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ABSTRACT

The purpose of this study was to modify the conceptual tempo (response style on a reflective-impulsive dimension) by training impulsive children to increase their response latency or by teaching more effective search strategies and scanning techniques. Subjects were 169 second graders from two lower class area schools. Each subject was assigned to one of four groups: Sc-Search and scan, Ti-Delay responses, Ci-impulsive but given no training, Cr-randomly selected controls. Sc and Ti children were taught a series of match-to-sample discrimination tasks. The Ti group was trained to "think about answers and take time" before responding. The Sc group was trained to apply rules and basic strategies. All subjects had been pretested on a portion of the Matching Familiar Figures (MFF). As a posttest, eight unfamiliar MFF items were given individually and the remaining eight items were used 7-9 days later as a delayed posttest. Changes in response latency and number of errors from pretest to posttests were analyzed. Results indicate that the training received by Sc and Ti groups did affect response latency but did not have much effect on error scores. (WY)

Modifying Response Latency and Error Rate of Impulsive Children*

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A number of recent investigations have attempted to study and modify conceptual tempo of school-age children. Conceptual tempo refers to a response style on a reflective-impulsive dimension where the cognitively "impulsive" child typically responds more quickly in situations of high response uncertainty. The child who takes relatively longer to respond and makes fewer errors is cognitively "reflective" (Kagan, 1965a). One of the reasons for the current interest in attempting to modify conceptual tempo is because of the broad educational implications of being able to change the response pattern of impulsive children. It has been shown that the performance of reflective children is generally superior to that of impulsive children on tasks such as intelligence tests (Michenbaum and Goodman, 1969), reading (Kagan, 1965b) and inductive reasoning (Kagan, 1965a). Thus, modification of response patterns would appear to have significant educational value.

Various attempts to modify conceptual tempo have met with only moderate success. Kagan, Pearson and Welch (1966) looked at the differential effects of training under a typical tutoring situation and in a situation where the child was led to believe that he shared many common attributes with the tutor. The tutors emphasized inhibition of impulsive responses but did not teach more efficient scanning techniques. The results showed increased response latencies among impulsive first-grade children with no change in error scores. During the course of the school year, response latencies were increased for first-grade children who were taught by reflective teachers (Yando and Kagan, 1966).

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Debus (1970) attempted to modify conceptual tempo by having impulsive Ss observe several patterns of model behavior with associated differing reinforcement contingencies. Several groups showed temporary increases in response latency; however, error scores were not effected by any of the experimental treatments.

The above studies suggest that it is quite possible to modify the response latency of impulsive children, but unfortunately increased response time has not resulted in a corresponding reduction in errors. It is important to point out that these studies have concentrated primarily on increasing response latency without giving much attention to reducing errors by attempting to improve scanning strategies. The purpose of the present study is to determine if impulsive Ss can be taught more efficient search strategies and scanning techniques and to compare such a group with impulsive Ss who have been trained to increase their response latency.

Siegelman (1969) and Drake (1970) examined how reflective and impulsive Ss deploy attention and organize visual search during the preresponse period. Their findings provide valuable information for developing training approaches for more effective search strategies. Siegelman (1969) found that impulsive Ss ignored two and one-half times as many alternatives on a match-to-sample visual discrimination task. Impulsive Ss devoted proportionately more time in looking at the most observed alternative, and in looking at the alternative finally chosen. The broad difference between the reflective and impulsive S is that the reflective S differentiates the components of the alternative, compares these components, and consults the standard to determine if the property is the same or different from that of the standard. On the other hand, the impulsive S compares the alternative globally with the standard and attempts to eliminate or confirm the alternative on a global basis. Using a small sample of third-grade children and undergraduate college students Drake (1970) found

that the differences between impulsive and reflective Ss depended on the S's age. Impulsive adults used search strategies similar to reflective children. Drake's results were somewhat similar to Siegelman's in that the most efficient search strategy seemed to be one in which the S looked at the distinctive feature of each alternative and then referred to the standard to determine the correct form of each feature. The alternatives that deviated from the standard in the particular feature being studied were eliminated. This process of elimination of alternatives based on differences of distinctive features was continued until all the alternatives except the correct one remained.

In the present study, an approach based largely on the findings of Drake (1970) and Siegelman (1969) was used to teach impulsive Ss more effective search strategies. A second group of impulsive Ss were taught to delay responses for at least 10-15 seconds, but were not told how to use this time for more effective problem solving. A third group of impulsive Ss served as one control group and a random sample of Ss not included in the sample of impulsive Ss served as a second control group. The differential effects of treatment were examined in terms of changes in response latency and error scores on Kagan's Matching Familiar Figures test.

METHOD

Subjects

A group of 169 second-grade Ss from two schools serving lower class areas were given the Matching Familiar Figures (MFF). The MFF is a match-to-sample visual discrimination task in which a picture of a common object is shown along with six similar variants. The Ss must select the one variant that is exactly like the standard. The S's response latency (to the first response) and number of errors made before the correct response are the major variables

studied. Eight items selected from the 24 items comprising Forms F and S of the MFF were used in the initial testing.

Sixty impulsive Ss -- 36 boys and 24 girls -- were selected from the total sample on the basis of fastest response time and greatest number of errors. All the impulsive Ss were above the median on the number of errors and below the median on response latency. Twenty impulsive Ss each were randomly assigned to one of three groups: a group trained to improve search strategies and scanning techniques (Sc - group); a group trained to delay responses at least 10-15 seconds (Ti- group); a control group of impulsive Ss receiving no training (Ci- group); and a second control group of Ss (Cr- group) selected at random from the pool of Ss not included in the Sc-, Ti-, or Ci- groups.

Training and Materials

Children in the two experimental conditions were taught in groups of four by the senior author and an advanced graduate student. The training sessions for each group consisted of four 30-minute sessions during a seven day period.

The training materials, which consisted of a series of match-to-sample visual discrimination tasks similar in format to the MFF were the same for the Sc- and Ti- groups. The figures were geometric designs ranging from simple items consisting of a standard and two alternatives to difficult items consisting of a complex design with six difficult-to-discriminate alternatives. Geometric designs were used because it was felt that they were best suited to an analysis of component parts which was part of the procedure for teaching the appropriate scanning techniques. The type of match-to-sample discrimination item used in the final two training sessions consisted of a nonsense word as the standard and six highly similar nonsense words as alternatives. Two exercises that generally followed the discrimination task were: 1) Ss were required to describe how the alternative differed from the standard, then they

corrected the alternatives that deviated from the standard and: 2) Ss were shown the standard for 10 seconds and asked to draw it from memory.

Other materials and exercises used for the two experimental groups involved an inductive reasoning task where an object was described to the Ss and they were to hypothesize as to what object was being described. For example, Ss were told, "What is round, grows on a tree, is red and you can eat it." If the Ss were not certain what object was being described additional clues were given. A "similarities and difference" task was used during the first two training sessions. Here the Ss were given two objects and asked to tell how they were different and how they were the same.

Ti-group training. Initially the Ss were shown some examples of the kind of work they would be doing during the four sessions. They were told that it was important not to make any mistakes, especially by guessing foolishly. It was explained that one way of increasing the likelihood of getting a correct answer was to "think about your answers and take your time." To practice this principal Ss were told to take at least 10-15 seconds before giving their answer. One of the tutors timed the Ss to make sure that the specified amount of time had passed before they responded. The Ss were constantly reminded to take their time, and whenever a S responded before the elapsed time the response was ignored.

Sc-group training. After presenting examples of the tasks, the Ss were told that by following certain rules, it would be easier to correctly solve the problems. Each rule was carefully explained, demonstrations of how to apply the rule were given by one of the tutors, and the Ss applied the rule in solving one of the problems. Following are the rules and basic strategies the Ss were taught to use in solving the match-to-sample discrimination task:

1) The $\underline{S}$s were told to look at the standard and <u>all</u> the alternatives. This would appear to be quite obvious, however, as reported in the introduction, impulsive $\underline{S}$s tend to globally analyze only a few of the alternatives and make their decision on the basis of this limited information.

2) The critical design features of the alternatives were abstracted by looking at certain components or details in all the alternatives. This principal just involved breaking the alternatives down into component parts.

3) One component was selected and comparisons across all alternatives were made. $\underline{S}$s were told to look for similarities and differences across alternatives on the component being studied.

4) Once differences in component parts across all alternatives were noted then the $\underline{S}$s were told to check the standard to determine the correct forms of the component part. Alternatives that deviated from the standard on the particular component being studied were successively eliminated.

5) The process of successively eliminating alternatives based on an analysis of component parts was repeated until only the correct alternative remained.

<u>Data Analysis</u>.

Of the 16 items of the MFF not used in the pretesting, eight were used for immediate posttesting (IPT) and the remaining eight items were used in the delayed posttest (DPT). The IPT was done the day after the final training session and the DPT was done 7-9 days after the IPT. The control groups were tested at the same intervals. The administration of the MFF was done by a male graduate student who was unaware to which group the $\underline{S}$ belonged. The testing was done individually in a quiet testing room outside the classroom.

A 4 x 3 repeated measures ANOVA was used to analyze changes in response latency and number of errors from pretest to IPT to DPT.

Results

The response latency and error scores at pretest, IPT and DPT for the

four groups are reported in Table 1. The repeated measures ANOVA showed significant main effects across testing trials for response latency ($F = 39.17$, $df = 2/152$, $p < .001$) and for error scores ($F = 26.73$, $df = 2/152$, $p < .001$). The treatment X trials interaction approached significance for response latency ($F = 2.13$, $df = 6/152$, $.05 < p < .06$) and was significant for error scores ($F = 3.45$, $df = 6/152$, $p < .01$). Since the interactions were significant or approached significance the analysis of variance for simple main effects was carried out separately for each treatment condition.

The analysis of changes in mean scores for each group showed that the important effects of treatment were to significantly increase response latency without a corresponding reduction in error scores. The error rate for the Sc- group stayed at the same level on IPT and DPT whereas the other groups showed significant increases in errors from pretest to DPT.

The training of the Ti-group to defer responses at least 10 seconds, did not have as much effect on response latency as did the training received by the Sc-group. All groups showed significant increases in response latency from pretest to IPT and DPT, but the increase at DPT for the Sc-group was significantly greater than the increase for the Ti-group when both groups were compared to the control group. The mean response latency at DPT for the Sc-group was significantly greater than the mean for the Ci-group ($F = 8.26$, $df = 3/228$, $p < .05$). There was no significant difference between the means for the Ti- and Ci-groups at DPT. ($F = 1.28$, $df = 3/228$). Training impulsive Ss to defer responses did increase response latency, but it was not as effective in increasing response latency as training impulsive Ss more improved search strategies.

The main purpose of training the Sc-group was to reduce the number of errors by providing impulsive Ss with more efficient and effective search

strategies in solving a match-to-sample visual discrimination problem. The results indicate that the training for the Sc-group met with only partial success. The Ti- and Ci- groups showed significant increases in errors on DPT, and the Cr-group showed a significant increase on IPT and DPT. However, the Sc-group continued to make the same number of errors on IPT and DPT. The Sc-group made the fewest errors on DPT compared to the other three groups.

Conclusions

The purpose of the present study was to modify conceptual tempo by either training impulsive Ss to defer responses or by training more effective search strategies and scanning techniques. The training received by the Sc- and Ti- groups did effect response latency but this did not have much effect on error scores. The Ti- and Ci-groups showed significant increases in errors on the DPT and the Cr-group showed a significant increase on the IPT and DPT. The increase in response latency without a corresponding decrease in error scores is consistent with the results of past research (Kagan, Pearson and Welch, 1966; Yando and Kagan, 1966; and Debus, 1970). The findings from past research and the Ti-group of the present study indicate that impulsive Ss can be trained to increase response latency but that during this increased response time they continue to use the same approach in solving a match-to-sample visual discrimination problem regardless of how long they take to respond. During the training of the Ti-group it was obvious that they continued to make their decisions very quickly even though they could not respond for at least 10 seconds. They did not use this 10 second period to study the problem differently or to check their hypothesis against other alternatives. The crucial variable in impulsive behavior does not seem to be the amount of time the S takes to respond but rather the strategy the S uses in solving the problem. It is interesting to note that for the entire sample of Ss who were pretested with the 8 items of the MFF the correlation between response latency

and errors was .35.

The present study was the first attempt to directly change the approach and strategy used by impulsive Ss in solving match-to-sample visual discrimination problems. Training the Sc-group in more efficient search strategies and scanning techniques resulted in a significant increase in response latency which was greater than the increases found for the other groups. The Sc-group did not show any change in error score. The fact that the Sc-group was the only one not to show an increase in errors at least suggests that their training did have some effect on the approach used in solving the MFF.

Subjectively it was quite apparent that the children in the Sc-groups learned the "reflective" strategy for solving match-to-sample problems. Their comments indicated how much easier it was to solve problems using this strategy and as the training progressed they made fewer errors on the practice exercises. It was interesting to note that on the difficult problems they encountered during training they would revert back to an impulsive way of responding. It appeared that these Ss had learned to respond in an impulsive fashion especially in situations where they anticipated failure. On easier tasks the children in the Sc-groups would respond in a more reflective fashion but when they anticipated difficulty they would globally scan a few of the alternatives and select the first one that appeared reasonable.

It is difficult to draw any definite conclusions regarding changes in error scores since the Cr-group showed significant increases in errors on the IPT and DPT and the Ti- and Ci-groups showed significant increases on the DPT. The forms of the MFF used for IPT and DPT were apparently more difficult than the form used for pretesting. Six of the eight items used in the IPT and DPT were from Kagan's Form S of the MFF. Form S is the less widely used version of the MFF

and apparently is more difficult than Form F. Since the forms of the MFF used for posttesting were more difficult it is quite possible that the Sc-group, as was subjectively observed during training, reverted back to an impulsive way of responding on the difficult items of the posttests. During training the Sc-group understood the strategy they were being taught and they had ample opportunity to practice this strategy. It is quite possible, however, that when faced with the difficult items of the posttests they quickly forgot their "reflective" strategy and instead responded in an impulsive fashion.

In conclusion, it is important to ask whether or not Ss who learn a reflective strategy can apply it to a variety of problem situations that require a choice among several alternative responses. Being able to change impulsive behavior has obvious educational implications as well as theoretical importance. Kagan, Rosman, Day, Albert and Phillips (1964) suggest that an antecedent to impulsive response style is constitutional predisposition; Drake (1970) suggests a developmental sequence from the impulsive child's strategy to the reflective adult's orientation. As yet, attempts at modification of impulsive behavior have not had much relevance to an educational setting nor have they been of much value in clarifying various theoretical considerations. Further attempts at modifying impulsive behavior are needed with particular emphasis placed on directly training Ss in more efficient search strategies and scanning techniques.

Table [illegible]

Mean Response Latency and Error Scores on MFF

Groups N=20	Response Latency (Seconds)			Error Scores		
	Pretest	[illegible]	[illegible]	Pretest	[illegible]	[illegible]
Scanning						
Mean	36.0	84.6*	105.6**	10.1	9.7	11.2
SD	9.7	43.0	72.2	4.2	3.6	5.0
Time						
Mean	37.8	86.[illegible]**	86.3**	9.3	10.2	14.2**
SD	9.6	40.7	6[illegible].3	3.7	3.4	4.7
Controls-Impulsive						
Mean	43.8	74.2**	6[illegible].5*	9.2	11.6	13.2*
SD	11.3	40.[illegible]	38.[illegible]	2.8	5.7	4.2
Controls-Reflective						
Mean	89.3	155.[illegible]**	128.5*	5.7	11.2**	13.5**
SD	52.2	86.9	78.3	3.8	4.9	5.6

Note: Means based on the total scores for the 8 items of the MFF

* significant increase from pretest, $p < .05$.

** significant increase from pretest, $p < .005$.

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