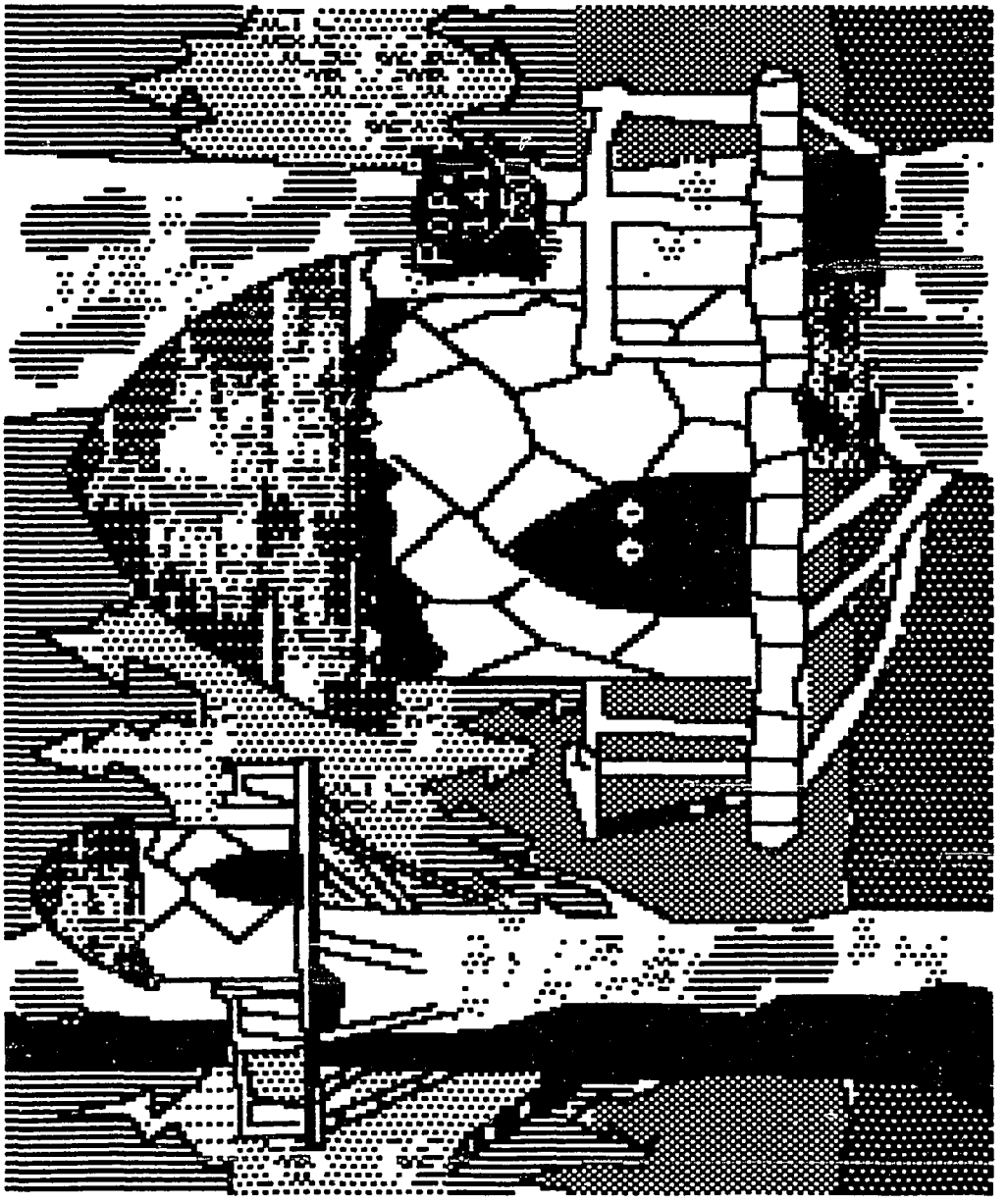

Fig. 16 Risk Taking Task display : Village scene.

Appendix K (continued)

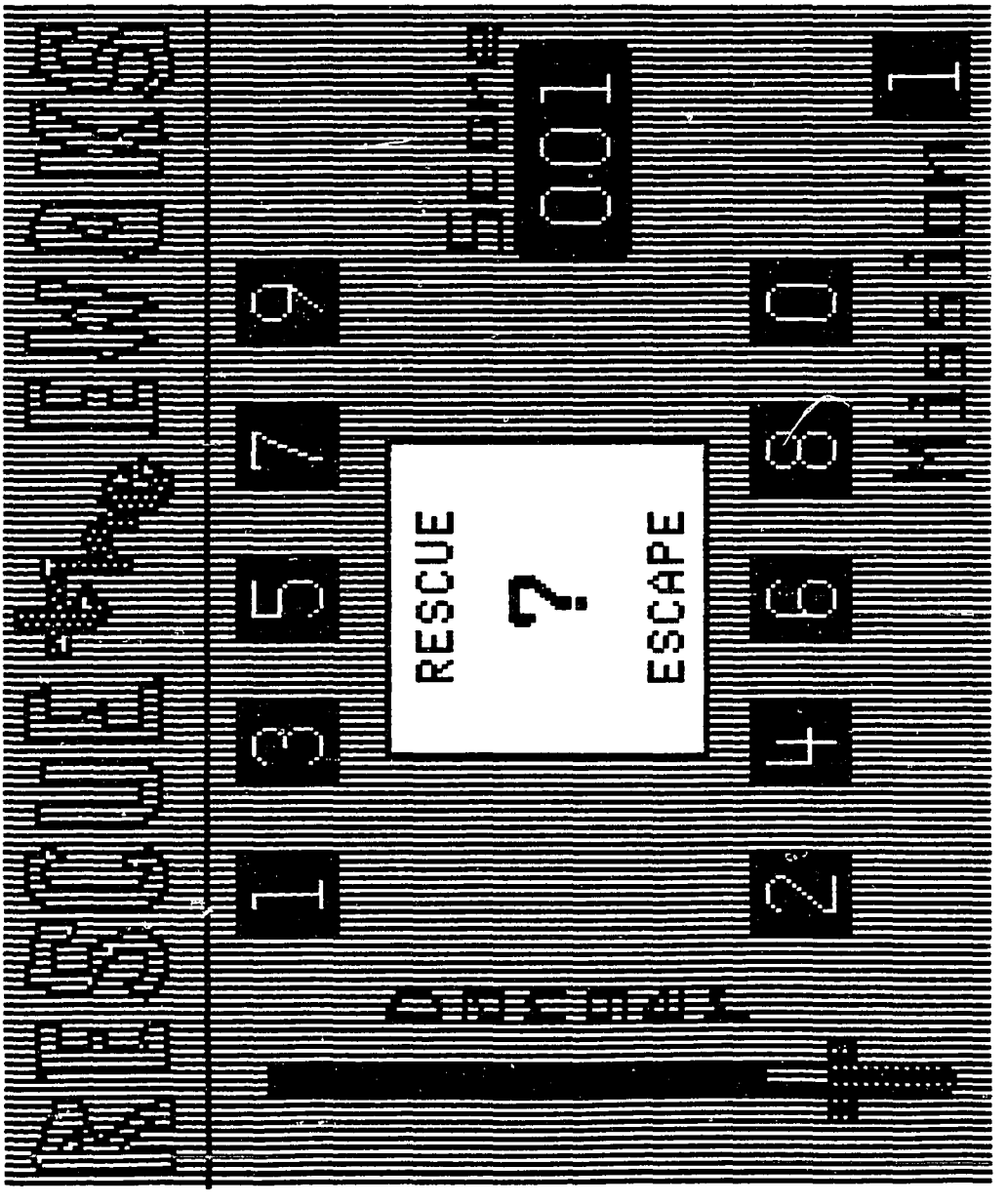

Fig. 17 Risk Taking Task display: Gameboard.

Appendix K (continued)

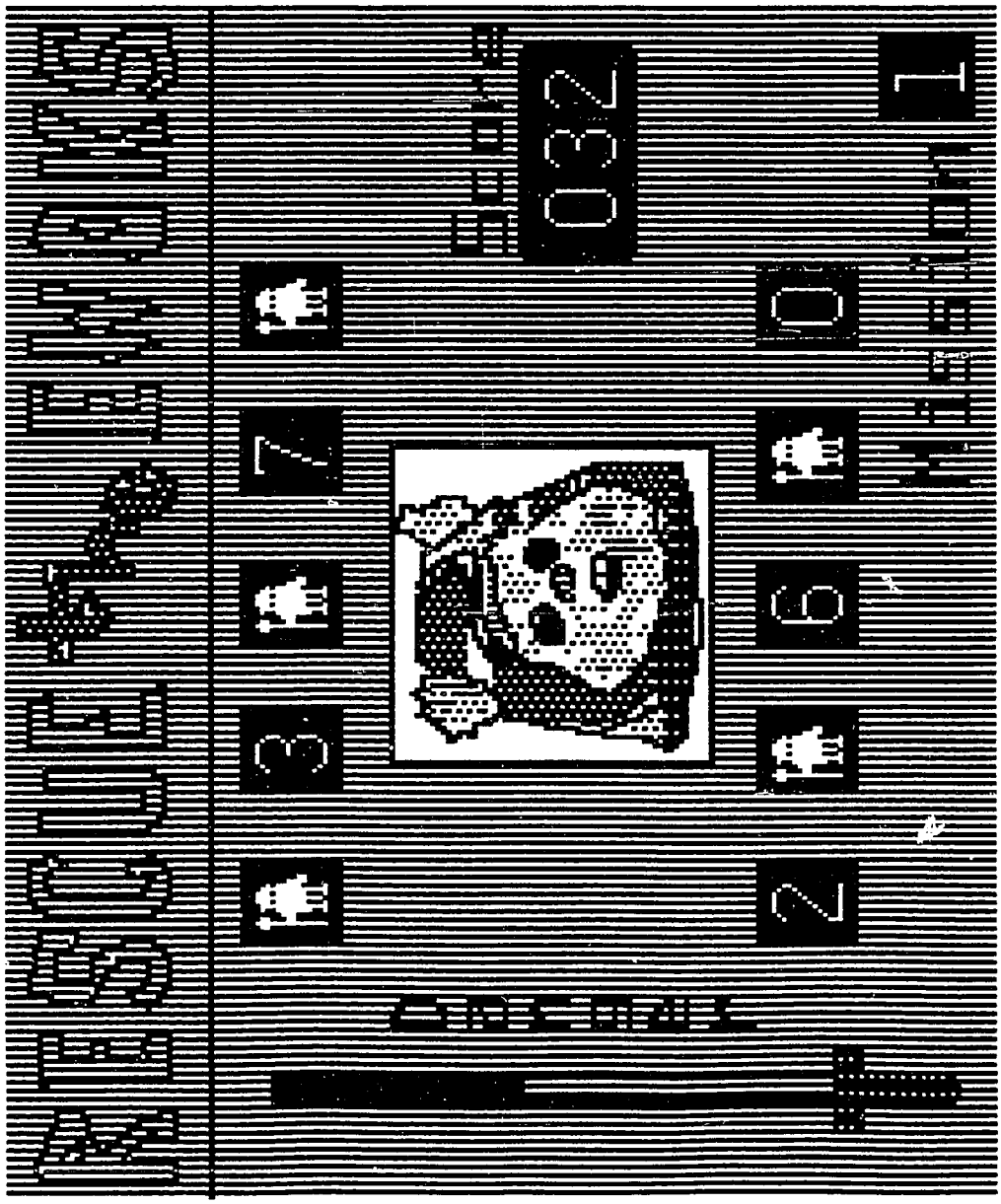

Fig. 18 Risk Taking Task display: Rescued Ewok.

Appendix K (continued)

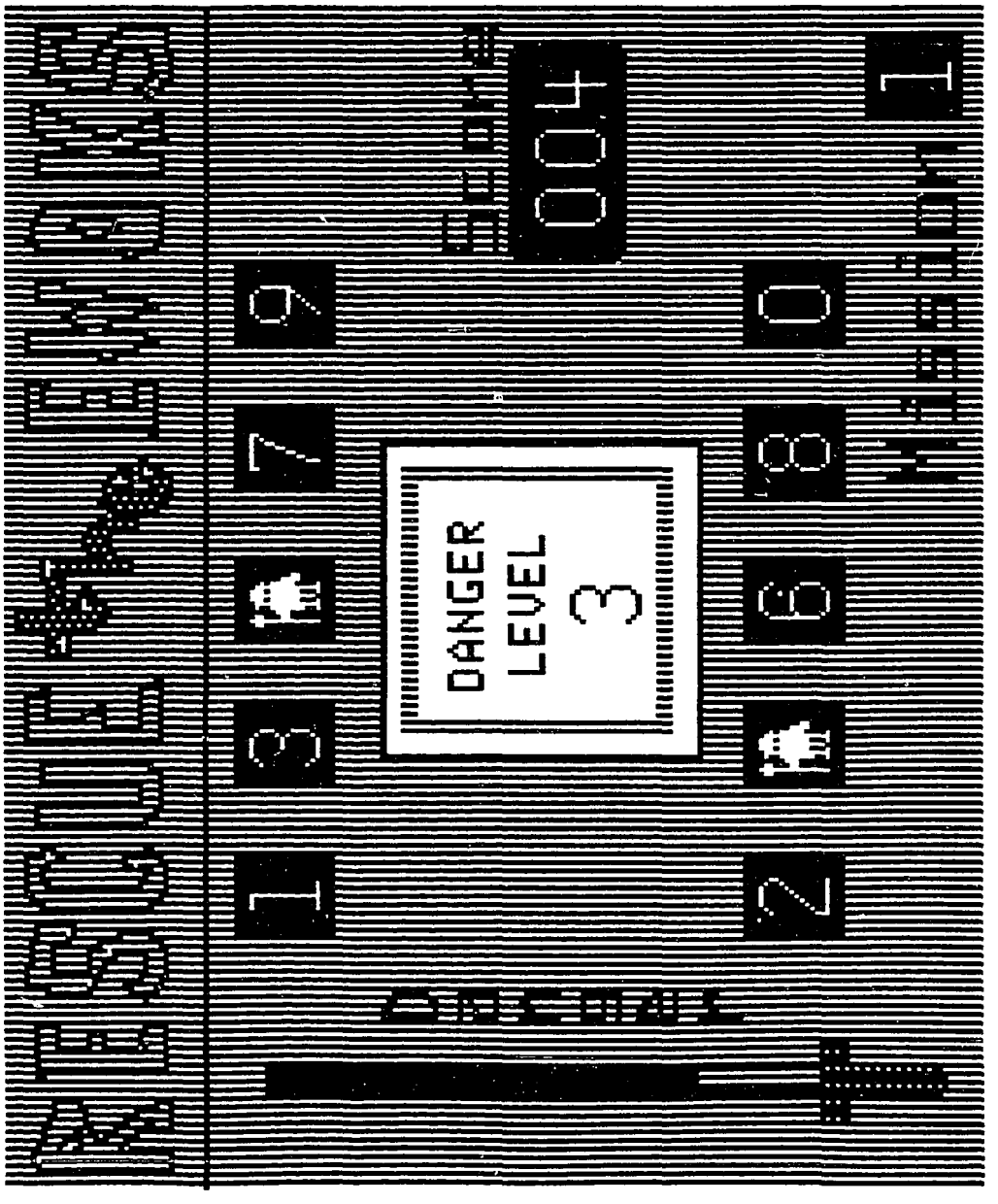

Fig. 19 Risk Taking Task display: Danger Level.

Appendix K (continued)

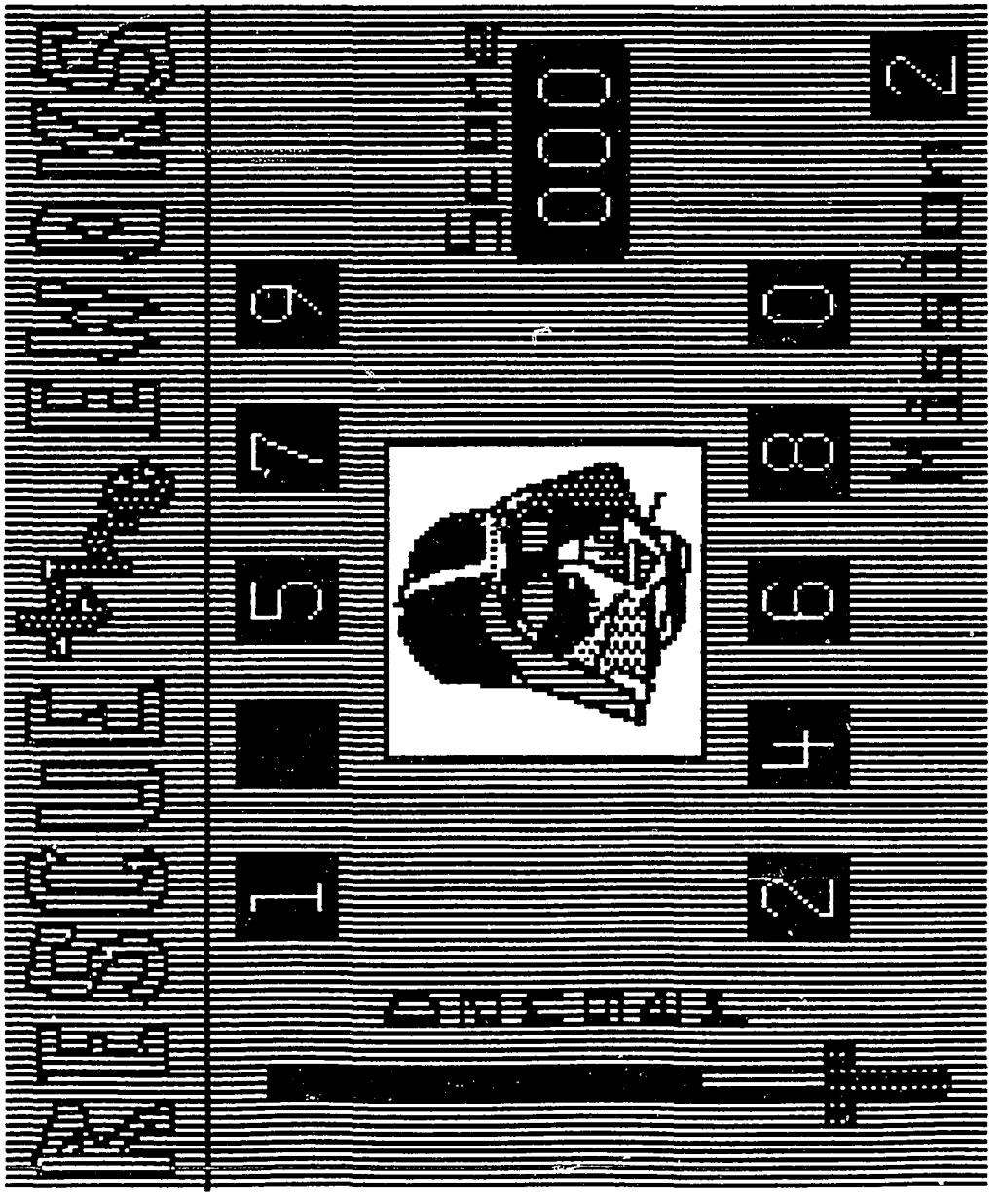

Fig. 20 Risk Taking Task display: Darth Vader.

Appendix K (continued)

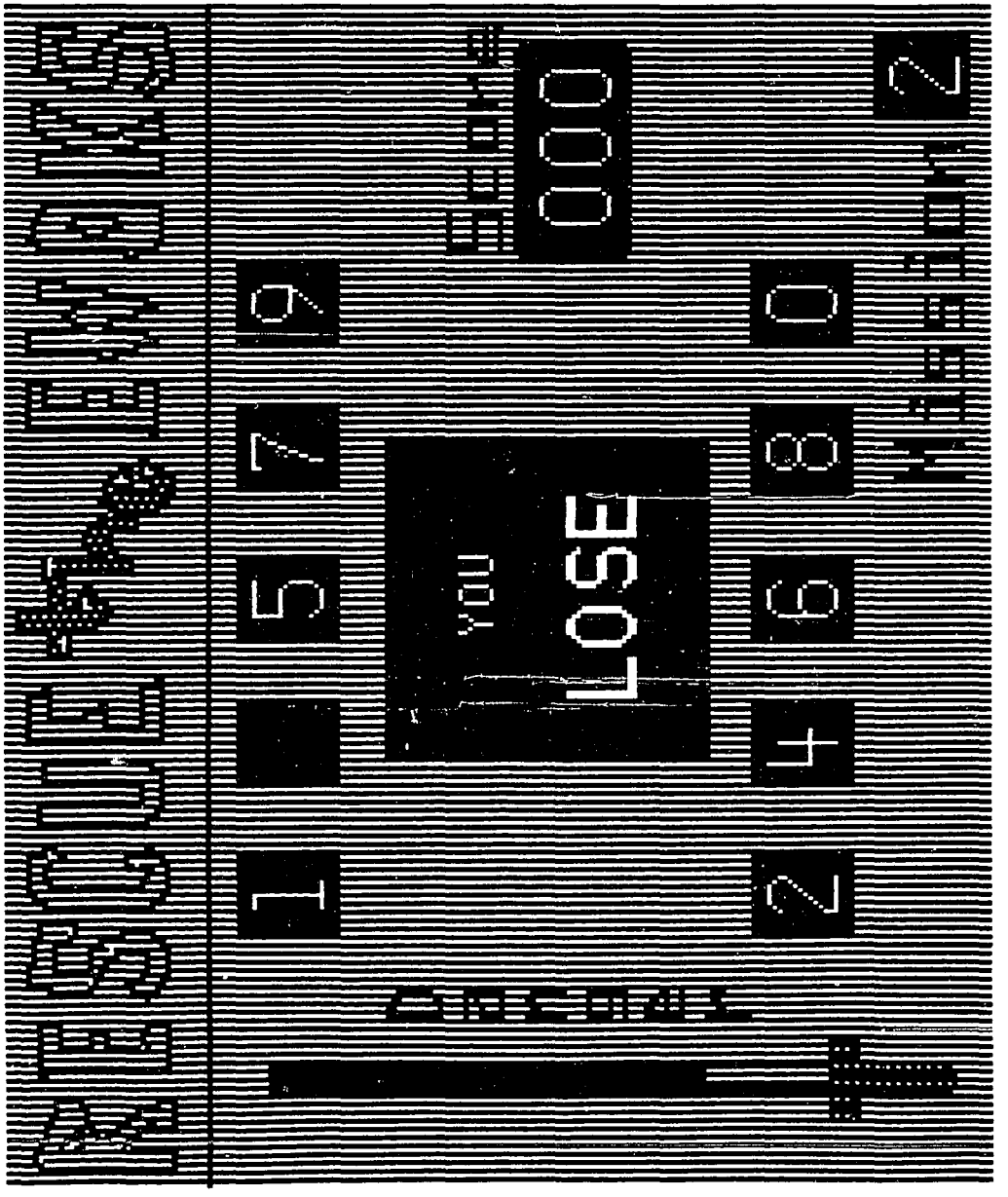

Fig. 21 Risk Taking Task display: You Lose.

Appendix K (continued)

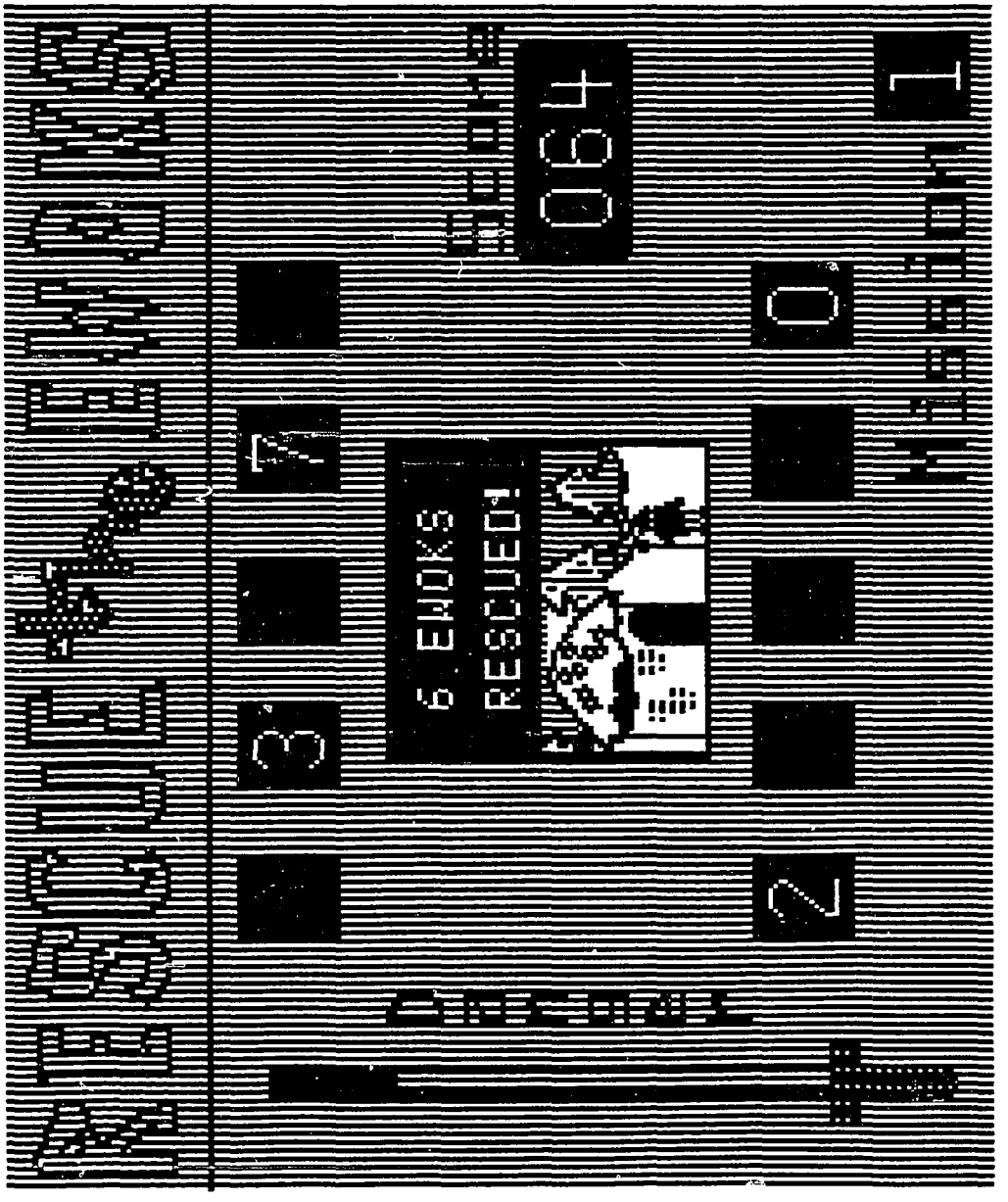

Fig. 22 Risk Taking Task display: Escape scene.

REFERENCES

Adejumo, D. (1979). Conceptual tempo and visual perceptual ability of some Nigerian children. Psychological Reports, 45, 911-916.

Albert, J. A. (1970). Modification of the impulsive conceptual style. (Doctoral dissertation, University of Illinois, 1969). Dissertation Abstracts International, 30, 3377B. (University Microfilms No. 70-778).

Ault, R. L. (1973). Problem-solving strategies of reflective, impulsive, fast-accurate, and slow inaccurate children. Child Development, 44, 259-266.

Ault, R. L., Crawford, D. E., & Jeffrey, W. E. (1972). Visual scanning strategies of reflective, impulsive, fast-accurate, and slow-inaccurate children on the matching familiar figures test. Child Development, 43, 1412-1417.

Ault, R. L., Mitchell, C., & Hartmann, D. P. (1976). Some methodological problems in reflection-impulsivity research. Child Development, 47, 227-231.

Ausburn, L. J. & Ausburn, F. B. (1978). Cognitive styles: Some information and implications for instructional design. Educational Communication & Technology Journal, 26, 337-354.

Ayabe, H. I. (1969). The effect of reflective and impulsive training on conceptual tempo. Unpublished doctoral dissertation, Indiana University.

Ayabe, H. I. (1979). The curvilinear relationship between reflection impulsivity and locus of control. The Journal of Genetic Psychology, 135, 309-310.

Ayabe, H. I., Freese, A. R., Kim, K., Arakaki, M., & Kameoka, K. (1983). Feedback and locus of control. The Journal of Genetic Psychology, 143, 141-142.

Ayabe, H. I. & Nitahara-Pang, C. (1981). Modifying locus of control scores through mnemonic training. The Journal of Genetic Psychology, 105, 269-271.

Ayabe, H. I. & Santo, S. (1972). Conceptual tempo and the Oriental American. The Journal of Psychology, 81, 121-123.

Bender, N. N. (1976). Self-verbalization versus tutor verbalization in modifying impulsivity. Developmental Psychology, 68, 347-354.

Berzonsky, M. (1974). Reflectivity, internality, and animistic thinking. Child Development, 45, 785-789.

Block, J., Block, J. H., & Harrington, D. M. (1974). Some misgivings about the matching familiar figures test as a measure of reflection-impulsivity. Developmental Psychology, 10, 611-632.

Borkowski, J. G., Peck, V. A., Reid, M. R., & Kurtz, B. E. (1983). Impulsivity and strategy transfer: Metamemory as mediator. Child Development, 54, 459-473.

Briggs, C. H. & Weinberg, R. A. (1973). Effects of reinforcement in training children's conceptual tempo. Journal of Educational Psychology, 65, 383-394.

Buchanan, J. P. (1983). An examination of Kagan's risk hypothesis for conceptual tempo. Genetic Psychology Monographs, 107, 135-142.

Butter, E. J. (1979). Visual and haptic training and cross-modal transfer of reflectivity. Journal of Educational Psychology, 71, 212-219.

Cairns, E. (1978 a). Age and conceptual tempo. The Journal of Genetic Psychology, 133, 13-17.

Cairns, E. (1978 b). Role task strategy and stimulus processing in reflective and impulsive tactual matching performance. Perceptual and Motor Skills, 47, 523-529.

Cairns, E. & Cammock, T. (1978). Development of a more reliable version of the matching familiar figures test. Developmental Psychology, 14, 555-560.

Campbell, D. T. & Stanley, J. C. (1963). Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally College Publishing.

Cathcart, G. & Liedtke, W. (1969). Reflectiveness/impulsiveness and mathematics achievement. Arithmetic Teacher, 16, 563-567.

Crandall, V. C., Katkovsky, W., & Crandall, V. J. (1965). Children's beliefs in their own control of reinforcements in intellectual-academic achievement situations. Child Development, 36, 91-109.

Denner, B. & Cashdan, S. (1967). Sensory processing and the recognition of forms in nursery school children. British Journal of Psychology, 58, 101-104.

Denny, R. L. (1972). Modeling effects upon conceptual style and cognitive cognitive tempo. Child Development, 43, 105-119.

Digate, G., Epstein, M. H., Cullinan, D., & Switzky. (1978). Modification of impulsivity: Implications for improved efficiency in learning for expectional children. The Journal of Special Education, 12, 459-468.

Drake, D. M. (1970). Perceptual correlates of impulsive and reflective behavior. Developmental Psychology, 2, 202-214.

Duryea, E. J. & Glover, J. A. (1982). A review of the research on reflection and impulsivity in children. Genetic Psychology Monographs, 106, 217-237.

Egeland, B. (1974). Training impulsive children in the use of more efficient scanning techniques. Child Development, 45, 165-171.

Egeland, B. & Higgins, A. T. (1976). Selective attention of impulsive and reflective children. Contemporary Educational Psychology, 1, 213-220.

Errickson, E. A., Wyne, M. D., & Routh, D. K. (1973). A response-cost procedure for reduction of impulsive behavior of academically handicapped children. Journal of Abnormal Child Psychology, 1, 350-357.

Eskra, B. & Black, K. N. (1971). Conceptual tempo in young grade-school children. Child Development, 42, 505-516.

Feuerstein, R. (1980). Instrumental Enrichment: An Intervention Program for Cognitive Modifiability. Baltimore: University Park Press.

Finch, A. J., Kendall, P., Deardorff, P. Anderson, J., & Sitarz, A. (1975). Reflection-impulsivity, persistence behavior, and locus of control in emotionally disturbed children. Journal of Consulting and Clinical Psychology, 43, 748.

Finch, A. J., Nelson, W. M., Montgomery, L. E., & Stein, A. B. (1974). Reflection-impulsivity and locus of control in emotionally disturbed children. Journal of Genetic Psychology, 125, 273-275.

Gagné, R. M. (1967). Instruction and the conditions of learning. In L. Siegel (Ed.), Contemporary Theories of Instruction. San Francisco: Springer.

Gibson, J. J. & Gibson, E. J. (1955). Perceptual learning: Differentiation or enrichment? Psychological Review, 62, 32-41.

Goodman, J. B. (1974). Impulsive and reflective behavior: A developmental analysis of attentional and cognitive strategies. (Doctoral dissertation, University of Waterloo, Canada, 1973). Dissertation Abstracts International, 34, 5190B.

Hallahan, D. P., Kauffman, J. M., & Ball, D. W. (1973). Selective attention and cognitive tempo of low achieving sixth grade males. Perceptual and Motor Skills, 36, 579-583.

Halpin, B. M. & Ottinger, D. R. (1983). Children's locus-of-control scales: A reappraisal of reliability characteristics. Child Development, 54, 484-487.

Hartley, D. (1976). The effect ofperceptual salience on reflective-impulsive performance differences. Developmental Psychology, 12, 218-225.

Heider, E. R. (1971). Information processing and the modification of an "impulsive conceptual tempo". Child Development, 42, 1276-1281.

Hemry, F. P. (1973). Effect of reinforcement conditions on a discrimination learning task for impulsive versus reflective children. Child Development, 44, 657-660.

Hybertson, D. R. (1976). The relationship between reflective and impulsive cognitive tempo classification and analytic vs. global perceptual processing. (Doctoral dissertation, University of Louisville, 1976). Dissertation Abstracts International, 37, 2480B. (University Microfilms No. 76-26,199).

Inagaki, K. & Hatano, G. (1979). Flexibility of accuracy versus speed orientation in reflective and impulsive children. Perceptual and Motor Skills, 48, 1099-1108.

Isakson M. B. & Isakson, R. L. (1978). Modifying impulsivity through training in analysis. The Elementary School Journal, 79, 99-107.

Kagan, J. (1965 a). Impulsive and reflective children: Significance of conceptual tempo. In J. D. Krumboltz (ed.), Learning and the Educational Process. Chicago: Rand-McNally.

Kagan, J. (1965 b). Reflection-impulsivity and reading ability in primary grade children. Child Development, 36, 609-628.

Kagan, J. (1966). Reflection-impulsivity: The generality and dynamics of conceptual tempo. Journal of Abnormal Psychology, 71, 17-24.

Kagan, J. & Messer, S. B. (1975). A reply to "Some misgivings about the matching familiar figures test as a measure of reflection-impulsivity". Developmental Psychology, 11, 244-248.

Kagan, J., Pearson, L., & Welch, L. (1966). Conceptual impulsivity and inductive reasoning. Child Development, 37, 583-594.

Kagan, J., Rosman, B. L., Day, D., Albert, J. & Phillips, W. (1964). Information processing in the child: Significance of analytic and reflective attitudes. Psychological Monographs, 78 (Whole No. 578).

Karabenick, S. & Addy, M. (1979). Locus of control and sex differences in skill and chance risk-taking conditions. The Journal of General Psychology, 100, 215-228.

Kerpelman, L. (1967). Stimulus dimensionality and manipulability in visual perceptionual learning. Child Development, 38, 563-571.

Kogan, N. (1971). Educational implications of cognitive styles. In G. S. Lesser (Ed.), Psychology and Educational Practice. Glenview, Ill.: Scott, Foresman.

Kogan, N. (1983). Stylistic variation in childhood and adolescence: Creativity, metaphor, and cognitive styles. In J. Flavell & E. Markman (Eds.), Vol. III, Handbook of Child Psychology. New York: Wiley.

Kogan, N. & Wallach, M. A. (1967). Risk taking as a function ofthe situation, the person, and the group. New Directions in Psychology, 3, 111-277.

Kojima, H. (1976). Some psychometric problems of the matching familiar figures test. Perceptual and Motor Skills, 43, 731-742.

Kopfstein, D. (1973). Risk-taking behavior and cognitive style. Child Development, 44, 190-192.

Lefcourt, H. M. (1976). Locus of Control: Current Trends in Theory and Research. New Jersey: Lawrence Erlbaum Associates.

Lesiak, W. J. (1970). The relationship of the internal-external locus of control dimension of scholastic achievement, reflection-impulsivity and residence in priority areas. (Doctoral dissertation, Ohio State University, 1970). Dissertation Abstracts International, 31, 2285B-2286B. (University Microfilms No. 70-19,331).

Loper, A. B., Hallahan, D. P., & McKinney, J. D. (1982). The effect of reinforcement for global or analytic strategies on the performance of reflective and impulsive children. Journal of Experimental Child Psychology, 33, 55-62.

Mann, L. (1973). Differences between reflective and impulsive children in tempo and quality of decision making. Child Development, 44, 274-279.

Massari, D. J. (1975). The relation of reflection-impulsivity to field dependence-independence and internal-external control in children. Journal of Genetic Psychology, 126, 61-67.

Massari, D. J. & Schack, M. L. (1972). Discrimination learning by reflective and impulsive children as a function of reinforcement schedule. Developmental Psychology, 6, 183.

Meichenbaum, D. H. & Goodman, J. (1971). Training impulsive children to talk to themselves: A means of developing self-control. Journal of Abnormal Psychology, 77, 115-126.

Messer, S. B. (1970 a). The effect of anxiety over intellectual performance on reflection-impulsivity in children. Child Development, 41, 723-735.

Messer, S. B. (1970 b). Reflection-impulsivity: Stability and school failure. Journal of Educational Psychology, 61, 487-490.

Messer, S. B. (1972). The relation of internal-external control to academic performance. Child Development, 43, 1456-1462.

Messer, S. B. (1976). Reflection-impulsivity: A review. Psychology Bulletin, 83, 1026-1052.

Messick, S. (1966). The Criterion Problem in the Evaluation of Instruction: Assessing Possible, Not Just Intended Outcomes. Princeton: Educational Testing Service.

Mitchell, C. & Ault, R. L. (1979). Reflection-impulsivity and evaluation process. Child Development, 50, 1043-1049.

Nelson, T. F. (1969). The effects of training in attention deployment on observing behavior in reflective and impulsive children. (Doctoral dissertation, University of Minnesota, 1968). Dissertation Abstracts International, 29, 2659B. (University Microfilms No. 68-17,703).

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

Nuessle, W. (1972). Reflectivity as an influence on focusing behavior of children. Journal of Experimental Child Psychology, 14, 265-276.

Odom, R. D., McIntyre, C. V., & Neale, G. S. (1971). The influence of cognitive style on perceptual learning. Child Development, 42, 883-891.

Orbach, B. (1977). Impulsive cognitive style: Three modification techniques. Psychology in the Schools, 14, 353-359.

Pick, A. D. (1965). Improvement of visual and tactual form discrimination. Journal of Experimental Psychology, 69, 331-339.

Reali, N. & Hall, V. (1970). Effect of success and failure on the reflective and impulsive child. Developmental Psychology, 3, 392-402.

Reid, D. W. & Ware, E. E. (1973). Multidimensionality of internal-external control: Implications for past and future research. Canadian Journal of Behavioural Science, 5, 264-271.

Reid, D. W. & Ware, E. E. (1974). Multidimensionality of internal versus external control: Addition of a third dimension and non-distinction of self versus others. Canadian Journal of Behavioural Science, 6, 131-142.

Ridberg, E. H., Parke, R. D., & Hetherington, E. M. (1971). Modification of impulsive and reflective cognitive styles through observation of film-mediated models. Developmental Psychology, 5, 369-377.

Rotenberg, K. J. (1980). Cognitive processes and young children's use of intention and consequence information in moral judgment. Merrill-Palmer Quarterly of Behavior and Development, 26, 359-370.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80 (Whole No. 609).

Rudel, R. G. & Teuber, H. (1964). Crossmodal transfer of shape discrimination by children. Neuropsychologia, 2, 1-8.

Salkind, N. J. (1978). Development of norms for the matching familiar figures test. Journal Supplement Abstract Service Catalog of Selected Documents in Psychology, 8, 61. (Ms. No. 1718)

Salkind, N. J. & Nelson, C. F. (1980). A note on the developmental nature of reflection-impulsivity. Developmental Psychology, 16, 237-238.

Salkind, N. J. & Wright, J. C. (1977). The development of reflection-impulsivity and cognitive efficiency. Human Development, 20, 377-387.

Shipe, D. (1971). Impulsivity and locus of control as predictors of achievement and adjustment in mildly retarded and borderline youth. American Journal of Mental Deficiency, 76, 12-22.

Siegel, A. W., Babich, J. M., & Kirasic, K. C. (1974). Visual recognition memory in reflective and impulsive children. Memory & Cognition, 2, 379-384.

Siegel, A. W., Kirasic, K. C., & Kilburg, R. R. (1973). Recognition memory in reflective and impulsive preschool children. Child Development, 44, 651-656.

Siegelman, E. (1969). Reflective and impulsive observing behavior. Child Development, 40, 1213-1222.

Slovic, P. (1966). Risk-taking in children: Age and sex differences. Child Development, 41, 1083-1088.

Spitz, H. H. & Borland, M. D. (1971). Redundancy in line drawings of familiar objects: Effects of age and intelligence. Cognitive Psychology, 2, 196-205.

Ward, W. C. (1968). Reflection-impulsivity in kindergarten children. Child Development, 39, 867-874.

Weiner, A. S. & Adams, W. V. (1974). The effect of failure and frustration on reflective and impulsive children. Journal of Experimental Child Psychology, 17, 353-359.

Weiner, A. S. & Berzonsky, M. D. (1975). Development of selective attention in reflective and impulsive children. Child Development, 46, 545-549.

Wolfgang, A. (1971). Errors and latency of response as a function of order of presentation of tactile-visual stimuli in concept identification. Psychonomic Science, 1, 192-200.

Yando, R. M. & Kagan, J. (1970). The effect of task complexity on reflection-impulsivity. Cognitive Psychology, 1, 192-200.

Young, L. M. (1983). An analysis of the effect of the Logo computer programming environment upon the reflective and impulsive cognitive styles of second-grade students. (Doctoral dissertation, University of Pittsburgh, 1982). Dissertation Abstracts International, 44, 64A. (University Microfilms No. DA8312545).

Zelniker, T. & Jeffrey, W. E. (1976). Reflective and impulsive children: Strategies of information processing underlying differences in problem solving. Monographs of the Society for Research in Child Development, 41 (5, Serial No. 168).

Zelniker, T., Jeffrey, W. E., Ault, R., & Parsons, J. (1972). Analysis and modification of search strategies of impulsive and reflective children on the matching familiar figures test. Child Development, 43, 321-335.

Zelniker, T. & Oppenheimer, L. (1973). Modification of information processing of impulsive children. Child Development, 44, 445-450.