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ABSTRACT

Two techniques were used to modify an impulsive conceptual tempo on a visual discrimination task. The subjects were 42 first grade white children who had previously been classified as impulsive or near-impulsive on the Matching Familiar Figures Test given to 82 children. These subjects, who had scored above the median on errors and below the median on latency, consisted of 21 boys and 21 girls who were randomly assigned to three conditions: forced delay of response, trained visual scanning, and a control condition. Two training tasks were used during two half hour training sessions for the experimental groups: the Haptic Visual Matching test and the Conceptual Styles Test. The results did not reach statistical significance, but indicated a trend of increased response latency and decreased match-to-sample errors for both experimental manipulations. Both experimental groups, compared to the control group, modified impulsivity to some extent, especially for boys. Comparing the visual scanning training group with the forced-delay group, the former tended to increase latency more for the boys; there was no significant difference between the two techniques in decreasing errors. (Author/SET)

THE MODIFICATION OF ATTENTIONAL STRATEGIES IN CHILDREN

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Abstract

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THE MODIFICATION OF ATTENTIONAL

STRATEGIES IN CHILDREN

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The present study brings together two areas of research which investigate the development of perceptual and cognitive processes. The first area developed from the research conducted by Kagan and his associates (Kagan, In Krumboltz, 1965; Kagan, Moss, and Siegel, 1963; Kagan, 1966a; Kagan et. al., 1964). These empirical accounts emphasize the individual's characteristic or preferred way of perceiving, organizing, and interpreting stimuli within the environment, or one's "cognitive style." Two components of cognitive style are conceived: "conceptual style" and "conceptual tempo." Certain individuals prefer to categorize items on the basis of an objective similarity of parts (analytic responses or analytic conceptual style). An example of the analytic response to the question, "Why do these two go together?", would be, "Both people are holding the same item." In contrast to giving a detailed analysis of stimuli, other individuals prefer to categorize items as complex wholes (non-analytic, global responses). Some examples of non-analytic responses to the same question would include: "two men" or "a dog and his dog house."

Conceptual tempo, or the decision time variable has been defined in terms of a reflection-impulsivity dimension (R-I). The R-I dimension is conceived as a unitary variable, representing the individual's consistent tendency to give fast or slow initial responses after considering alternative solutions in problem solving tasks. The particular tasks are the variety that have high response uncertainty. For experimental purposes however, Kagan and others have utilized a dual criterion for classification of subjects: response time and errors. A subject's position along the R-I dimension is determined by the Matching Familiar Figures test (MFF). The MFF is a visual discrimination task which requires subjects to select from an array of variants, one picture which is similar to a standard picture. Persons classified as reflective score above the median in response time to first decision, and below the median in errors. Persons classified as impulsive score below the median in response time and above the median in number of errors.

The operational measure of the R-I construct (MFF) has evidenced both reliability and validity (Kagan, 1965a; Kagan, 1965b; Kagan, 1966b; Kagan et. al., 1964). The tendency toward fast or slow decision times has generality across tasks involving matching problems or visual recognition, and stability over time. Ward (1968) presented evidence which suggested that individual differences in conceptual tempo were reliable across variations in test content and testing atmosphere. Yando and Kagan (1970) have shown that subjects retain their preferred mode of decision making behavior independent of task complexity. The tendency to be reflective or impulsive remained stable with MFF forms having between 2 and 10 alternatives per test item. Drake (1970) and Siegelman (1969) presented the MFF with apparatus that varied from the standard material. Drake's use of an eye marker camera and film and Siegelman's use of a button pressing apparatus showed that obtained mean response times and errors were comparable to those obtained in standard testing procedures.

The relative position on the R-I dimension has predictive validity for various problem solving situations. Previous investigators have extended the correlates of a reflective or impulsive tempo into other cognitive spheres. With verbal ability controlled, the reflective child compared to the impulsive child has made fewer errors of recognition on a reading task (Kagan, 1965b); fewer errors of commission in recalling words in a serial learning task (Kagan, 1966b); and fewer errors on an inductive reasoning task (Kagan, Pearson, & Welch, 1966a).

Certain behavioral correlates of reflection-impulsivity have been investigated (Kagan et. al., 1963; Reppucci, 1970). The reflective child contrasted with the impulsive child of like age gives evidence of being less distractable; having a longer attention span; preferring low-risk situations and more solitary intellectual tasks; and being less motorically active. Meichenbaum and Goodman (1969) examined the relationship between the child's ability to control motor behavior verbally and the R-I dimension. The results of a finger-tapping and a foot-depression task revealed that impulsive subjects evidenced greater motor activity; their self-verbalizations were less effective in controlling an inhibitory motor response -- "don't push." Harrison and Nadelman (1968) investigated the relationship between the R-I dimension and the ability to inhibit movement on request. Their operational measures of inhibition of movement, Draw a Line Slowly and Walk Slowly, revealed that more reflective subjects were able to inhibit motor movement.

Various plausible antecedent of the R-I dimension have been hypothesized: constitutional predisposition, involvement in the task (Kagan, 1966; Reppucci, 1970), and anxiety over task competence (Kagan, 1966a; Messer, 1970). Reali and Hall (1970) investigated the effect of previous success and failure on expectation of success and decision time.

Their findings revealed that past experience (success or failure) modified expectancy, but decision time remained the same irregardless of experimental conditions. Reflective subjects continued to show longer decision times than impulsives.

The accumulated data suggest that conceptual tempo is an important dimension in cognitive development.

The second area of research stems from investigations of developmental trends of attention ability (Hagen and Sabo, 1967; Druker and Hagen, 1969; Maccoby and Hagen, 1965) and investigations of attention deployment (Siegelman, 1969; Drake, 1970). The results suggest that young children are inefficient in performance on perceptual-cognitive tasks. Their inefficiency is partially due to global and undifferentiated perception. Indiscriminant processing of information (Hagen, Maccoby, et. al.), minimal scanning of visual stimuli, and greater inequality of attention deployment (Siegelman, 1969; Drake, 1970) characterize the young child. In contrast, older subjects demonstrate greater selective attention, more differentiation of stimulus components, and proportionately more scanning of stimuli (measured by frequency and duration of observing response).

The general paradigm for recall of task-relevant items consisted of pairs of spatially contiguous pictures (i.e. household objects and animals). One of the items was designated as the central or task-relevant stimulus, and the other was labeled the incidental stimulus. Subjects were instructed to attend to the central stimulus. The irrelevant or incidental stimuli were either not mentioned in the instructions, or subjects were told to ignore them. Results indicated that during the recall trial, younger subjects remembered the central-incidental pairings better than older subjects who occasionally could not recall the pairings associated during the previous inspection trial.

Druker and Hagen (1969) extended the previous research of central-incidental learning. They predicted that spatial separation of relevant and irrelevant items would result in improved visual discrimination and selective attention, especially for younger subjects. However, the results showed that spatial separation of paired stimuli decreased incidental recall of older subjects but did not necessarily lead to a decrease in incidental recall of younger subjects. Druker and Hagen (1969) concluded that older subjects employ superior encoding strategies which are related to specific verbal labeling and focused visual scanning.

Drake (1970) investigated developmental trends in two visual discrimination tasks: a modified MFF test and matching of pair items. A Mackworth's eye marker camera recorded the eye fixations of third grade children and college students. The general findings revealed that adults scored higher than children on the number of variants observed, on percentage of visual area examined, and on mean comparisons of homologous parts. The data reflected that adults tended to compare a larger number of design features across variants and to make more frequent repeated comparisons of homologous features. Drake (1970) extended the study of developmental differences in visual discrimination to the R-I dimension by comparing discrimination strategies of reflective and impulsive subjects of both age groups. Perceptual correlates of reflective and impulsive observing behavior suggested that during the first six seconds of performance on MFF items, same-aged impulsive and reflective subjects employed different task strategies even on the initial approach to the task. Reflective children and impulsive adults gave a significantly larger portion of their scanning time to the standard than did impulsive children or reflective adults. Once the reflective child and impulsive adult examined the critical features of the standard, they shifted to more of the variants. The reflective adult scanned more of the variants and gradually eliminated each variant that deviated from the standard.

Siegelman (1969) investigated observing behavior in impulsive and reflective fourth grade boys. The findings revealed a trend that was the exact opposite of that found by Drake (1970). Siegelman found that impulsives and reflectives displayed different strategies. However, reflective subjects as opposed to impulsives devoted <u>less</u> looking time as well as less frequent looks to the standard and more extensive looks among the array of variants. Impulsive subjects ignored more of the alternatives and devoted most of their time and extent of scanning to the chosen variant.

It is necessary that we consider the differences in methodology that exist between the two studies. The subjects in Drake's study were allowed free viewing of the visual array which was displayed by film. Siegelman's subjects were required to press a button in order to bring into focus any of six variants or the standard. The pictures were presented in a wooden panel which contained seven windows. Secondly, Siegelman's subjects were presented six alternatives, while Drake's subjects viewed four alternatives. If we consider both sets of data together, we find that when reflectives were presented four alternatives, an average of 3.3 were observed (Drake, 1970). When presented six alternatives, reflectives looked at an average of 4.89 (Siegelman, 1969). The striking feature is that irrespective of the number of alternatives presented, impulsive subjects continued to look at about three variants: 3.20 when given four (Drake, 1970) and 3.17 when given six (Siegelman, 1969).

The findings lend support to the notion that impulsive and reflective subjects show a difference in attentional strategies. The impulsive child globally examines a few variants, then immediately selects one that resembles the standard. The reflective child's scanning performance may be gauged by the number of variants available. Moreover, the reflective child scans the alternatives in a more efficient manner, and makes fewer match-to-sample errors. It seems reasonable to suggest that there may exist a developmental lag between impulsive children and their same-aged reflective peers.

In view of the conclusions drawn by earlier studies that cognitive style (Kagan et. al.) and developmental differences in selective attention (Hagen et. al.) contribute to the individual's efficiency of observation and discrimination, the present study asks the question: Can specific training enhance the cognitive-perceptual performance of young children? More specifically, can specific techniques modify the less efficient search of the impulsive children?

Previous research which attempted to modify cognitive style have relied upon three basic techniques: the use of external reinforcement, the use of imitation of models, and the use of forced delay of response.

Baird and Bee (1969) employed the direct reinforcement technique in an attempt to modify the analytic and non-analytic conceptual style. The question was raised: 'Was it possible to train subjects with analytic or non-analytic conceptual styles to give either an increased or decreased number of analytic responses by application of appropriate differential reward?" First and second graders were designated as analytic or non-analytic on the basis of scores on the Conceptual Style Test (CST) (Kagan et. al., 1963; Kagan et. al., 1964). Colored chips which could be exchanged for M&Ms were given for appropriate responses. Results showed that regardless of initial conceptual style, during training subjects increased in the type of response that was rewarded. Reinforcement for analytic responses increased the rate of those responses during training but reinforcement for non-analytic responses caused a decrease in rate of analytic responses. Posttest-pretest comparisons revealed the greater impact of analytic training and suggested a developmental shift toward more analytic responding. Analytic training increased analytic responding from pretest to posttest, while non-analytic training did not decrease analytic responding.

The modification of conceptual tempo through imitation of models has been investigated in various modeling conditions. Kagan et. al. (1966b) compared the differential effectiveness of training in reflection under two tutoring conditions, one in which training occurred under conditions of perceived similarity to the same-sexed adult trainer, and one in which there was a normally nurturant condition between subject and tutor, but no perceived similarity. In both conditions three training tasks were used: a haptic visual matching task, a design matching task, and an inductive reasoning task. Subjects were instructed to delay their responses for a fixed period of 10 to 15 seconds. During training the subject was encouraged to study the stimuli in the task, and to think about their answers, but did not receive training in more efficient procedures or reinforcement for correct responses. The hypothesis that perceived similarity would facilitate increased response latencies was not supported. The findings revealed that direct training in reflection lengthened response times to MFF, but did not necessarily affect the quality of the performance by reducing the number of errors on the MFF test.

Yando and Kagan (1967) investigated the influence of the teacher on changes in their pupils' decision time during the first year in school. Subjects were tested for the tendency to be impulsive or reflective during the fall and again during the spring of the school. The results showed that children taught by experienced, reflective teachers showed a greater increase in response time during a period of one academic year; these results were significant for boys only. However, the Kagan and Yando findings did not show a significant change in number of recognition errors.

Debus (1970) investigated the short term modifiability of an impulsive conceptual tempo by having third grade impulsive subjects observe sixth grade models who showed differing patterns of reflective and/or impulsive responses associated with different reinforcement contingencies as they responded to items of a visual discrimination task. The experimental treatment represented a more indirect training procedure in which subjects were exposed to verbal and behavioral cues from a model and observed rather than experienced the subsequent reinforcement contigencies. In essence, the results of Debus' (1970) study showed that subjects who observed a competent reflective model, and girls who observed contrasting patterns in which models fluctuated between impulsive and reflective response tendencies, increased in response latency. Observation of an impulsive model who made frequent errors did not cause an increase in latency. Again, error scores were not significantly affected by any one of the experiemntal treatments. However, it was noted that subjects whose latency scores increased during posttesting made fewer errors than those subjects whose latencies did not change.

The studies that have attempted to modify an impulsive tempo have shown that training which emphasizes a delay in response may produce increased posttest latencies, but a corresponding decrease in error scores does not necessarily occur. The forced delay paradigm and various modeling techniques have concentrated principally on increasing response latencies without emphasizing improved scanning strategies in the impulsive child. Perhaps the specific behavior of delaying responses is more easily recognized than mere verbalizations about scanning strategies.

The present study was designed to explore the modifiability of an impulsive conceptual tempo through training in forced delay of response and training in improved visual scanning strategies. A change in both response time and error scores of an impulsive problem solving strategy was stressed. The rationale for the study was that in order to maximize efficiency in search, longer latencies plus accuracy of solution is necessary. The implication was that improvement in the ability to attend selectively to relevant aspects and to abstract differences between given stimuli is very crucial in cognitive-perceptual tasks.

The theoretical and empirical basis for modifying an impulsive conceptual tempo becomes evident. Therefore, the following results as measured by the MFF were hypothesized:

1. Increases in posttest latencies will result for subjects in the forced delay condition.
2. Increases in posttest latencies will result for subjects in the visual scanning condition.

   There was not a specific prediction of the relative efficacy of the two experimental conditions on the latency dimension.
3. There will be a direct effect on error rate in the visual scanning condition. Posttest change will reflect a decrease in errors.
4. It was predicted that there would be a greater decrease in errors for the visual scanning treatment than for the focused delay condition.

Method

Subjects

Subjects used in the initial pretesting for conceptual tempo were 82 Caucasian boys and girls, the total enrollment of first grade classes in a public elementary school in Ann Arbor, Michigan.[1] The school was located in a mixed working class and middle class neighborhood. The initial group consisted of 45 boys (ages 6.3-7.3) and 37 girls (ages 6.3-7.3). None of the subjects had repeated first grade. Subjects were called out of their classrooms one at a time, and were tested individually by a Black experimenter in a quiet trailer parked on the school grounds.[2] Inside the trailer were two chairs, a table, and adequate lighting. Each child was seen a maximum of three times.

Procedure

All subjects were given the MFF (Kagan et. al., 1964), and were scored for latency to first response, number and order of errors. On the basis of the pretest assessment, 14 boys and 14 girls were classified as reflective (R, above the sex median on response time and below the sex median on errors), and 14 boys and 14 girls were classified as impulsive (I, below the median on response time and above the median for errors). There were no observable sex differences found on the criterion variables. For boys: response latency Mean = 15.33 seconds, Median = 13.13 sec.; errors Mean = 12.12 errors, Mdn. = 12 errors. For girls: latency Mean = 15.58 sec., Mdn. = 13.83 sec.; errors Mean = 12.24 errors, Mdn. = 11 errors.

For the training procedure and posttest assessment, additional subjects were included and were randomly assigned to treatment groups. The additional subjects were labeled non-extremes (I*).[3]

Apparatus

The MFF test was used to determine the R-I dimension. The Conceptual Style Test (CST) and a modified version of the Haptic Visual Matching test (HVM) were used for training.[4] The visual items in the MFF, CST, and HVM test consisted of black ink drawings. The haptic materials were three-dimensional wooden forms which consisted of both geometric figures and familiar objects. The HVM materials were presented in a plywood box that had two holes cut out, and a dark curtain was suspended just behind the holes. Subjects could put their hands through the holes in order to palpate HVM materials, but they could not simultaneously observe the wooden object. An interval timer with buzzer was used for the forced delayed condition. A stop watch was used to record latencies to the nearest .5 second.

Session I: Matching Familiar Figures Pretest

The MFF pretest period lasted about 15 minutes. The items consisted of black ink drawings of familiar objects. The stimuli consisted of a standard picture and six variants, only one of which was identical to the standard. The child was shown two practice items and 12 test items. Latency to the first response and number of errors per item prior to correct solution were recorded. If the child was correct, he was told, "Yes, that is correct." If he was wrong, he was told, "No, that is not the correct one. Try to find the one that is just like this one." The experimenter pointed to the standard. Responses were recorded until the subject got the item correct, or until a maximum of six errors were made. If the sixth response was an error, the experimenter showed the subject the correct answer.

Persons classified as impulsive were assigned to one of three groups during the training session:

Condition 1: Training in visual scanning

Condition 2: Forced Delay of response

Condition 3: Control -- no experimental manipulations

Persons classified as reflective were omitted from the remaining portion of the study.

Session II - Experimental Intervention

The second session occurred three weeks after the MFF pretest. The testing lasted about 30 minutes.

Condition 1: Training in visual scanning. The HVM and CST tests were used to train the subjects in the following manner. HVM test - the experimenter placed one stimulus item at a time inside a plywood box. The child was first allowed to explore with his fingers a three-dimensional wooden form (approximately 3 inches square). Palpation time was unlimited. When the child withdrew his hands, the experimenter recorded exploration time. Next the child was presented with a visual array of five stimuli (black ink drawings), one of which illustrated the wooden form that was explored haptically. The entire HVM consisted of 8 familiar objects (pipe, boy, pig, tree, cat, shirt, scissors, train) and 8 geometric objects. During one training session, 4 familiar objects and four geometric objects were presented. The child was shown one practice item and eight test items. If the child was correct, the experimenter replied, "Yes, that is correct." If he was wrong, he was told, "No, that is not the correct one." (the experimenter covered the visual array.) The child was then allowed to explore the wooden object haptically a second time, without visual access to the array. While the subject explored, he was encouraged to notice the dissimilarities between the standard item and the chosen item. He was then asked, "Can you tell me the difference between the object you are touching right now, and the object that you just picked?" The experimenter recorded the subjects comments. After the subject removed his hands, the experimenter displayed the visual array a second time, and said "Now find the one that is just like the one you just touched." If an error occurred on the second trial, the haptic material and the visual array were presented simultaneously. The experimenter and the subject would mutually point out dissimilarities and agree on the correct variant.

Conceptual Styles Test (CST) - The test consisted of a set of visual stimuli, each of which contained three black and white drawings. For each test time, the subject was required to select two of the figures that "are alike or go together in some way." One practice item and nine test items were presented. The subjects were trained to scan the stimuli for objective similarity in parts. Analytic rather than non-analytic responses were encouraged. For example, the child was shown an item that contained two rabbits and a donkey. If the subject paired the two rabbits, he was told, "Yes, that's so but now find two that are alike in another way." If the subject paired the donkey and the rabbit (based on some objective similarity, i.e. "They both have one ear up and the other ear down."), he was told, "Yes, that is correct." On the first two trials the experimenter gave tutored corrective feedback, and on later trials, the experimenter encouraged the subject to give self-corrective feedback. If the subject could not, or would not answer analytically, the experimenter continued to assist the subject.

<u>Condition 2</u>: Forced delay of response (15 seconds)

HVM - The procedure was the same as condition 1, except the subject was presented the wooden stimuli and was asked to explore the object until he heard a buzzer (15 seconds), and then remove his hands. The experimenter presented the visual array and the subject was instructed to delay the selection of a variant until he heard the buzzer (15 seconds). The first decision was accepted, and no corrective feedback or training in visual scanning was given. The experimenter said, "Point to the one that is just like the one you just touched, but before you tell me, think about it until you hear the buzzer. Then pick the right one -- the one that is just like this one." (The experimenter points to the box.)

CST (15 second delay) - The procedures were similar to condition 1. The subject was presented the test item and was asked which two belong together. The subject was required to think about his answer until he heard the buzzer. The first pairing was accepted.

Condition 3: Controls

The control subjects were randomly assigned to subgroups of four persons, and were read a story by the experimenter. This was done in order that the subjects in the control condition could interact with the experimenter for three sessions comparable to both treatment groups.

Session III - Training and posttest occurred four weeks after the pretest.

Part 1 - Training - The second training session followed the format of the first training session conducted during the prior week. Subjects were given the second sequence of the respective tests, HVM test followed by the second part of the CST.

Rest period - five minutes

Part 2 - Matching Familiar Figures posttest - The MFF posttest was administered in order to assess a change in conceptual tempo. Mean response time and mean errors were computed for each subject.

Results

The results were examined in the following sequence: (a) a comparison of 1st grade subjects' performance on the MFF test with that reported by Kagan and (b) a comparison of treatment effects for posttest latency and error scores.

The 82 first grade children were classified according to the median split for each sex. Girls (n = 37) had a mean response time of 15.58 seconds to the selection of the first variant and a mean number of total errors of 12.24. Boys (n = 45) had a mean response time of 15.33 seconds and a mean number of total errors of 12.12. There were no observable sex differences obtained on the two criterion variables, latency and error.

Insert Table 1 about here

Compared with the data reported by Kagan (1966a), the present sample of first graders showed a longer response time and made fewer errors. However, we must take into consideration that the present sample was tested in the last three months of the school year. We can expect the comparable developmental shift into the more reflective direction.

Table 1 makes a comparison between reflective and impulsive subjects. The mean response time and mean total errors for impulsive girls were 10.06 seconds and 18.21 errors. For impulsive boys, mean response time and mean errors were 8.62 and 18.85 respectively. For reflective girls, mean response time and mean errors were 22.74 and 7.07 respectively. For reflective boys, mean response time was 23.26 seconds and 5.93 errors. Kagan (1966 b) reported that impulsive children in grades 1-4 have mean response times between 4 and 10 seconds, and make about 15-20 errors. Reflective children have mean response times between 30 and 40 seconds; they make between 2 and 6 errors. The present sample of impulsive subjects approximates Kagan's impulsive group. The reflective subjects, however, showed comparable errors, but were not as reflective in response time. The data showed that the present sample of first graders were representative when one examines the reflective and impulsive groups. However, the sample also reveals that a larger percentage (32%) than is usually reported could not be classified.

The mean latency and error scores for each of the experimental conditions are shown in Table 2. An examination of the change scores for latency and errors reveals that both the forced delay and visual scanning groups showed increases in mean latency and decreases in mean error for the posttest situation. The control group's results showed that the change in errors and the change in latency were negligible. Due to nonhomogeneity of variance in the pretest data, a logarithmic transformation was performed on latency and error scores.

Product moment correlations between recognition errors and average response latency for the present sample reveals certain interesting trends. A comparison of the correlation between latency with errors on the pretest (-0.27) and the correlation between latency with errors on the posttest (-0.55) reveals an increase in negative correlation for the posttest situation. The posttest correlation reached the .01 level of significance. The latter correlation is more consistent with the range of negative correlations reported by Kagan. There was a significant negative correlation between latency difference and error difference (-.34). In other words, there was a tendency for an increase in latency to accompany a decrease in errors during the posttest situation. There was a significant positive correlation between latency on the pretest with latency on the posttest (.53). However, the same did not hold as strongly for the correlation between errors on the pretest with errors on the posttest (.24). Longer latency scores on the pretest were predictive of longer latency scores on the posttest; however, similar predictions did not hold for the error variable, for the correlation was not statistically significant. The predictive value of latency scores on the pretest and error scores on the pretest was reversed when we compare the correlation between the latency scores on the pretest with latency change (-.25) and the correlation between the error scores on the pretest with error change (-.54). Subjects who had higher error scores on the pretest tended to show the least change in errors on the posttest. However, the correlation between latency scores on the pretest was not significantly correlated with a change in latency.

Insert Table 4 about here

An analysis of covariance of the transformed latency and error data showed that adjusted mean latencies and mean errors on the pretest did not result in a significant difference in the change score that was attributable to experimental treatments or sex or interaction between the variables. See Tables 5 and 6.

The data on male subjects in contrast to the females, revealed trends which conformed to the hypothesis. A $\underline{t}$-test matrix for adjusted group means revealed that trained males showed a significant latency change compared to control males, $t = 2.59$, $p < .05$ (two-tailed). Forced delay males compared to control males approached significance in the adjusted group mean for the error variable, $t = 1.75$, $.10 > p > .05$, d.f. = 12. The data suggest that a larger n is needed in order to confirm the suggested trend toward the decrease in errors. Thus, the direction of the changes in error and latency was exactly in the direction of the hypotheses.

Latency increased and errors decreased for the respective experimental treatment groups in comparison to the control group.

Discussion

The present study raised the question: "Can specific techniques modify the less efficient problem solving and searching strategies of impulsive children?" A change in both characteristics of an impulsive conceptual tempo was stressed: increased response latencies and accuracy of solutions.

The results indicate a trend of increased response latency and decreased match-to-sample errors for both experimental groups. Both experimental groups, compared to the control group, modified impulsivity to some extent. With regard to the initial expectations of increased latencies, the resultant trends suggest a confirmation of this expectation. However, we hesitate to accept the notion of a differential effect on the error variable for the two treatment groups--forced delay of response and trained visual scanning. The sex X treatment effect showed no significant difference attributable to experimental treatments or sex. In other words, despite the indication of improvement, we cannot state that boys or girls improved due to a particular type of treatment; nor can we state that one particular treatment was more successful than another treatment. Individual differences were masked by the analysis given the adjusted group means for errors and latency. A closer examination revealed that trained males showed a greater latency change than control males. Also a decrease in errors seemed to have occurred with the increase in latency. The female subjects accounted for the increased variability of mean scores on the posttest. Support for the finding of increased response time accompanied by a decrease in errors comes from a study by Messer (1970). Also the more conforming data shown by males is suggested by Siegelman (1969).

Though the trends of the present data suggested an improvement in problem solving after experimental treatment, a comparison of the posttest data of the 42 impulsive subjects revealed that their error change and latency change were not comparable to the pretest data exhibited by the reflective subjects. Attentional strategies may, indeed, be deep-seated and established at an early age as is suggested by Siegelman (1969) and Reppucci (1970).

The finding that the present sample of subjects exhibited an increased negative correlation for pretest latency with error scores compared with posttest scores for latency and errors suggests the increased reliability of the MFF test. In other words, with increased experience with the MFF test, the subjects' preferred modes of problem-solving become even more evident.

The theoretical and empirical considerations of the increased correlation between errors and latency can also be discussed in terms of a critique of the present design. Ideally, the design should have incorporated an alternative form for the posttest MFF rather than a second administration of the original MFF. (Note: Two forms were not available from the originator of the MFF tests.) Perhaps this very consideration can account for the discrepancy found between scanning strategies for impulsive and reflective subjects in the Drake (1970) study and the Siegelman (1969) investigation. Siegelman used the same MFF form, and Drake used different forms for the pretest and the posttest situation; this may account for the discrepant findings. Indeed, if the posttest operational measure had been unique to the present sample of subjects, and had similar trends been found, we would urge even a stronger acceptance of the findings. Secondly, the size of the sample for each treatment group should be increased in order to override the effects of individual deviation from the means on both criterion variables--error and latency.

The relevancy of the problem of impulsive problem solving becomes evident. The inefficiency of search, the global examinations of alternatives, and the rapid selection of solution will continue to detract from the impulsive child's performance. The present study did not find an overall differential effect between the forced delay of response technique and the trained scanning technique, but both experimental manipulations did modify impulsivity to some extent. However, trained visual scanning is the preferred technique because previous studies have not been successful in decreasing errors when the forced delay paradigm was the only manipulation used. In view of other findings (Yando and Kagan, 1968; Kagan, 1966b), it seems reasonable to retain this theoretical interpretation. A follow-up study might incorporate an explicit training in visual scanning technique with a direct reinforcement paradigm, or even a vicarious reinforcement paradigm. It seems plausible that such a paradigm may be a viable solution for modifying an impulsive conceptual tempo. The accumulated data concerning reinforcement contingencies in the classroom (Yando and Kagan, 1968) and in experimental settings (Kagan et. al., 1966b; Debus, 1970; Baird and Bee, 1969), and the data concerning efficient scanning strategies (Siegelman, 1969; Drake, 1970) lend credence to this notion.

The necessity of improving problem solving skills becomes extremely important when we consider that past experience modifies expectancy of success (Reali and Hall, 1970). We can sympathize with the problems and the fears experienced by the child who continually blurts out wrong answers in the classroom. His classmates often laugh at him; his less tolerant teachers begin to ignore him. We might speculate that such experiences may lead to a loss in self-confidence and a formation of a failure set. Then a "Why should I even try" or "I don't care" attitude may become the predominant response. Inevitably this becomes detrimental to school performance. The significance to the educational process of attempting to develop techniques which could modify the child's impulsivity of response and his selective attention thus appear to be obvious.

TABLE 1

Comparison of Reflective and Impulsive

Subjects on MFF R-I Dimension

Group	Response Latency		Errors	
	Mean	S.D.	Mean	S.D.
Girls				
Reflective (R)	22.74	5.00	7.07	2.52
n = 14				
Impulsive (I)	10.06	2.68	18.21	6.57
n = 14				
Non-extremes (I*)	12.77	3.46	11.71	1.70
n = 7				
Boys				
Reflective (R)	23.26	9.56	5.93	2.81
n = 14				
Impulsive (I)	8.62	6.35	18.85	3.39
n = 13				
Non-extremes (I*)	14.90	4.06	15.75	4.52
n = 8				

TABLE 2

Measures of Central Tendency and Variability

for Matching Familiar Figures Test (MFF)

Impulsive Subjects by Condition

Group	Statistic	Pretest Latency (in seconds)	Pretest Error (Per 12 items)	Post Test Latency	Post Test Error	Change Scores Latency	Change Scores Error
Control n = 14	Mean	10.62	16.86	10.20	16.00	-0.42	-0.86
	S.D.	3.79	4.82	4.34	5.91	2.88	6.11
Forced n = 14	Mean	12.09	17.35	13.29	12.14	1.19	-5.21
	S.D.	4.40	5.60	5.45	5.68	2.78	6.40
Trained n = 14	Mean	10.25	16.36	13.65	12.78	3.40	-3.58
	S.D.	3.39	6.18	5.39	7.11	6.45	8.87
Total n = 42	Mean	10.99	16.86	12.38	13.64	1.39	-3.22
	S.D.	3.87	5.44	5.20	6.35	4.56	7.28

TABLE 3

Summary of Experimental Design

Experimental Group	Session I: Assessment of Reflection-Impulsivity Dimension	Session II: Experimental Treatments	Session III: MFF Post Test and Treatments
Reflective Ss n = 28	Administration of Matching Familiar Figures: MFF (12 items)	None	None
Trained visual scanning	Same	Training in scanning with corrective feedback (HVM and CST tests)	Training as before - Rest - MFF post test
Forced Delayed Response n = 14	Same	15 second delay of response (HVM and CST tests)	Delay as before - Rest - MFF post test
Controls n = 14	Same	None (Ss listened to stories in groups of four each)	Listened to stories - Rest - MFF post test

TABLE 4

Product Moment Correlations Among the Measures of Conceptual Tempo

for 42 Impulsive First Graders (MFF test)

Variables	Prelatency	Pre-errors	Post latency	Post errors	Latency diff.	Error diff.
Pre-latency	1.00	-0.27	0.53**	-0.22	-0.25	0.01
Pre-error	-0.27	1.00	-0.25	0.24	-0.06	-0.54**
Post latency	0.53**	-0.25	1.00	-0.55*	0.69**	-0.29
Post errors	-0.22	0.24	-0.55**	1.00	-0.44**	0.69**
Latency diff.	-0.25	-0.06	0.69**	-0.44**	1.00	-0.34*
Error diff.	0.01	-0.54**	-0.29	0.69**	-0.34*	1.00

Note: *p < .05, 40 d.f., .304

**p < .01, 40 d.f., .393

TABLE 4

Product Moment Correlations among the Measures of Conceptual Tempo for 42 Impulsive First Graders (MFF test)

	Pretest		Post Test		Differences	
Variables	Latency	Error	Latency	Error	Latency	Error
Prelatency	1.0000	-0.2694	0.5281	-0.2182	-0.2465	0.0111
Pre-error	-0.2694	1.0000	-0.2495	0.2427	-0.0560	-0.5351
Postlatency	0.5281	-0.2495	1.0000	-0.5514	0.6928	-0.2940
Post Errors	-0.2182	0.2427	-0.5514	1.0000	-0.4441	0.6897
Latency Diff.	-0.2465	-0.0560	0.6928	-0.4441	1.0000	-0.3449
Error Diff.	0.0111	-0.5351	-0.2940	0.6897	-0.3449	1.0000

TABLE 5

Analysis of Covariance for Latency Scores

Source	SS	d.f.	MS	F	
Mean	85.3112	1	85.3112	4.53	$p < .05$
Treatment	96.785	2	48.392	2.568	n.s.
Sex(s)	6.624	1	6.624	0.351	n.s.
T X S	37.257	2	18.629	0.9884	n.s.
Covariate I	45.577	1	45.577	2.4183	
Within	659.64	35	18.847		

TABLE 6

Analysis of Covariance for Error Scores

Source	SS	d.f.	MS	F	$p < .05$
Mean	252.53	1	252.53	6.53	n.s.
Treatment	123.11	2	61.55	1.59	n.s.
Sex(s)	42.08	1	42.08	1.08	n.s.
T X S	33.11	2	16.56	0.42	
Covariate 1	509.66	1	509.66	13.18	
Within	1353.20	35	38.66		

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Footnotes

[1]The school had a small black population. Only 10 of the original 92 first-graders were black (7 girls and 3 boys). The experimenter pretested all first graders, but due to the disproportionate percentage of black students, an adequate statistical and analysis could not be made. Therefore, the scores used were those of the reduced sample of 82 Caucasian subjects.

[2]Note the exception for the subjects in the control group.

[3]The non-extremes (I*) usually fell on the median for errors and/or time, or either had response time, or either had response times that were just over the median plus showed a great deal of errors. Non-extremes with low time and low errors were not included. For girls I* = 7. For boys I* = 8. One original impulsive boy transferred to another school.

[4]The original HVM materials were not available. The authors Kagan and Siegel gave permission to construct very similar materials appropriate for the subjects selected.