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ABSTRACT

The purpose of this study was to explore the concept of impulsivity as a stylistic dimension affecting cognitive behavior, and whether impulsivity operates as a comprehensive, inflexible orientation in low achievers more than in high achievers. The Matching Familiar Figures Test, the Porteus Maze Test, and the Stroop Color-Word Test were used to assess impulsivity in 240 lower class, disadvantaged, third and fifth grade children. Analysis of variance and of covariance with IQ control were used to study the effects of achievement, age, and instructional sets; correlational analysis was used to examine the relationship between test indices. Among the conclusions of the study were that: (1) low achieving lower class boys are more impulsive in their approach to cognitive tasks than are high achieving lower class boys; (2) cognitive tasks could be temporarily modified by instructions, but such modification does not necessarily result in changes in performance level; (3) low achievers were found to be more consistent in style than high achievers, but there was no evidence to support the hypothesis that the former were more inflexible in approach than the latter; (4) there was moderate consistency in style of approach to cognitive tasks as measured by the tests; and (5) no over-all differences in style were found between the age-grade groups. (RJ)

Final Report

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A Study of Impulsivity in Low-Achieving and High-Achieving Boys from Lower Income Homes

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May 1969

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I--PROBLEM AND BACKGROUND

One of the most pressing problems in education today is the high percentage of school failure among lower class, inner-city children. The question of how to teach tne "culturally deprived" slum child more effectively has been one of the major topics at important educational conferences throughout the past few years, and every week new books and articles are published on this topic. Yet in spite of all this activity, achievement levels have improved little. There is still a large gap between the achievement levels of these children and their middle class counterparts, and this gap progressively widens throughout the school years.

A number of mediating variables have been proposed to explain the differences in achievement between lower and middle class children, e.g., motoric vs. conceptual style;[1] present time orientation vs. future time orientation;[2] attention; achievement motivation; linguistic codes;[3] genetically based differences in intelligence.[4] Among the variables proposed is impulsivity--an impulsive vs. reflective disposition or style. Kagan writes:

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[1] Daniel R. Miller & Guy E. Swanson, Inner conflict and defense. New York: Holt, 1960.

[2] Martin Deutsch, The disadvantaged child and the learning process. In A. Harry Passow (Ed.), Education in depressed areas. New York: Teachers College, Bureau of Publications, 1963. Pp. 163-179.

[3] Basil Bernstein, Language and social class. British Journal of Psychology, 1960, 11, 271-276.

[4] Arthur Jensen, Social class, race, and genetics: implications for education. American Educational Research Journal, 1968, 5, 1-42.

> Some children act first and discover later if they were correct; others reflect before responding, eliminating potentially incorrect answers mentally. The importance of this subtle cognitive process may not be fully appreciated. An impulsive approach to problem solving is likely to be associated with the execution of solution hypotheses that are incorrect.... The anxiety resulting from repeated failure, as a consequent of impulsive reporting, could lead to generalized expectations of failure and withdrawal of involvement from intellectual tasks.[1] Investigators working with 'culturally deprived' children believe that one reason for their poor performance is their impulsive orientation.[2]

Davids and Sidman conclude from their research that:

> ...underachievers are less able to comply with instructions that require them to work in a slow, methodical, stable manner. That is, they are unable to inhibit their motor activities and they respond in an impulsive manner when the situation calls for control and inhibition.... To succeed in school situations one must inhibit certain behaviors and exert considerable control over natural impulsive tendencies.[3]

While there is considerable indirect support for the theory that impulsivity plays an important role in the poor performance of lower class children, there is little direct research evidence to support this view. In addition, one can find descriptions of the deprived child as slow and cautious in his approach to cognitive tasks, in contrast to his

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[1] Jerome Kagan, Bernice L. Rosman, Deborah Day, Joseph Alpert, and William Phillips, Information processing in the child: significance of analytic and reflective attitudes. Psychological Monographs: General and Applied, 1964, 78, (1), 1-37, P. 13.

[2] Jerome Kagan, Reflection-impulsivity: the generality and dynamics of conceptual tempo. Journal of Abnormal Psychology, 1966, 71, 17-24, P. 24.

[3] Anthony Davids & Jack Sidman, A pilot study--impulsivity, time orientation, and delayed gratification in future scientists and in underachieving high school students. Exceptional Children, 1962, 29, 170-174, P. 173.

more usual quick pace and decision making style.[1] The present study was therefore designed to experimentally examine the hypothesis that there are differences between low-achieving and high-achieving lower class boys on an impulsive-reflective dimension. More specifically, it is hypothesized that the low-achieving boys will exhibit more impulsivity than the high-achieving boys, and that impulsivity will operate as a comprehensive, inflexible orientation to a greater extent in the low-achieving group than in the high-achieving group.

The Concept of Impulsivity

What is impulsivity? Impulsivity can be viewed as a stage in development, as a situational response, and as a trait or characteristic style of response.

Immediacy of response to stimulation--lack of mediation--is a characteristic of relatively primitive organisms. Thus Hunter's 1913 study[2] showed that animals were distinctly inferior to young children on problems involving delayed responses. Luria[3] found that the higher mental processes, particularly speech, are important to the inhibitory process, and that the neurological basis for this connection is not fully established until three and one half to four years of age. Verbal instructions

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[1] Frank Riessman, The culturally deprived child. New York: Harper, 1962.

[2] Walter S. Hunter, The delayed reaction in animals and children. Behavior Monographs, 1913, 2, 1-86.

[3] A. R. Luria, Verbal regulation of behavior. In Celia Stendler (Ed.), Readings in child behavior and development. New York: Harcourt, 1964. Pp. 392-403.

can act as release mechanisms for children below this age, but can not act as inhibiting mechanisms for actions already begun. Similarly, Diamond[1] proposes that impulsiveness is a reflection of inadequacy of inhibitory processes based on physiological limitations in young children or brain-injured individuals.

Psychoanalysts and ego-psychologists speak of impulsiveness as a developmental phenomenon or milestone, reflecting an early stage in the growth of the ego.[2] Impulsiveness is drive or impulse unmediated by reality demands. It is behavior ruled by primary processes. The impulsive child's thinking is dominated by the demands of drive-satisfaction. Development of the regulative controls which make possible the delay and modulation of need is minimal. While impulsiveness is a normal state in the young child, it is a pathological symptom when it persists unabated past the early childhood years. In the older child or adult it signifies retardation or arrest in ego development. Thus Fenichel[3] speaks of an impulse neurosis--the person is intolerant of tension and must satisfy his needs immediately; he acts instead of thinking. Other psychoanalysts speak of an impulsive psychopathic character,[4] who manifests disturbance

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[1] Solomon Diamond, Richard S. Balvin, & Florence Diamond, Inhibition and choice. New York: Harper & Row, 1963.

[2] Jane Loevinger, The meaning and measurement of ego development. American Psychologist, 1966, 21, 195-206.

[3] Otto Fenichel, The psychoanalytic theory of neurosis. New York: Norton, 1945.

[4] Joseph J. Michaels & Irene Stiver, The impulsive psychopathic character according to the diagnostic profile. In Ruth S. Eissler, Anna Freud, Heinz Hartmann, & Marianne Kris (Eds.), The psychoanalytic study of the child. Vol. 20. New York: International Universities Press, 1965. Pp. 124-141.

in inhibition, difficulty in control, an orientation towards immediate need satisfaction, and anti-social behavior.

Impulsivity may be conceived of as an attempt at quick solution in order to avoid or escape from an anxiety provoking situation.[1] The person cannot tolerate the uncertainty and tension of the period of circumspection which normally intervenes between the presentation of a problem and its solution. The relationship of anxiety to impulsivity seems, however, to be more complex in its effect upon the nature of response to problems than the above view implies. Experimental data point to differential effects of high anxiety, with impulsivity sometimes the result, and high cautiousness sometimes the result. In children anxiety appears to lead to cautiousness more often than to impulsivity.[2]

Impulsivity is most often conceived of as a trait, or characteristic style of expression, which may have both cognitive and affective aspects. Several factor analytic studies have identified traits which may be seen as representing impulsivity. Thus Guilford[3] finds a dimension which he labels impulsiveness vs. deliberateness, with impulsiveness seen as the tendency to react promptly without thinking, to act on the spur of the moment without prior planning. Barratt[4] finds a trait of impulsivity

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[1] George Kelley, The psychology of personal constructs. Vol. 1. New York: Norton, 1955.

[2] Seymour B. Sarason, Kenneth S. Davidson, Frederick F. Lighthall, Richard R. Wait & Britton K. Ruebush, Anxiety in elementary school children. New York: Wiley, 1960.

[3] J. P. Guilford, Personality. New York: McGraw-Hill, 1959.

[4] Ernest S. Barratt, Factor analysis of some psychometric measures of impulsivity and anxiety. Psychological Reports, 1963, 16, 547-554.

which is made up of speed in cognitive response, acting without thinking, lack of persistence, adventure seeking and high risk taking. Cattell[1] speaks of a factor of inhibition which may be seen as the polar opposite of impulsivity, and which consists of deliberateness in perception and judgment, caution and slow reaction time in complex situations.

A cognitive control principle of inhibition is postulated by Gardner.[2] He cites evidence such as the following to support this idea. Inhibition of irrelevant responses on the Stroop Color-Word Test is related to inhibition in estimating the length of short time periods, inhibition of the effect of need upon cognition, and extensive scanning preceding response on a cognitive judgment task. A cognitive control principle is a mediating structure which guides the expression of drive in response to classes of adaptive requirements.

Kagan describes an impulsive vs. relective style dimension which he found to be extremely important in understanding differences in cognitive performance in children.

> ...there has been a tendency to ignore the relevance of differences in two aspects of information processing--differences in the degree of stimulus analysis that precedes initial coding, and the degree of reflection attendant upon classification and hypothesis selection. It now appears that children and adults have clear preference hierarchies with respect to these two variables.[3]

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[1] Raymond B. Cattell, Neuroticism and anxiety. New York: Ronald Press, 1961.

[2] Riley W. Gardner & Robert I. Long, Cognitive controls of attention and inhibition: a study of individual consistencies. British Journal of Psychology, 1962, 53, 381-388.

[3] Jerome Kagan, Developmental studies in reflection and analysis. In Aline Kidd & Jeanne Rivoire (Eds.), Perceptual development in children. New York: International Universities Press, 1966, Pp. 487-524. P. 488.

Kagan states that impulsivity may have both physiological origins, e.g., a constitutionally based tempo variable, or subtle brain damage, and psychodynamic origins, e.g., low anxiety over failure.[1]

Relevant Research

Several studies have sought to test associations between various forms of behavior thought to reflect impulsivity. These studies point to a low positive relationship between self-report or observational scale responses such as lack of planning, high risk taking, high activity level, high aggressive expression or known delinquent behavior; and poor performance on motor inhibition tests, poor estimation of short time intervals, poor performance on maze tests, and low future orientation.[2, 3, 4]

In a study of high-achieving and low-achieving high school boys of superior intellectual ability, Davids and Sidman[5] found that the high

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[1] Jerome Kagan, Biological aspects of inhibition systems. American Journal of the Diseases of Children, 1967, 114, 507-512.

[2] Julian Metzoff, The relationship between motor and cognitive inhibition. Journal of Consulting Psychology, 1954, 18, 355-358.

[3] Aron Siegman, The relationship between future time perspective, time estimation, and impulse control in a group of young offenders and in a control group. Journal of Consulting Psychology, 1961, 25, 470-475.

[4] Stanley D. Porteus, Porteus maze tests: fifty years application. Palo Alto: Pacific Books, 1965.

[5] Davids & Sidman, Exceptional Children, 1962, 29, 170-174.

achievers: showed better motor inhibition; were more future oriented; tended less to seek immediate gratification. They interpreted these differences in impulsive vs. controlled and inhibited manner as probable causal factors in the achievement differences between the two groups. In a later study with the same subjects Davids[1] reports that the low achievers had significantly shorter response latencies on ambiguous picture tests. The mean I.Q. of the high achievers in these studies was 130, while that of the low achievers was 128.

Sarason,[2] in a study on anxiety in children, found a factor which he labeled cautiousness to have a significant effect upon performance. On the Witkin Embedded Figures Test when the children were told that they could study the simple figure as long as they wanted to without penalty, one group of children spent a great deal of time referring back to the simple figure before venturing a guess. These children had significantly fewer errors than children who spent little time on the standard and began guessing almost immediately.

Schwebel[3] was interested in the effects of impulsivity on performance in middle and lower class children. He hypothesized that there is a tendency towards impulsivity in lower class children and that this characteristic is a causal factor in social class language differences. He constructed and administered several language tests to middle and

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[1] Anthony Davids, Cognitive styles in potential scientists and in underachieving high school students. Journal of Special Education, 1968, 2, 197-201.

[2] Sarason, Anxiety in elementary school children.

[3] Andrew Schwebel, Effects of impulsivity on performance of verbal tasks in middle-and-lower class children. American Journal of Orthopsychiatry, 1966, XXXVI, 13-21.

lower class boys. On half of the test items the subjects were forced to wait fifteen seconds before responding. On the other half they were allowed to respond according to their own natural tempos. The middle class boys did better on all tests, as expected. However, under forced long latency conditions the performance of the lower class boys improved significantly, while the performance of the middle class boys did not.

Kagan[1, 2, 3, 4, 5, 6] has done most of the research which attempts to directly relate impulsivity and quality of cognitive performance in young children. His primary index of impulsive (vs. reflective) disposition is response latency, on tasks with response uncertainty and the simultaneous availability of alternative responses, where long response latencies are associated with less errors. In his later studies he focused on two sub-groups within his samples--those children who were below the median on latency and above the median on errors (impulsives), and those children who were above the median on latency and below the median on errors (reflectives). Kagan offers considerable evidence to

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[1] Kagan, Psychological Monographs, 1964, 78, 1-37.

[2] Jerome Kagan, Impulsive and reflective children. In John D. Krumboltz (Ed.), Learning and the educational process. Chicago: Rand McNally, 1965, Pp. 133-161.

[3] Jerome Kagan, Individual differences in the resolution of response uncertainty. Journal of Personality and Social Psychology, 1965, 2, 154-160.

[4] Jerome Kagan, Reflection-impulsivity and reading ability in primary grade children. Child Development, 1965, 36, 609-628.

[5] Jerome Kagan, Leslie Pearson & Lois Welch, Conceptual impulsivity and inductive reasoning. Child Development, 1966, 37, 583-594.

[6] Kagan, American Journal of the Diseases of Children, 1967, 114, 507-512.

support the generality and stability of an impulsive disposition in children of elementary school age. Using as his impulsivity measures several tests which he constructed, Kagan found impulsivity to be associated with: high word recognition errors; high intrusion errors on a serial learning task; high errors on inductive reasoning tasks; poor scores on the Bender-Gestalt Test; poor reproduction of incongrous figures which had been described adequately; more relational groupings and fewer analytic groupings on a categorizing test; low selection and persistence at difficult tasks; greater restlessness and distractability. These differences were present in spite of matching or equating for verbal ability. While error scores on the various measures of impulsivity had a low negative relationship to verbal I.Q., decision time was found to be unrelated to verbal I.Q. A correlation of .81 to .97 was found between response latencies and head-eye fixations of the standard, indicating that the children labeled reflective were actually considering alternative answers during the period before first response. When children's eye movements were photographed for the first six seconds of exposure to each test item, it was found that impulsive children spent less time studying the standard and made fewer comparisons of homologous areas of the variants.

A study by Kagan, Pearson and Welch[1] raises questions about the previous findings as to the important role which response speed plays in

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1 Jerome Kagan, Leslie Pearson & Lois Welch, The modifiability of an impulsive tempo. Journal of Educational Psychology, 1966, 57, 359-365.

cognitive performance on the kind of tasks used by Kagan. Impulsive children in the first grade were exposed to three training sessions where long response latencies were encouraged on matching and inductive reasoning tasks. The children were instructed to study the alternatives and to think about their answers for a period of 10 or 15 seconds before responding. Pre-training and post-training performance on Kagan's Matching Familiar Figures Test was compared. The only significant effect of the training was to lengthen the response latencies. There was no significant difference between pre-training and post-training error scores in spite of the longer latencies.

In a more recent piece of research Yando and Kagan[1] studied the effect of teacher tempo on impulsivity in first grade children. Impulsive and reflective first grade teachers in an Ohio school system were identified on the basis of an adult version of Kagan's Matching Familiar Figures Test. Children randomly selected from the class lists of the impulsive and reflective teachers were given the children's version of the Matching Familiar Figures Test in the fall and again in the spring. While there was no difference between the performance of pupils of impulsive teachers and pupils of reflective teachers in the fall, in the spring the pupils of reflective teachers had significantly longer latencies on Kagan's test. However, no difference was found between the groups on number of errors.

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[1] Regina M. Yando & Jerome Kagan, The effect of teacher tempo on the child. Child Development, 1968, 39, 27-34.

In a study of the impulsive-reflection dimension in kindergarten children, Ward[1] found consistencies in response latencies on the five tests administered even though some of the tests were given in an evaluation-laden atmosphere and others were given in an evaluation free context. The five tests used were the Matching Familiar Figures Test in two different versions, two forms of the Peabody Picture Vocabulary Test, and a "Dots" test. Thus, this study appears to show that situational anxiety is not an important influence on response latencies.

Palkes, Stewart and Kahana,[2] in a study using middle class hyperactive boys as the subjects, found that impulsivity could be reduced by training. The measures of impulsivity used were the Test Quotient and Qualitative score on the Porteus Maze Test. The training consisted of having the subjects read reflective instructions out loud before each item on the Matching Familiar Figures Test, the Embedded Figures Test, and the Trail Making Test.

Questions for Investigation

The major questions to be addressed in the current study are whether low-achieving boys are more impulsive than high-achieving boys, and whether impulsivity operates as a comprehensive, inflexible orientation to a greater extent in the low-achieving group than in the high-achieving group. More specifically, this study seeks to determine: (1)

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[1] William Ward, Reflection-impulsivity in kindergarten children. Child Development, 1968, 39, 867-874.

[2] Helen Palkes, Mark Stewart & Boaz Kahana, Porteus Maze performance of hyperactive boys after training in self-directed commands. Child Development, 1968, 39, 817-826.

Are there consistencies in impulsive (vs. reflective) style of response across a variety of cognitive tasks? (2) What are the effects of instructional sets designed to induce a reflective or impulsive style of response, upon response speed and level of performance? (3) What is the relationship of impulsivity to age? (4) How is impulsivity related to achievement?

II--METHOD

Subjects

The subjects of this experiment are 240 boys, 120 in the fifth grade and 120 in the third grade. The sample is comprised of boys whose I.Q.'s fall in the range of 85 to 115. The subjects were obtained from two schools which serve inner-city lower class families. The mean age of the third grade subjects at the beginning of testing was 103.3 months with a standard deviation of 10.7. The mean age of the fifth graders at that time was 127.4 months, with a standard deviation of 13.4.

Rationale for the Sample Selection

Boys were chosen for study because they contribute more to the low achievement of the lower class group than do girls, and because impulsivity is more often attributed to boys than to girls.

Two age groups were used because it is conceivable that an impulsive-reflective style dimension plays a significant role in cognitive performance at one stage of development and not at another. A major change in thinking appears to take place at seven years of age.[1] Almy[2] recently found that this change comes at a later age in lower class children. The fifth grade sample was selected because it is the highest

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[1] Jean Piaget, The child's conception of number. London: Routledge & Kegan Paul, 1952.

[2] Millie Almy, Young children's thinking. New York: Teachers College Press, 1966.

grade level in the schools used. The third grade sample was selected (in preference to a second grade sample) because pilot work with low-achieving lower class boys convinced the experimenter that none of the tests being considered for use would be productive with this age group, even though they had been used with middle class children as young as age five.

Extremes of the I.Q. distribution were eliminated in order to limit differences in achievement and in performance on the tests used in this study which could be explained on the basis of general ability.

Socio-Economic Status

Most measures of socio-economic status include education, residence and income or occupation. The designation "lower class" which was used in this study is made primarily on the basis of information from the 1960 census study. Of all the census tracts included either partially or totally within the areas serviced by Schools A and B, most fall into the lowest quartile on income, educational level and employment; a few fall into the lowest quartile on only two of these criteria. Boys who resided in the one census tract serviced by School B which did not fall into the lowest quartile on at least two criteria were eliminated as potential subjects. Most of the housing in the areas serviced by Schools A and B received a "delapidated" rating on the 1960 census. Direct observation by the current investigator led to the conclusion that virtually all of the housing in the area of School A and most of the housing in the area of School B could be assigned to the lowest category on the six point

residence scale of the Hollingshead Index of Social Position.[1] The ethnic composition of School A is approximately 70 percent Negro and 30 percent Puerto Rican. The ethnic composition of School B is approximately 90 percent Negro and 10 percent Puerto Rican and others.

School A is located within the Brownsville Model Cities Area. School B borders on the Bedford-Stuyvesant Model Cities Area.

Low Achievers and High Achievers

The achievement designation is based on the reading score of the Metropolitan Achievement Test administered in April 1967, when the younger group was in the second grade (grade level 2-8) and the older group was in the fourth grade (grade level 4-8). This score was used because it is the only standardized achievement measure available for all children in New York City elementary schools. As such, it is the index used by the New York City school system to evaluate the results of educational programs and to make decisions about future programs. Thus, in spite of the limitations of group tests for evaluating achievement in lower class children, it appeared that the Metropolitan Achievement Test reading score was an appropriate index.

High achievers are those boys whose scores fall above the median for the total grade population of the two schools; low achievers are those boys whose scores fall below the median. Before combining populations from the two schools the median achievement scores were computed separately, so as to rule out the possibility of large differences between

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[1] August B. Hollingshead & Frederick C. Redlich, Social class and mental illness. New York: Wiley, 1958.

the two schools. On the fifth grade level the median achievement scores of the two schools were 3.1 and 3.3 for Schools A and B respectively. On the third grade level the median achievement scores of the two schools were 2.2 and 2.3 for Schools A and B respectively.

The mean achievement score for the fifth grade high achievers is 4.5, with a standard deviation of .89 and a range from 3.2 to 6.7; while that of the fifth grade low achievers is 2.7, with a standard deviation of .36 and a range from 1.9 to 3.1.

The mean achievement score for the third grade high achievers is 2.8, with a standard deviation of .36 and a range from 2.2 to 3.7; while that of the third grade low achievers is 1.8, with a standard deviation of .22 and a range from 1.3 to 2.2.

Subjects Eliminated from the Final Sample

Since a substantial number of boys were eliminated from the final sample it seems important to describe this group. Eighteen boys from the fifth grade and seventeen boys from the third grade were not used in the final sample because their prorated I.Q.'s were below 85. Three fifth graders and six third graders were not included in the final sample because their prorated I.Q.'s were above 115. Six children could not read the color names on the Stroop Color-Word Test, and could not be taught to name these words even for the duration of the test. However, four of these children were among those eliminated for low I.Q.'s. All of the boys eliminated from the final sample either because they could not be taught to read the color names or because their I.Q.'s were below 85 were low achievers. The nine children not used in the final sample

because their I.Q.'s were above 115 were all high achievers. All of the fifth graders and many of the third graders who were eliminated for low I.Q.'s had repeated a grade, whereas only a small number of the boys included in the final sample had done so.

Tasks

Impulsivity is defined in this study in terms of immediacy of response in task situations where delay is basic to success. The primary impulsivity criterion in the present study is response latency on the Matching Familiar Figures Test. A second impulsivity criterion which is used in the current study is response latency on the Porteus Maze Test. Several additional indices from the Porteus Maze Test and the Stroop Color-Word Test, which have been considered by other researchers to reflect impulsivity, are also used. While these latter indices do not fit the operational definition of impulsivity used in the current study, it is of interest to find out how they relate to the latency scores.

The Matching Familiar Figures Test (MFF)

This test was constructed by Kagan and used with hundreds of elementary school children in studies of impulsivity conducted by Kagan and by other investigators. Kagan considers it the best single instrument for tapping conceptual impulsivity. The construction of this test grew out of the observation that in task situations with high response uncertainty and the simultaneous availability of several alternatives, some children typically decide carefully, withholding any response until they have a high probability of being right, while other children typically respond quickly and with minimal consideration of the various alterna-

tives. Moreover, these types of approaches appeared to be associated with differences in performance level and in cognitive products, e.g., types of groupings on a concept sorting task.

The Matching Familiar Figures Test consists of twelve items on each of which the subject must select one out of six alternatives which is identical with a standard. The child continues to respond to each item until he has selected the correct alternative or until he has made six errors. The figures used are complex familiar objects. Fast response times are associated with high error frequencies on this test. The correlation between response time and errors at any one age is typically in the -.5 to -.6 range. The scores obtained from this test are mean latency to first response and total number of errors. No relationship has been found between response latency and I.Q. Response latencies on this test typically increase with age from first grade to at least third grade. Kagan reports high correlations between response latency on the Matching Familiar Figures Test and response latencies on several other cognitive tasks which he studied. Children who are classified as impulsive on the Matching Familiar Figures Test make fewer fixations of the standard and spend less time studying the variants on this test than do children who are classified as reflective. Short latencies are taken as a sign of impulsivity. This test will be referred to as the MFF test in the tables of results.

The Porteus Maze Test

The Porteus Maze Test is a well standardized, non-verbal intelligence test which has been used extensively for over fifty years. This test has long been considered to reflect cautiousness vs. impulsiveness

in style or approach. Good performance on these mazes requires deliberation over alternative possibilities before action. Porteus[1] considers his test to tap a "non-intellective aspect of intelligence," the ability to use reason to inhibit action. Research studies have shown that delinquents and disturbed children do significantly lower on this test than normal controls, even when intelligence as measured by a verbal I.Q. test is equated.

The two scores normally obtained from the Porteus Maze Test are the Test Quotient (TQ) and the Qualitative (Q) score. The Test Quotient is based on the number of mazes correctly completed, with a penalty for incorrect trials. Two trials are allowed for each maze. A low Test Quotient is taken to be a reflection, in part, of an impulsive approach to the task. The Test Quotient will be referred to as the TQ in the tables of results.

The Qualitative score is a weighted total of errors in execution such as cut corners, crossed lines and changes in direction. A high Qualitative score is interpreted, at least in part, as the result of an impulsive approach to the task. It may also reflect poor motor control. A major limitation of the Qualitative score lies in the fact that children who complete more mazes have more opportunities for making qualitative errors. The Qualitative score will be referred to as the Q score in the tables of results.

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[1] Stanley D. Porteus, Porteus Maze Tests: Fifty years application. Palo Alto: Pacific Books, 1965, P. 107.

For the purpose of the current study a latency measure, mean latency on trial one of all mazes administered, was obtained. Short response latencies are taken to indicate an impulsive approach to the task. However, it must be recognized that this measure has a built-in limitation, since there may be differences in the amount of time spent in deliberation after the maze has been begun. One child may pre-plan an entire maze before beginning to draw, while another child may stop and plan at each choice point.

The Stroop Color-Word Test

This test has been used extensively in research studies for more than thirty years, and has been widely used in recent research on cognitive styles. Previous investigators have found that inhibition of inappropriate responses on the Stroop Test is closely related to ability to control impulses, inhibition in estimating time intervals, inhibition of the effect of need upon cognition, and extensive scanning.[1]

The test consists of three cards. On Card A the subject is asked to read the color words red, blue and green which are written in black ink. On Card B the subject is asked to name patches of the colors red, blue and green. On Card C the subject is asked to name the color of the ink in which the words red, blue and green are written, under conditions such that the ink color conflicts with the color word. The first natural response to the stimulus must be inhibited. While the Stroop cards contain one hundred stimuli each, only fifty were presented on each card in

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[1] Riley W. Gardner & Robert I. Long, Cognitive controls of attention and inhibition: A study of individual consistencies. British Journal of Psychology, 1962, 53, 381-388.

order to avoid fatigue and boredom. When a child made three errors in a row he was stopped and the directions were repeated. Responses were tape recorded to assure accurate data recording.

The scores usually obtained from the Stroop Color-Word Test are time measures. Rand,[1] however, has pointed out that the use of only a time measure is based upon the questionable presumption that a unitary factor underlies performance of the task, i.e., that there is a one-to-one relationship between indicator and underlying process." Thus, in the present study error scores as well as time scores were obtained for both Card C and for the three cards combined. A high error score is taken to be, at least partially, an indicator of an impulsive style. A high time score is also considered an indicator of impulsivity, both because of past research findings, and because it is likely to be the result of difficulty in the inhibition of incorrect responses or disruption of performance arising from errors.

Although each of the three tests selected for use in the current study has been used extensively, there is still some lack of definitiveness about their reliabilities.

I.Q. Measure

The vocabulary and block design sub-tests of the WISC were administered to all subjects. These two sub-tests were selected because of their high correlation with the full scale WISC score. In a recent study of nine thousand children of elementary school age conducted by the

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[1] George Rand, Seymour Wapner, Heinz Werner & Joseph H. McFarland, Age differences in performance on the Stroop Color-Word Test. Journal of Personality, 1963, 31, 534-558.

National Center for Health Statistics[1] it was concluded that these two sub-tests constitute a suitable short form of the total WISC Test.

Design

The impulsivity tasks were administered under three different experimental conditions, which are as follows. Instructional Set I: The three impulsivity tasks were administered with directions designed to induce a slow, cautious, reflective style of response. Instructional Set II: The three impulsivity tasks were administered with instructions which do not direct the subject to either a reflective or an impulsive style. This is the natural or free response condition. Instructional Set III: The three impulsivity tasks were administered with directions designed to induce an immediate, unreflective style of response.

The special instructions for inducing either a reflective set or an impulsive set are given below for each test instrument.

Matching Familiar Figures (Instructions repeated on first three items.)

Instructional Set I: "I want you to do this very carefully. Think about your answer before you point to it. You can take as much time as you want. The important thing is to figure out the right answer before you point. Remember, take your time."

Instructional Set III: "I want you to do this as quickly as you can. As soon as you think you know the answer, point to it. Remember, do it as fast as you can."

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[1] National Center for Health Statistics, Evaluation of psychological measures used in the health examination survey of children ages 6-11. Newsletter of the Society for Research in Child Development, summer 1966. (Abstract)

Stroop Color-Word Test (Instructions repeated on each card.)

Instructional Set I: "I want you to do this very carefully. Do one at a time. Try not to make mistakes. Remember, take your time."

Instructional Set III: "I want you to do this as quickly as you can. Remember, do it as fast as you can."

Porteus Maze Test (Instructions repeated on first three items.)

Instructional Set I: "I want you to do this very carefully. Figure out the right way before you draw the line. The important thing is not to make mistakes. Remember, take your time."

Instructional Set III: "I want you to find your way out as quickly as you can. Remember, do it as fast as you can."

Also eliminate from standard instructions the following phrases: "You must be very careful...." "This is not a speed test." "You can stop anywhere as long as you like...."

From within each achievement group on both grade levels twenty boys were randomly assigned to each of the three treatment conditions. The design of the experiment is illustrated below.

	Instructional Set I	Instructional Set II	Instructional Set III	
Grade 3	n = 20	n = 20	n = 20	High Achievers
	n = 20	n = 20	n = 20	Low Achievers
Grade 5	n = 20	n = 20	n = 20	High Achievers
	n = 20	n = 20	n = 20	Low Achievers

In order to control for the effects of order of administration, each subject was randomly assigned to one of the six possible orders of administration of the three tests: (1) Porteus, Stroop, MFF; (2) Porteus, MFF, Stroop; (3) Stroop, Porteus, MFF; (4) Stroop, MFF, Porteus; (5) MFF, Porteus, Stroop; (6) MFF, Stroop, Porteus.

Statistical Analysis

A three by two by two analysis of variance (instructional set by achievement by grade) was performed on each of the scores obtained from the three impulsivity tests. The Scheffé Test was used to determine which of the differences between the three instructional set groups was significant. In order to take into account differences in the size of the standard deviations of the instructional set groups a modification of the Scheffé Test was performed. This technique involved treating each instructional set group as a population and using as the critical value for significance at the .05 level the chi square value for 95% of the population.[1] T tests and Scheffé Tests were also used to determine whether differences in (prorated) Verbal and Performance I.Q.'s between treatment and achievement groups were significant. An analysis of covariance was performed to determine whether differences in test scores between low and high achievers were still significant when (prorated) Verbal and Performance I.Q.'s were controlled.

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[1] Recommended by Professor Rosedith Sitgreaves of Teachers College, Columbia University.

An additional analysis was performed on the data from the Matching Familiar Figures Test for subjects in the natural instruction group. Those children within the natural instruction group who were above the median on latency and below the median on errors were identified as reflectives, while those children who were below the median on latency and above the median of errors were identified as impulsives. A chi square analysis was performed to determine whether differences in the numbers of low and high achievers within the above defined impulsive and reflective groups were significant.

Intercorrelations were obtained between all test and I.Q. scores for the entire sample, for each achievement group, for each grade level, and for each instructional set group.

Since the results of the analysis of variance and the correlational analysis showed that the Stroop Color-Word scores from Card C alone and from all three cards combined were providing similar information, only the scores from the total test were included in the tables.

III--RESULTS

This study attempted to shed light on the nature of impulsivity and its relationship to achievement in lower class boys. The data came from a sample of 240 boys, stratified by achievement and grade level, and then randomly assigned to each of three instructional set groups. Impulsivity was measured by three tests: the Matching Familiar Figures Test, the Porteus Maze Test and the Stroop Color-Word Test. Analysis of variance was used to identify the main and interaction effects of instructional set, achievement level and grade level for each test score. Correlations were obtained between all test scores so that consistencies between tests could be analyzed.

Results are reported both within sub-groups and with sub-groups combined, depending on appropriateness to the questions being posed. Since an attempt was made to manipulate performance styles in the reflective and impulsive set groups, it is the natural instruction group which is particularly focused upon in relation to the question of stylistic differences between low and high achievers.

Impulsivity and I.Q.

While the tests used in this study were selected because they appeared to tap differences in style along an impulsive-reflective dimension, they undoubtedly also sample or reflect other differences. A question can be raised, for example, as to what role intelligence plays in performance on these tests. For this reason correlations of (prorated) WISC Verbal and Performance I.Q.'s with all test scores were obtained.

These correlations are presented in Tables 1-8. Table 1 shows the intercorrelations among test and I.Q. scores for the sample as a whole. Tables 2-4 present results within instructional set groups, with grade and achievement sub-groups combined. Tables 5 and 6 present results within achievement groups, with grade and instructional set sub-groups combined. Tables 7 and 8 present results within grade groups, with achievement and instructional set sub-groups combined.

As can be seen from Table 1, when the sample as a whole is considered most of the test scores have low but significant correlations with Verbal I.Q. The only test score which does not have a significant correlation with either Verbal or Performance I.Q. is time on the Stroop Color-Word Test.

An examination of Tables 2-4 shows that the correlations of test and I.Q. scores differ in the three instructional set groups. In the reflective and impulsive set groups there are no significant correlations between latency and I.Q. scores. In the natural set group the correlation of .22 between latency on the Matching Familiar Figures Test and Performance I.Q. just achieves significance at the .05 level. The relationship between Porteus Maze Test Quotient and I.Q. is strikingly different in the different instructional set groups. While there is no significant correlation between Test Quotient and I.Q. in the natural set group, there is a correlation of .52 between Test Quotient and Performance I.Q. in the reflective set group, and a correlation of .43 between these test scores in the impulsive set group. These were the highest correlations found between test and I.Q. scores. It may be noted that the standard instructions for the Porteus Maze Test include reflective

TABLE 1

Intercorrelations Among Test Scores in the Total Sample

(N=240)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.41**	.39**	-.10	.36**	-.01	-.20**	.17*	.08
2. MFF: Errors		1.00	-.17*	.36**	-.42**	.17*	.29**	-.29**	-.11*
3. Porteus Mazes: Latency			1.00	.06	.22**	.11*	-.08	.11*	-.13*
4. Porteus Mazes: Q score				1.00	-.37**	.57**	.41**	-.18*	-.07
5. Porteus Mazes: TQ					1.00	-.39**	-.37**	.16*	.26**
6. Stroop Color-Wor : Time						1.00	.51**	-.09	.03
7. Stroop Color-Word: Errors							1.00	.01	-.15*
8. WISC: Verbal I.Q.								1.00	-.02
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 2

Intercorrelations Among Test Scores in Instructional Group I (Reflective Set)

(N=80)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.43**	.29**	-.18	.41**	-.22*	-.38**	.20	.12
2. MFF: Errors		1.00	-.03	.21	-.45**	.37**	.27**	-.31**	-.23*
3. Porteus Mazes: Latency			1.00	.12	.19	-.02	-.12	.09	-.06
4. Porteus Mazes: Q score				1.00	-.28**	.07	.24*	-.02	-.00
5. Porteus Mazes: TQ					1.00	-.35**	-.55**	.28**	.52**
6. Stroop Color-Word: Time						1.00	.33**	-.23*	-.26*
7. Stroop Color-Word: Errors							1.00	-.06	-.38**
8. WISC: Verbal I.Q.								1.00	-.12
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 3

Intercorrelations Among Test Scores in Instructional Group II (Natural Set)

(N=80)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.28**	.23*	-.02	.30.**	-.06	-.16	.19	.22*
2. MFF: Errors		1.00	.03	.24*	-.21	.01	.24*	-.26*	-.13
3. Porteus Mazes: Latency			1.00	.17	.22*	.04	-.06	.13	-.13
4. Porteus Mazes: Q score				1.00	-.26*	.46**	-.09	-.35**	.15
5. Porteus Mazes: TQ					1.00	-.60**	-.21	.08	.06
6. Stroop Color-Word: Time						1.00	.11	-.14	.24*
7. Stroop Color-Word: Errors							1.00	.02	-.20
8. WISC: Verbal I.Q.								1.00	-.29*
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 4

Intercorrelations Among Test Scores in Instructional Group III (Impulsive Set)

(N=80)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.28**	.38**	.12	-.01	.17	-.01	-.00	.11
2. MFF: Errors		1.00	-.15	.42**	-.43**	.20	.20	-.31**	-.18
3. Porteus Mazes: Latency			1.00	.40**	-.21	.38**	-.29**	.01	-.13
4. Porteus Mazes: Q score				1.00	-.47**	.81**	.73**	-.08	.01
5. Porteus Mazes: TQ					1.00	-.32**	-.32**	.11	.43**
6. Stroop Color-Word: Time						1.00	.86**	-.03	-.06
7. Stroop Color- Word: Errors							1.00	.09	-.14
8. WISC: Verbal I.Q.								1.00	-.07
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 5

Intercorrelations Among Test Scores in the Low Achievement Group

(N=120)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.43**	.51**	-.05	.23*	.05	-.11	.14	-.07
2. MFF: Errors	—	1.00	-.32**	.19*	-.25**	.17	.32**	-.10	.03
3. Porteus Mazes: Latency			1.00	.10	.13	.17	-.01	.08	-.22*
4. Porteus Mazes: Q score				1.00	-.47**	.83**	.64**	.01	.17
5. Porteus Mazes: TQ					1.00	-.48**	-.34**	-.03	.07
6. Stroop Color-Word: Time						1.00	.57**	.01	.13*
7. Stroop Color-Word: Errors							1.00	.15	-.06
8. WISC: Verbal I.Q.								1.00	-.01
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 6

Intercorrelations Among Test Scores in the High Achievement Group

(N=120)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.37**	.29**	-.13	.43**	-.06	-.28**	.16	.12
2. MFF: Errors		1.00	-.04	.53**	-.48**	.08	.19*	-.29**	-.09
3. Porteus Mazes: Latency			1.00	.04	.28**	.07	-.14	.09	-.12
4. Porteus Mazes: Q score				1.00	-.28**	-.08	.06	-.41**	-.03
5. Porteus Mazes: TQ					1.00	-.16	-.33**	.07	.27**
6. Stroop Color-Word: Time						1.00	.24*	-.09	-.16
7. Stroop Color-Word: Errors							1.00	.06	-.17
8. WISC: Verbal I.Q.								1.00	-.00
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 7

Intercorrelations Among Test Scores in the Third Grade Sample

(N=120)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.41**	.29**	-.10	.36**	-.02	-.29**	.19*	.08
2. MFF: Errors		1.00	-.11	.54**	-.42**	.16	.27**	-.28**	-.02
3. Porteus Mazes: Latency			1.00	-.07	.21*	.01	-.22*	.12	-.06
4. Porteus Mazes: Q score				1.00	.31**	-.18	-.01	-.17	.07
5. Porteus Mazes: TQ					1.00	.05	-.11	.12	.26**
6. Stroop Color-Word: Time						1.00	.29**	-.13	.00
7. Stroop Color-Word: Errors							1.00	-.03	-.24*
8. WISC: Verbal I.Q.								1.00	.08
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

TABLE 8

Intercorrelations Among Test Scores in the Fifth Grade Sample

(N=120)

Test	1	2	3	4	5	6	7	8	9
1. MFF: Latency	1.00	-.39**	.49**	-.10	.37**	.01	-.15	.12	.04
2. MFF: Errors		1.00	-.23*	.31**	-.44**	.20*	.35**	-.27**	-.17
3. Porteus Mazes: Latency			1.00	.15	.24*	.16	.02	.08	.10
4. Porteus Mazes: Q score				1.00	-.39**	.69**	.55**	-.23*	-.32**
5. Porteus Mazes: TQ					1.00	-.50**	-.48**	.07	.19*
6. Stroop Color-Word: Time						1.00	.59**	-.10	-.11
7. Stroop Color-Word: Errors							1.00	.04	-.09
8. WISC: Verbal I.Q.								1.00	-.01
9. WISC: Performance I.Q.									1.00

* $p < .05$.

** $p < .01$.

directives such as "You must be very careful." which are most like the directions used in the reflective set condition in the current study. More significant correlations are found between test and I.Q. scores in the reflective set group than in the two other instructional groups. The only correlation which holds up across instructional groups is the negative relationship between errors on the Matching Familiar Figures Test and Verbal I.Q.

An examination of Tables 5 and 6 shows that there are some differences in the relationship between test and I.Q. scores in the two achievement groups. A negative relationship exists between Qualitative score on the Porteus Maze Test and Verbal I.Q. within the high achieving group, but not within the low achieving group. A positive relationship exists between Porteus Maze Test Quotient and Performance I.Q. in the high achieving group but not in the low achieving group.

An examination of Tables 7 and 8 points up the fact that there is a negative relationship between Qualitative score and I.Q. at fifth grade level but not at third grade level. While there is no significant correlation between latency on the Matching Familiar Figures Test and I.Q. in the fifth grade sample, the correlation of .19 between Verbal I.Q. and latency in the third grade sample just achieves significance at the .05 level.

Thus it can be said in summary that I.Q. scores interact with impulsivity test scores somewhat differently in the different achievement, grade and instructional set groups. While it is very possible that I.Q. scores too are affected by stylistic factors, in view of the significant

correlations obtained, analysis of covariance with I.Q. control was performed. The results from this procedure will be reported along with results from the analysis of variance.

The lack of positive correlation between (prorated) Verbal and Performance I.Q.'s in the sample is probably a result of the elimination of 44 children whose (prorated) Full Scale I.Q.'s were either below 85 or above 115.

Question 1

Are there consistencies in impulsive vs. reflective styles of response across a variety of cognitive tasks?

An affirmative answer to this question would result from the finding of a positive correlation between latency on the Matching Familiar Figures Test, latency on the Porteus Maze Test and Test Quotient on the Porteus Maze Test; and a negative correlation between these scores and the Qualitative score on the Porteus Maze Test, the time score on the Stroop Color-Word Test and the error score on the Stroop Color-Word Test.

The correlations of prime interest are those between the latency scores. An examination of Table 1, which reports the results for the sample as a whole, shows that there is a correlation of .39 ($p < .01$) between the two latency scores. This correlation is somewhat lower in the natural instruction group than in the two other instructional set groups (see Tables 5 and 6); and is higher in the fifth grade sample than in the third grade sample (see Tables 7 and 8). The highest correlation between the latency scores, .51, was found in the low achievement group.

The latency score on the Matching Familiar Figures Test correlates positively with the Porteus Maze Test Quotient, as expected, under all

conditions except impulsive instructional set. The latency measure on the Porteus Maze Test has lower correlations with Porteus Maze Test Quotient than does the latency score on the Matching Familiar Figures Test. The two Porteus Maze Test scores are positively correlated when the sample as a whole is considered, and when the natural set group is considered separately. The low correlations found between these two scores may reflect the built-in limitation of the latency measure from the Porteus Maze Test, namely, that there may be differences in amount of time spent in reflection at choice points within the maze.

The expected negative correlations between latency scores and Test Quotient on the one hand, and Stroop Color-Word scores and Porteus Maze Qualitative score on the other hand, were only occasionally found. Latency on the Matching Familiar Figures Test did correlate negatively with errors on the Stroop Color-Word Test under some conditions. It only correlated negatively with time on the Stroop Color-Word Test in the reflective set group. It did not correlate negatively with the Qualitative score. Latency on the Porteus Maze Test was negatively correlated with errors on the Color-Word Test in the third grade sample, as expected, but was positively correlated to the Color-Word scores and to the Qualitative score under impulsive set conditions. The Test Quotient from the Porteus Maze Test did correlate negatively with the Qualitative score and the Color-Word scores under most conditions, and these correlations were moderately high.

On the basis of the results reported above it may be concluded that there are low to moderate consistencies in performance on some tests which purport to measure impulsivity. Latency scores from the Matching

Familiar Figures Test and from the Porteus Maze Test are significantly correlated. It appears that the latency scores are sampling a factor which is reflected in the Test Quotient but not in the Qualitative score on the Porteus Maze Test, and which is only minimally reflected in the scores from the Stroop Color-Word Test. These latter scores appear to be sampling another factor which is also reflected in the Test Quotient, but not in the latency scores. It may be that two different aspects of what is generally referred to as impulsivity are being sampled in the tests used in the current study.

Question 2

What are the effects of instructional sets designed to induce a reflective or impulsive style of response, upon response speed and level of performance?

This question addresses itself to two issues. The first of these is whether an impulsive or reflective approach to cognitive tasks can be modified by a simple directive technique. The second is whether performance level or error scores will change significantly as a result of stylistic modifications which may take place. Means and standard deviations on test scores for the three instructional set groups are presented in Table 9.

TABLE 9

Means and Standard Deviations on Impulsivity Tests for the Three Groups Under Different Instructional Sets

Test	I: Reflective		II: Natural		III: Impulsive	
	Mean	SD	Mean	SD	Mean	SD
MFF						
Latency (seconds)	16.60	7.18	12.94	7.80	9.07	3.97
Errors	12.55	5.36	14.10	4.90	17.61	6.78
Porteus Mazes						
Latency (seconds)	20.78	13.26	12.36	10.75	8.06	6.95
Q score	22.14	10.11	30.30	27.99	32.91	33.82
TQ	111.85	12.96	107.53	15.21	101.69	13.00
Stroop Color-Word						
Time (seconds)	79.13	17.69	82.30	52.04	77.21	55.37
Errors	9.93	5.94	11.65	7.70	15.59	11.96

Note.---N for each group is 80.

An examination of the means on this table shows that latencies decrease and errors increase from reflective to natural to impulsive set groups. The Test Quotient also decreases as one considers instructional groups in this order. Tables 10-16 which report results from analysis of variance

show that there are significant differences between instructional set groups on all test measures except time on the Stroop Color-Word Test.

TABLE 10

Analysis of Variance: Mean Latenc.

Trial 1 of the Matching Familiar Figures Test

Source	df	MS	F
Instructional Set (A)	2	1136.220	27.79**
Achievement (B)	1	209.918	5.13*
Grade (C)	1	110.092	2.69
A x B	2	92.953	2.27
A x C	2	101.021	2.47
B x C	1	82.622	2.02
A x B x C	2	2.264	.05
Within Cells	228	40.879	

* $p < .05$.

** $p < .01$.

TABLE 11

Analysis of Variance: Total Number of Errors on the Matching Familiar Figures Test

Source	df	MS	F
Instructional Set (A)	2	538.254	18.60**
Achievement (B)	1	567.337	19.61**
Grade (C)	1	519.204	17.94**
A x B	2	24.238	.83
A x C	2	8.879	.30
B x C	1	10.005	.34
A x B x C	2	10.527	.36
Within Cells	228	28.930	

** $p < .01$.

The fact that there were no significant differences between groups on the Color-Word time score may be a result of the interaction of approach and errors. Thus, a child who attempts to deal with this task quickly may make many errors and lose much time over these errors, thereby taking a long time to complete the task. A child who attempts to deal with this task slowly and cautiously may make very few errors, thereby completing the task in a relatively short time.

TABLE 12

Analysis of Variance: Mean Latency on Trial 1 of the Porteus Maze Test

Source	df	MS	F
Instructional Set (A)	2	3347.119	30.10**
Achievement (B)	1	163.880	1.47
Grade (C)	1	94.395	.84
A x B	2	282.830	2.54
A x C	2	14.426	.12
B x C	1	470.541	4.23*
A x B x C	2	79.684	.71
Within Cells	228	111.199	

* $p < .05$.

** $p < .01$.

Since the analysis of variance showed only that there were significant differences between instructional set groups, but did not pinpoint these differences, a Scheffé analysis was performed. According to the Scheffe analysis all possible differences between instructional set groups were significant in regard to latency on the Matching Familiar Figures Test and latency on the Porteus Maze Test. However, in regard to the four other scores (errors on the Matching Familiar Figures Test, Qualitative score and Test Quotient on the Porteus Maze Test, and errors on the Stroop Color-Word Test) this was not the case. The differences

TABLE 13

Analysis of Variance: Qualitative (Q) Score on the Porteus Maze Test

Source	df	MS	F
Instructional Set (A)	2	2527.360	3.74*
Achievement (B)	1	33.750	.04
Grade (C)	1	1601.660	2.37
A x B	2	275.890	.40
A x C	2	890.785	1.31
B x C	1	2172.020	3.21
A x B x C	2	80.950	.11
Within Cells	228	675.587	

* $p < .05$.

between instructional group I (reflective) and instructional group III (impulsive) were significant in regard to the above mentioned four scores; the differences between instructional group II (natural) and instructional group III (impulsive) were significant in regard to all scores other than the Qualitative score on the Porteus Maze Test; but the differences between instructional group I (reflective) and instructional group II (natural) were not significant in regard to any scores other than the latency ones.

TABLE 14

Analysis of Variance: Test Quotient on the Porteus Maze Test

Source	df	MS	F
Instructional Set (A)	2	2080.750	12.84**
Achievement (B)	1	5367.600	33.12**
Grade (C)	1	207.200	1.27
A x B	2	227.450	1.40
A x C	2	545.500	3.36*
B x C	1	752.500	4.64*
A x B x C	2	34.300	.21
Within Cells	228	162.033	

* $p < .05$.

** $p < .01$.

Since there were large differences in the size of the standard deviations from group to group on some of the test measures, a modification of the Scheffé technique which would take those differences into account was also performed. The results obtained from the Scheffe analysis were born out in this second analysis.

TABLE 15

Analysis of Variance: Mean Time per Card on the Stroop Color-Word Test

Source	df	MS	F
Instructional Set (A)	2	529.500	.26
Achievement (B)	1	19512.200	9.83**
Grade (C)	1	2132.100	1.07
A x B	2	473.650	.23
A x C	2	1084.750	.54
B x C	1	2778.900	1.40
A x B x C	2	487.350	.24
Within Cells	228	1983.828	

** $p < .01$.

Only one interaction involving instructional set proved significant, that of set and grade on the Porteus Maze Test Quotient. Under reflective instructions the fifth graders had higher Test Quotients than did the third graders, even though the fifth graders did not have higher Test Quotients than the third graders when instructional set groups were combined. While the performance of the third graders did not improve under reflective instructions, the performance of the fifth graders did improve on one of the tasks, the Porteus Maze Test, under reflective instructions.

TABLE 16

Analysis of Variance: Total Number of Errors on the Stroop Color-Word Test

Source	df	MS	F
Instructional Set (A)	2	637.912	8.83**
Achievement (B)	1	738.504	9.67**
Grade (C)	1	3.038	.03
A x B	2	16.404	.21
A x C	2	179.587	2.35
B x C	1	.204	0.00
A x B x C	2	118.679	1.55
Within Cells	228	76.316	

** $p < .01$.

The results reported above indicate that the time aspect of stylistic approach to cognitive tasks can be manipulated by instructions. However, this modification in response time does not always affect the child's success, or level of performance, on these tasks. When children respond more quickly than they could have been expected to respond under free conditions, their performance does deteriorate; but when children respond more slowly than they could have been expected to respond under free conditions, their performance does not necessarily improve significantly.

Question 3

What is the relationship of impulsivity to age?

Grade level was used as an indicator of age in this study. The mean age of the fifth grade sample was two years higher than the mean age of the third grade sample. The mean ages were 10-7 and 8-7 respectively.

An examination of Tables 10 and 12 shows that there were no significant differences in latency scores between third and fifth graders, when achievement and instructional set subgroups were combined. The only significant difference found between grade groups was in number of errors on the Matching Familiar Figures Test. The mean number of errors in the fifth grade group was 13.3, while that of the third grade group was 16.3.

There was, however, a significant interaction effect between achievement and grade in relation to latency on the Porteus Maze Test. According to a Scheffé analysis fifth grade low achievers had longer latencies on the Porteus Maze Test than did third grade low achievers. There was also a significant interaction effect in relation to Porteus Maze Test Quotient, with fifth grade high achievers having higher Test Quotients than third grade high achievers. These two findings would support a conclusion that impulsivity decreases with age. However, in view of the fact that there were so few differences between grade groups, it must be concluded that the hypothesis of decreasing impulsivity with age was not clearly supported by the results of this study.

It may also be noted that the intercorrelations between test scores are generally higher in the fifth grade sample than in the third grade sample. The correlation between latency on the Matching Familiar Figures Test and latency on the Porteus Maze Test is .49 in the fifth grade and .29 in the third grade. The intercorrelations between the two other Porteus Maze Test scores and the Stroop Color-Word Test scores are also strikingly higher in the fifth grade sample. It thus appears that the fifth graders were more consistent in stylistic approach to the tasks used in this study than were the third graders.

Question 4

How is impulsivity related to achievement?

Means and standard deviations for low and high achievers on the three impulsivity tests are reported in Table 17. From this table it can be seen that high achievers had longer latencies on both the Matching Familiar Figures Test and the Porteus Maze Test. They also had higher Test Quotients, lower time and error scores on the Stroop Color-Word Test, and lower error scores on the Matching Familiar Figures Test. An examination of Tables 10-16 shows that the difference between groups in relation to latency on the Porteus Maze Test is not significant; but the other differences mentioned above are significant. All of those differences support the hypothesis that low achievers are more impulsive than high achievers.

TABLE 17

Means and Standard Deviations on

Impulsivity and I.Q. Tests for the Two Achievement Groups

Test	Low Achievers		High Achievers	
	Mean	SD	Mean	SD
MFF				
Latency (seconds)	11.94	6.45	13.81	7.79
Errors	16.29	5.62	13.22	6.17
Porteus Mazes				
Latency (seconds)	12.91	11.00	14.56	12.63
Q score	28.08	28.81	28.83	23.66
TQ	102.29	13.68	111.75	13.41
Stroop Color-Word				
Time (seconds)	88.57	60.70	70.53	14.16
Errors	14.14	10.64	10.63	7.05
WISC				
Verbal I.Q.	93.19	10.03	104.08	12.97
Performance I.Q.	91.03	11.84	98.93	14.62

Note.--N for each group is 120.

However, it is also apparent from Table 17 that low achievers have lower Verbal and Performance I.Q.'s than high achievers. These differences are significant at the .01 level according to a t test. In view of this fact, it was deemed important to determine to what extent I.Q. differences might underlie differences in impulsivity scores. Analysis of covariance with I.Q. control was therefore performed. After I.Q. was controlled, the scores which were still significantly different in the two achievement groups were errors on the Matching Familiar Figures Test, Porteus Maze Test Quotient, and time and error scores on the Stroop Color-Word Test. There was no difference between low and high achievers on either Matching Familiar Figures latency or Porteus Maze Test latency.

Since each achievement group contained boys from all three instructional set groups, and since it was deemed possible that instructional set and I.Q. may have interacted differentially, analysis of covariance with I.Q. control was performed on the low and high achievers within each instructional set group. It was found that the performance differences between low and high achievers shifted from set to set. In the natural instructional set group low achievers did have shorter latencies on both the Matching Familiar Figures Test and on the Porteus Maze Test than did high achievers. They also had lower Porteus Maze Test Quotients. These results support the hypothesis that low achievers are more impulsive in their approach to cognitive tasks than are high achievers. It is interesting to note that although the low achievers in the natural instruction group had shorter latencies on the

Matching Familiar Figures Test, they did not have more errors on this test. No differences were found between achievement groups on Stroop Color-Word scores, although the low achievers in the natural instruction group did have higher time scores on this test when I.Q. was not controlled.

In the reflective instructional set group low achievers had more errors on the Matching Familiar Figures Test, lower Porteus Maze Test Quotients, and more errors and longer times on the Stroop Color-Word Test than did high achievers, although there were no differences in latency scores. Low achievers appear to be less able to benefit from longer latencies after a certain point than are high achievers. Some specific ability or skill limitation may come into operation at this point. In relation to the question of flexibility of stylistic approach, it is interesting to note that there was a greater increase in latency from natural to reflective instructional set among low achievers than among high achievers.

In the impulsive instructional set group there were no differences between high and low achievers on any test measures. Apparently, when a premium is put on immediacy of response and response latencies go below a certain point, high achievers do as poorly as do low achievers. Whatever advantage high achievers have under natural or free instructions is lost. In relation to the question of flexibility of stylistic approach, it may be noted that there was a greater decrease in latency from natural to impulsive set among high achievers than among low achievers. In spite of the fact that the latency scores of the low achievers decreased only slightly under impulsive instructions, they did make more errors on the

Matching Familiar Figures Test, more qualitative errors on the Porteus Maze Test, and more errors on the Stroop Color-Word Test in the impulsive set condition.

The above results appear to indicate that while there is in fact a significant difference in response time on cognitive tasks between low and high achievers, this difference is not sufficient to explain the differences in performance found even when Verbal and Performance I.Q.'s were controlled. It appears also that a threshold effect may be operating in regard to response time. Given response latencies which lie below threshold level, additional time will improve performance. Given latencies at or above threshold level, additional time will not improve performance.

In accordance with Kagan's recent use of the Matching Familiar Figures Test, an additional type of analysis was made of the results from this test in the natural instruction group. In this analysis errors and latencies were combined into one index. The impulsive child was defined as the child who was below the median of the group on latency and above the median of the group on errors. The reflective child was defined as the child who was above the median on latency and below the median on errors. In the low achievement group under natural instructions 21 children were identified as impulsive and nine as reflective. In the high achievement group seven were identified as impulsive and 19 as reflective. According to a chi square analysis these differences between the number of low achievers and the number of high achievers in the impulsive and reflective categories are significant at the .01 level.

This study posed a general question as to whether the characterization of impulsivity as a comprehensive, inflexible orientation applies to a greater extent to low achievers than to high achievers. It has already been concluded that low achievers are more impulsive in their approach to cognitive tasks than are high achievers. It was also found that there is a significantly higher correlation between the two latency scores in the low achievement group than in the high achievement group; and that the intercorrelations between Porteus Maze Qualitative score, Porteus Maze Test Quotient, time on the Stroop Color-Word Test and errors on the Stroop Color-Word Test are higher in the low achievement group. In addition, when intercorrelations within achievement, grade and instructional set sub-groups were examined, it was found that the fifth grade high achievers only showed more consistency than the third grade high achievers in the special instruction groups, whereas the fifth grade low achievers were more consistent than third graders under natural instructions as well as under special instructions. The evidence seems to point to the conclusion that there is more consistency of stylistic approach within the low achievement group. There is also an increase in consistency among low achievers over the two year period studied in this research.

The question of flexibility in orientation can best be answered by an examination of the test scores of the low and high achievers in the different instructional conditions. In the analysis of variance no significant interaction effects were found between instructional set and achievement. Moreover, as was previously reported, when I.Q. was con-

trolled there was a larger difference between the latency scores of the low achievers under reflective vs. natural instructions, than there was between the analogous latency scores of the high achievers. When the latency scores under natural vs. impulsive instructions were compared, however, the reverse was true; namely, there was a greater difference between the scores of the high achievers under these two conditions. The latter results do not support the hypothesis that inflexibility of approach characterizes low achievers more than high achievers. However, it can be argued that consistency or persistence of an impulsive approach throughout the three tasks is in itself an indication of inflexibility, since an impulsive style is generally linked with poor performance on these tasks. Children who showed a consistently impulsive style might be viewed as having limited ability to assess situational demands and adjust their styles accordingly. Since there was more impulsivity, more consistency of style, and greater increase in consistency of style with age in the low achievement group, this latter point of view would lead to the conclusion that low achievers are more inflexible in orientation than are high achievers.

Qualitative Observations

A number of striking differences in approach to the tasks used in this study were noted during the testing sessions. Many of the high achievers verbalized a systematic method of considering alternatives on the Matching Familiar Figures Test. The most common approach was to compare the standard with one variant at a time, and then to compare each feature of the standard with the like features on the variants not

eliminated in the first examination. Sometimes the children verbalized their method while practicing it; sometimes they explained it to the examiner after they had completed the task. Many of the children used their fingers in comparing parts of the figures. None of the low achievers verbalized a completely systematic step-by-step process for considering alternatives. In general there was less verbalization about approach by low achievers. Whether this is a reflection of less conscious awareness of methods of dealing with tasks, or of more limited verbal communication with white, adult school figures, is not entirely clear. Both factors may well be operating. Some of the low achievers did state that they had "just guessed." On the Porteus Maze Test high achievers commonly traced above the maze with a pencil or with their fingers before beginning the drawing. Pre-tracing was much less frequently practiced by low achievers.

Another striking difference between high and low achievers was in stated expectation of success or failure at the tasks. Thus, while a typical comment by a high achiever on item one of the Matching Familiar Figures Test was, "They all look the same to me but I'll find it," more common comments from low achievers were, "I'll get the wrong one"; "I can't do that one"; "They all look alike."

Other differences between high and low achievers were less universal, but were nonetheless highly revealing of manner of approach to the task. Some of the low achievers looked at the examiner very often between glances at the figures on the Matching Familiar Figures Test or the choice points on the Porteus Maze Test. They appeared to want or expect feedback from the examiner before their choices were

finalized, and in a few cases said to the examiner, "You tell me." On Card C of the Stroop Color-Word Test nervous mannerisms were more apparent among the low achievers than among the high achievers.

Thus, on the basis of observations during the testing sessions it can be said that low achievers appeared to use less systematic methods of considering alternatives and of pre-planning. They also appeared to approach task situations with greater expectation of failure, and showed both more nervous mannerisms and more dependence on the examiner when faced with difficult tasks.

The results of this study can be summarized as follows: (1) Low-achieving lower class boys are more impulsive in their approach to cognitive tasks than are high-achieving lower class boys. (2) Approach to cognitive tasks can be temporarily modified by instructions, but these modifications do not necessarily result in changes in performance level. When children are instructed to perform impulsively their accuracy and effectiveness does deteriorate; but when children are cautioned to respond reflectively only the performance of the high achievers improves significantly. (3) There is moderate consistency in style of approach to cognitive tasks as measured on the one hand by latency scores, and on the other by Stroop Color-Word scores and the Qualitative score on the Porteus Maze Test. These two sets of scores appear to be tapping different aspects of what is referred to as impulsivity. The Porteus Maze Test Quotient has low to moderate correlations with both sets of scores. (4) No consistent differences in style were found between the age-grade groups. (5) Low achievers were found to be more consistent in style than high achievers, but there is no clear-cut evidence that they are more inflexible as to approach than are high achievers.

IV--DISCUSSION

Since this study attempted to explore the nature of cognitive impulsivity it is of interest to try to account for the relationships between tests found in the study. The three tests used were selected because they appeared to measure impulsivity in style vs. inhibition of immediate responding. In addition, the tests were selected to tap different aspects of cognitive impulsivity. Thus, on the Porteus Maze Test a sensory-motor component is prominent, and pre-planning is required for successful performance. On the Stroop Color-Word Test a verbal inhibition factor is prominent, and selectivity of verbal responses to visual cues is involved. On the Matching Familiar Figures Test systematic visual analysis is basic to successful performance, and immediate motor and/or verbal responding must be inhibited. According to the results of this study cognitive impulsivity is not a unitary trait among eight to 11 year old children. Rather, it appears that there are at least two fairly independent aspects of cognitive impulsivity in this age group. One aspect relates primarily to time prior to response, and to the task analysis and pre-planning which take place during this period. The other aspect appears to involve performance during an on-going task.

From a developmental point of view, the finding that impulsivity is not a unitary factor in children is not difficult to explain. In the eight to 11 year old age group various aspects of inhibitory controls may still be in the process of formation, and may be developing at different

rates. Aside from Kagan's work, previous studies which found high intercorrelations among impulsivity measures used adolescents or adults as subjects. While Kagan did find high stylistic consistency in young children, all of his impulsivity indices were latency scores. Thus, the findings of the current study do not contradict Kagan's findings. When only the two latency measures were considered in the current study, moderate correlations were obtained. However, Kagan's conclusion that there is a high consistency in impulsive vs. reflective style on cognitive tasks in young children is only relevant if one accepts response latency as a sufficient representative of this style dimension. This question of the unitary or non-unitary nature of impulsivity needs further exploration.

Cognitive Style and Intelligence

Because significant, although low, correlations were found in the current study between scores on the impulsivity tests and scores on the vocabulary and block design sub-tests of the WISC, analysis of variance with I.Q. control was performed on the results. In this process some differences between achievement groups were reduced or eliminated. It can be argued that valid and relevant findings about stylistic differences were lost in the process of statistically controlling I.Q. differences, since I.Q. may very well reflect stylistic factors. It is possible that the correlations found between impulsivity and I.Q. scores are a result of common stylistic factors reflected in both sets of scores. Many studies have shown a positive relationship between measures of

tolerance for delay of gratification and I.Q. Considered developmentally, it makes sense that impulsive children will be inferior in intellectual development to children who can tolerate delay and inhibit immediate responses.

Impulsivity and Age

It is very possible that the lack of consistent differences in impulsivity scores between age-grade groups in this study is a result of the particular age groups selected. The two age groups were selected for practical reasons which have already been mentioned. In terms of developmental theory it would have made more sense to use first graders (six to seven year olds) and fourth graders (nine to ten year olds), or ten year olds and 15 year olds. It may be that while impulsivity is a developmental phenomenon, no significant changes in this stylistic dimension take place during the two years between the third and fifth grades. This is especially plausible because no major psychodynamic or cognitive changes appear to take place during this period.

On the other hand, it is possible that no difference in impulsivity between age groups was found because this stylistic dimension is heavily determined by constitutional factors which are stable over time. Many researchers are currently finding that individual differences on such variables as distractability, persistence and activity level in early infancy are rathe stable over time. It may well be that differences in impulsivity are largely based on such stable constitutional variables.

The fact that differences in impulsivity may reflect constitutionally based variables does not, however, diminish the likelihood that there are also developmental differences in impulsivity. A child may become less impulsive over time but still maintain his position along an impulsivity dimension in relation to other children of his age. Kagan found that children are consistent in stylistic approach across tasks and with increase in age. However, there is a trend towards longer latencies on the Matching Familiar Figures Test with increase in age from grades two to four. Developmental studies of the Stroop Color-Word Test have reported a decrease in time over the three cards between ages six and 12.

It would be interesting to further explore this question of the relationship of impulsivity to age by extending the current study to include adolescents.

Impulsivity and Socio-Economic Status

This study did not concern itself with differences between socio-economic groups. The subjects in the current study were all lower class boys. However, since it has often been hypothesized that lower class children are more impulsive than middle class children, and that this difference in impulsivity is partly responsible for the poorer achievement of lower class children, it is interesting to compare the scores obtained in the current study with scores reported for middle class children of comparable age.

Kagan reports mean latency scores ranging from 11.5 to 20.3 seconds on different samples of middle class third graders. The third graders

under natural instructions in the current study had had a mean latency of 13.2 seconds on the Matching Familiar Figures Test. Thus, they were not noticeably more impulsive than some of Kagan's middle class samples. However, when the third grade low achievers in the current study were considered separately, their mean latency was found to be 10.7 seconds, which was lower than the mean latency of any middle class sample studied.

The mean Porteus Maze Test Quotient of the boys under natural instructions in the current study was somewhat higher than the standard mean for this test. Again the hypothesis that lower class boys are more impulsive than middle class boys was not verified.

Modifying Cognitive Styles

This study demonstrated that style of approach to cognitive tasks can be at least temporarily modified by instructions. This finding supports and extends earlier research findings that approach to cognitive tasks can be modified through training. The finding that increase in latency does not necessarily lead to better performance is also congruent with the results of earlier studies using the Matching Familiar Figures Test. The current study provided new information about the relationship between change in style and quality of performance. It appears that a threshold effect may be operating in regard to stylistic factors. A very impulsive approach will lead to poor performance. Change from a very impulsive approach to a less impulsive approach will lead to better performance. But once threshold level is attained in relation to inhibition or reflection, further decreases in impulsivity will not in themselves

lead to better performance. At this point other variables, probably specific skill and ability factors such as visual analysis techniques and scanning strategies, come into the foreground.

The above results have direct implications for education, which may be summarized as follows. It is not unlikely that techniques for successfully modifying an impulsive approach to cognitive tasks can be designed. The development of such techniques would be a valuable contribution. It is worthwhile to attempt to modify the response time aspect of style in children who are very impulsive. With children who are not extremely impulsive, but who are low achievers, it is not worthwhile to focus on training in counteracting impulsivity, if this is taken to mean increasing latency or time for reflection. It would probably be more worthwhile with such children to focus on the development of skills such as systematic scanning strategies and techniques of evaluating hypotheses, which are basic to the solution of a wide range of cognitive tasks.

Impulsivity: Can't vs. Won't

It must be pointed out that while the current study found low achievers to be more impulsive than high achievers, it did not shed much light on the question of why such differences exist. Specifically, the results of this study provide no evidence that low achievers are unable to inhibit or delay; nor do they support the view that low achievers are more impulsive because they are reluctant to inhibit or delay. It is true that the response latencies of the low achievers under reflective instructions were longer than their response latencies under natural

instructions. On the other hand, it can be pointed out that the high achievers also had longer latencies under reflective instructions than under natural instructions; and that even brain damaged children who usually exhibit a great deal of impulsivity can be induced to delay, at least over short periods of time. The question of the relative roles of constitutional and motivational factors in a developmental sense as well as in a short-term sense, needs to be further examined. Perhaps this issue can best be examined through longitudinal studies which begin with young infants, focus on precursors and early indices of this style dimension, and experimentally examine the relationship between constitutional and motivational variables at different stages.

V--SUMMARY

The purpose of this study was to explore the concept of impulsivity as a stylistic dimension affecting cognitive behavior. Since impulsivity is often imputed to be a mediating variable in the poor achievement of lower class children, the major question addressed was whether impulsivity operates as a comprehensive, inflexible orientation in low achievers more than in high achievers.

Two hundred and forty lower class, inner-city boys in third and fifth grades were studied. The Matching Familiar Figures Test, the Porteus Maze Test and the Stroop Color-Word Test were used to assess impulsivity. Equal numbers of high and low achievers at each grade level were randomly assigned to each of three different types of administration of these tests. One group was given instructions designed to induce an impulsive style; another group was given instructions designed to induce a reflective style; the third group was given instructions designed so as not to effect the natural styles of the children.

Analysis of variance and analysis of covariance with I.Q. control were used to study the effects of achievement, age and instructional sets. Correlational analysis was used to study the relationship between test indices.

The conclusions of the study are as follows: (1) Low-achieving lower class boys are more impulsive in their approach to cognitive tasks than are high-achieving lower class boys. (2) Approach to cog-

nitive tasks can be temporarily modified by instructions, but such modification does not necessarily result in changes in performance level. When children are instructed to perform impulsively their accuracy and effectiveness does deteriorate; but when children are instructed to respond reflectively, only the performance of the high achievers improves significantly. (3) There is moderate consistency in style of approach to cognitive tasks as measured on the one hand by latency scores, and on the other hand by Stroop Color-Word scores and the Qualitative score of the Porteus Maze Test. These two sets of scores appear to be tapping different aspects of what is referred to as impulsivity. The Porteus Maze Test Quotient correlates moderately with both of these sets of scores. (4) Low achievers were found to be more consistent in style than high achievers, but there is no clear-cut evidence to support the hypothesis that they are more inflexible in approach than are high achievers. (5) No over-all differences in style were found between the age-grade groups.

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