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NAME OF AUTHOR/*NOM DE L'AUTEUR* YAIR REZNIK

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NAME OF SUPERVISOR/*NOM DU DIRECTEUR DE THÈSE* Dr. C. C. Anderson

DATED/*DATÉ* March 20, 1975 SIGNED/*SIGNÉ* Yair Reznik

PERMANENT ADDRESS/*RÉSIDENCE FIXE* 411 - 10711 SASK. DR. Edmonton, Alberta

NL-91 (3-74)

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REFLECTION-IMPULSIVITY:
AN INVESTIGATION OF CORRELATES AND MODIFICATION

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Reflection-Impulsivity: An Investigation of Correlates and Modification" submitted by Yair Reznik in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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Supervisor

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External Examiner

Date. March 12/75 ....

ABSTRACT

The purpose of this study was to investigate the relationship between reflection-impulsivity (R-I) and verbal, cognitive, scholastic, motor and perceptual-motor tasks; to determine whether incentive motivation ameliorates the performance of impulsive children and to find out whether the ability to delay immediate gratification is associated with reflection-impulsivity.

The subjects were 121 grade two pupils. The tests which were utilized in this research were the Matching Familiar Figures (MFF), WISC Vocabulary and Digit Span subtests, the Raven, Draw A Person (DAP), Draw A Line (DAL), Rutgers, and tests of scholastic achievement as well as a test for preference for delayed reward.

Results of this study revealed the following:

1. Reflectives performed better than impulsives on the Vocabulary, Rutgers, Raven, DAP and scholastic achievement tests and their performance on the DAP test was slower. The groups did not differ on the Digit Span and DAL tests. Also, reflectives did not differ from impulsives on the time taken to complete the Raven and the Rutgers.

2. Multiple correlation between academic achievement as a criterion and Vocabulary and R-I scores as predictors was not significantly larger than the correlation between

the criterion and vocabulary alone.

3. Following induced motivation impulsive children increased their latencies on the MFF. Incentive motivation had no differential effect on the performance of impulsives on the DAP, DAL and Rutgers tests.

4. The reflection-impulsivity dimension is not related to the ability to delay immediate gratification.

5. The performance of the two 'anomalous groups', the fast-accurate and the slow-inaccurate groups, did not differ on verbal, motor, perceptual-motor, scholastic and cognitive tasks.

Implications based on the findings of this study were discussed and suggestions for further research were made.

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CHAPTER I

INTRODUCTION

The reflection-impulsivity (R-I) dimension is defined by Kagan and Kogan (1970) as "... the degree to which the subject reflects on the validity of his solution hypotheses in problems that contain response uncertainty" (p. 1309). On one hand, reflective children characteristically delay before responding and consider alternatives available to them and compare their validity. Impulsive children, on the other hand, have a fast conceptual tempo; they report the first classification that occurs to them or carry out the first "solution sequence" that appears appropriate. Since the R-I dimension was first postulated (Kagan, Rosman, Day, Albert & Phillips, 1964), it has been claimed that conceptual tempo can account for individual differences on various psychological tasks and especially those of educational significance. However there is insufficient and often inconclusive knowledge of the differential effects of an impulsive or reflective conceptual style on learning and classroom performance.

The purpose of the present study was to determine whether reflective and impulsive children differ in their performance on verbal, cognitive, scholastic, motor and perceptual-motor tasks; to determine whether reflectives can delay immediate gratification better than impulsives and to find out whether incentive motivation ameliorates the performance of impulsive children.

In Chapter Two of this study the research literature on reflection-impulsivity is reviewed and critically examined. Measurements of the construct, its correlates, its hypothesized antecedents, and the attempts that have been made to modify it are discussed. Implications relevant to the field of education are explored and an attempt is made to relate the R-I dimension to the mainstream of psychology. Where pertinent, implications derived from the literature are presented and several issues of theoretical and applied significance are raised. Chapter Two concludes with the presentation of six testable hypotheses which were derived from both theory and research. Method and procedure are considered in Chapter Three and the results of this research are presented and discussed in Chapter Four. The findings and conclusions arrived at are summarized in the final chapter and suggestions for further research complete the matter.

CHAPTER II

REVIEW OF THE RESEARCH AND THEORETICAL FRAMEWORK

Definition of Reflection-Impulsivity

Kagan, Rosman, Day, Albert and Phillips (1964) developed the construct reflection-impulsivity to account for individual differences on tasks which are characterized by high response uncertainty. This behavioral dimension may be defined as the degree to which an individual delays responding in order to reflect upon the differential validity of alternative solutions in problem situations where several probable responses are simultaneously available. The conceptually reflective individual takes relatively longer to respond and makes fewer errors whereas the conceptually impulsive individual responds more quickly and makes a greater number of errors. This is the primary thesis in the entire field of R-I research.

Measurement of the R-I Dimension

Conceptual tempo or R-I attitude was investigated, operationally defined and measured utilizing the following test (Kagan et al., 1964; Kagan, 1965b; Kagan, 1966):

Conceptual Style Test (CST). This test consists of thirty stimuli each illustrating line drawings of three familiar objects (i.e., watch, man, ruler). The subject is asked to select two pictures that are alike in some way and to state the reason for his grouping. Responses are classified as analytic concepts (i.e., a concept based on similarity in an objective element that was a differentiated component of only two of the stimuli, such as "the watch and ruler have numbers") or as inferential concepts (i.e., thematic, such as "the man can wear the watch"). Scores are the number of analytic concepts and the average response time to concept selection.

Haptic-Visual Matching Test (HVM). In this test the subject explores with his fingers a wooden form to which he has no visual access. When the subject withdraws his hands, he is presented with an array of five stimuli and asked to recognize the form he explored haptically. Scores are the number of errors, response time and palpation time.

Delayed Recall of Designs Test (DRT). In this test the subject is shown a drawing of a simple geometric design for five seconds. This standard is removed and af fifteen seconds the subject is presented with an array of similar stimuli and told to select a design that is identical to the standard. Scores are the number of errors and average response time.

Matching Familiar Figures Test (MFF). In this test the subject is shown a picture of a familiar object (the standard) and six similar stimuli only one of which is identical to the standard (no attempt is made to determine whether the figures are indeed familiar to the subject). The subject is told to select the one stimulus that is identical to the standard. Scores are the number of errors and average response time to first selection. This test is the one most widely used in studies of R-I.

Pervasiveness of R-I

These tests of R-I were administered to children of different ages in a variety of schools. In general the results indicate (Kagan et al., 1964; Kagan, 1965, 1966; Kagan & Kogan, 1970):

1. Developmental trend: With age, there is an increase in analytic concepts on CST, decrease in error and increase in response time on DRT, MFF and HVM. Souch (1970) found no relationship between age and reflectivity (as measured by the MFF). For example, grade one and grade five children did not differ with respect to MFF latencies.

2. Generality across tasks: Extensive work was done by Kagan (1965a) investigating the intercorrelations between response time and error scores on these tests for boys and girls in grades 1, 2 and 3. (Sample size ranged from 46 to 84). The results indicate that the

intercorrelati s were moderate to high. For example, the correlations between MFF and HVM response time ranged between .61 and .87 with a median coefficient of .64. Also, the time the child took to explore a wooden form in HVM (palpation time) was positively related to response time on HVM (r ranged from .36 to .72 with a median r of .61).

3. Relationship between decision time and errors: The correlations between errors and response time for each of the tests (DRT, HVM and MFF) were negative, ranging between -.30 to -.75 with a median coefficient of -.48.

4. Stability of scores: Stability of scores as assessed by test-retest after varying intervals was adequate for psychometric purposes. Kagan (1965a) reported that the average test-retest coefficient after a one year interval was .62 (n = 104 grade 3 or 4 pupils). In a second study (n = 102 grade one pupils) test-retest coefficients after a one year interval were .48 for boys and .52 for girls. Recently Duckworth, Ragland, Sommerfeld and Wyne (1974) reported that test-retest reliability over a two month period was .96 for mean response time and .87 for number of errors on the MFF.

On these tests, impulsives had relatively short latencies and made relatively more errors. The reverse was true for reflectives. In addition, two small "anamalous groups" were identified (Kagan, 1966). The first group was made up of "... bright subjects who can have relatively fast response times on easy tasks b t make few errors" (p. 503). The second group contained "... children whose long response times result from extreme fear" (p. 503), an apparently plausible speculation. They fail to respond quickly according to Kagan because they have no idea what to say and are afraid of offering any answer. It is unfortunate that most researchers have excluded these two anamalous groups from their studies. For example, insight about scanning strategies and decision making might be gained by comparing fast and accurate with slow and accurate subjects. Research which compares the behavior of the four groups rather than that of the two groups is needed.

Correlates of R-I

R-I and Intelligence. The correlations between verbal ability (mean score on WISC vocabulary, information and similarities) and recognition error ranged from -.02 to -.36 for the MFF and from -.06 to -.51 for the HVM. The correlations between verbal ability and decision time ranged from .46 to -.16 for the MFF (Kagan, et al., 1964; Kagan, 1965b; Kagan, 1966). It should be noted that Kagan and his associates did not comment about these discrepancies and did not offer an explanation as to why the remaining WISC subtests were not administered. Recently, Kagan and Kogan (1970) stated that "... there is generally a low, usually nonsignificant relation between language skill and this dimension" (p. 1310). However Gupta (1970) and Souch (1970) found that reflective subjects had a higher Lorge-Thorndike mean IQ score compared with impulsives. Williams (1970) using a large sample of subjects from grades 1 to 6 found that reflectives scored higher than impulsives on the Goodenough-Harris Test. Also, Meichenbaum and Goodman (1969) found that Primary Mental Abilities scores correlated -.61 with MFF error and .38 with MFF time. West (1973) found a significant curvilinear relationship between MFF latencies and WISC Full Scale IQ and his data suggest that children who performed fast on the MFF had lower Verbal IQ scores as compared with those whose performance on the MFF was relatively slow. It should be noted that in those studies in which differences in intelligence were found between reflectives and impulsives, tests with multiple choices were used. Multiple-choice items require reflection over alternative solutions, a task which impulsives do not or can not perform adequately. On multiple-choice items, a person does not produce, or generate hypotheses. He only evaluates the adequacy of existing solutions. The available data suggest that the relationship between R-I and intelligence as measured by different IQ tests should be re-evaluated and the following questions answered:

1. Are impulsives duller than reflectives?

2. On a multiple choice vocabulary test with many response alternatives (i.e.--Spade: Card, Hoe, Digging Tool, Cut, Spear), will impulsives perform more poorly than reflectives and will the difference between the groups (if found), diminish as a function of response alternatives?

3. Will impulsives, matched with reflectives on Wisc information, arithmetic, vocabulary and digit span subtests (or other tests with minimum response alternatives) perform poorly on the Raven Progressive Matrices or any other test which requires reflection over the choice of alternatives?

4. In general, one wonders whether a long history of impulsivity will have a deleterious affect on cognitive functions. It might be that what starts as a faulty habit eventually ends up as a deficit. It would be worthwhile to find out whether older, as compared with younger impulsive subjects show larger deficits on various psychological tests.

R-I and school achievement. Kagan (1965a) demonstrated that first-grade impulsives made more errors on word and letter recognition and on oral reading tests as compared with reflectives. Cathcart and Liedtke (1969) found that reflectives performed better than impulsives on an arithmetic test. Messer (1970a) showed that children who failed a grade were more impulsive when they started grade one and remained more impulsive at the end of 2.5 years, compared with children of the same age who did not fail a grade. Gupta (1970) found that reflectives obtained higher grades in high school than impulsives, while Campbell (1968) did not find any differences in scholastic achievement between reflectives and impulsives. Keogh and Donlon (1972) found that children who manifested serious learning and behavioral disorders were more impulsive compared with boys who had more moderate learning difficulties. It is unfortunate that in this study the groups were not matched for age and IQ. Also, it is impossible to determine whether severity of learning disorder or severity of behavior disorder accounts for the difference between the groups. These findings raise the following issues:

1. Will children diagnosed "Dyslexics" perform as impulsives on the MFF?

2. Does impulsivity contribute to school failure of children with normal intelligence?

<u>R-I, motor and perceptual-motor tasks</u>. Kagan, Rosman, Day, Albert and Phillips (1964) instructed grade two and three subjects to draw a line as slowly as they could. The correlations between DRT error and time to draw a line were -.44 and -.39 for boys. The relationship was lower for girls. It should be noted that drawing a line does not call for reflection over alternatives. What is

required is the inhibition of a tendency to respond quickly. Meichenbaum and Goodman (1969) found that impulsive pre-school children were less capable of inhibiting a motor response as compared with reflectives. Kagan (1966) observed that boys who reported many analytic concepts were less distractible in the classroom and "... were less likely to display task-irrelevant gross motor behavior" (p. 500). He further mentioned that extremely impulsive boys in their studies were also excessively restless and distractible and he speculated (without any basis) that they may have suffered "subtle cerebral damage early in life" (p. 519). Fisher (1966) reported that a group of disturbed children whose main characteristics were extreme impulsivity, distractability and lack of control did not differ significantly from a normal control group on the CST performance. Fisher offered a reinterpretation of Kagan's finding: A child who takes more time, puts off rewards and carefully appraises visual stimuli "... is not so much 'reflective' as anxiously indecisive" (p. 431). Campbell, Douglas and Morganstern (1971) showed that a group of hyperactive children made more errors and had shorter latencies on the MFF as compared with normal children. Juliano (1974) found that hyperactive children did not differ from normals on MFF latencies. R-I was also implicated in educational and behavioral functioning of hyperactive children with learning problems. Keogh (1971) speculated that hyperactive children make decisions too rapidly - behavior much resembling that of impulsives. Kagan (1965a) reported correlations in the .70s between MFF response time and good Bender-Gestalt scores. (Kagan did not specify the criterion by which 'good' Bender-Gestalt scores were determined). In his opinion "... poor Bender scores from subjects with reading problems may arise from an impulsive disposition" (p. 627) and not from a perceptual deficiency. Keogh and Donlon (1972) reported a significant correlation between MFF error and scores on the Pattern Walking Test (r = -.41, n = 27 severe learning disability subjects). This correlation was not significant for a second sample of children with moderate learning disability. In this second sample MFF latencies correlated significantly with scores on the Pattern Walking Test (r = .48, n = 25).

Anderson (1962) found a significant correlation between motor inhibition and cognitive performance. He offered two probable explanations for his finding. (a) An impulsive person acts quickly, without much reflection, generalizes on the minimum of evidence and reaches perceptual closure quickly--characteristics which impair cognitive performance. (b) The impulsive is easily aroused and his capacity to exercise corticoreticular control is weak. Anderson further hypothesized that the antecedents of impulsivity are child-rearing practices which do not involve positive reinforcement of motor inhibition.

The following questions arise from the literature which was surveyed:

1. What is the relationship between R-I and gross and fine motor activity?

2. What is the relationship between R-I and performance on perceptual motor tests such as the Frostig and the Rutgers?

3. If Kagan's argument that poor performance on the Bender is caused by an impulsive approach to execution of the problem and not to perceptual deficit, will modification of impulsivity result in better performance on the Bender-Gestalt or other perceptual-motor tests?

4. Are retardates more impulsive than normals?

R-I and self-generated alternatives. Kagan (1965b) stated that R-I performance also generalizes "... to tasks where the child must generate his own alternatives" (p. 141). When incongruous pictures were presented on a tachistoscope, latency of response correlated .40 with response time on the MFF. On a serial learning task, impulsives and reflectives did not differ on number of words correctly recalled. However, impulsives made more errors of commission (intrusion errors) while reflectives were better able to inhibit inappropriate responses. Kagan et al. (1964) instructed children to "draw a face" (DAF). Score on this test was the number of features drawn. Impulsive subjects scored lower than reflectives on this task. Of interest is the finding of no significant relationship between scores on the DAF and verbal IQ, since DAF is very similar to the Draw-A-Person Test (DAP) which was shown to correlate significantly with various IQ and achievement tests (Goodenough, 1928; Harris, 1963). Williams (1970) using a large sample (n = 450 grades 1 to 6 pupils) found that impulsives performed poorer than reflectives on the Goodenough-Harris. The differences were significant for males and combined males and females group, but not for females. When Lorge Thorndike IQ scores were partialled out the differences were found to be not significant. In that study, IQ was related to both R-I and DAP and partialling out its effect may have removed the effect of R-I on the DAP.

The research reviewed suggests that:

1. The relationship between R-I, DAF, DAP, IQ and achievement should be re-evaluated.

2. Perhaps the most important question is: Does the knowledge of a child's relative position on the R-I dimension add to the understanding and better prediction of his behavior? If verbal IQ and R-I are independent (as Kagan suggests) and, if both IQ and R-I scores predict academic achievement, it follows that multiple correlations between academic achievement as a criterion and IQ and R-I scores as predictors will be significantly greater than the correlations between the criterion and IQ alone.

R-I and attention. Kagan et al. (1964) observed that analytic responses were preceded by a delay and suggested that during this delay the subject was reflecting over alternative solutions. Impulsives acted first, and discovered later if they were correct. Kagan (1965b) reported a high correlation (.91) between head-eye fixation of the standard on the MFF test and mean response time. Campbell (1968) who labelled this behavior "Vicarious Trial and Error" (VTE) found that VTE frequency in reflective children was more than double than that of impulsive children. Siegleman (1969) who required that subjects press a button to view the stimuli, found that reflectives had a higher frequency of observing responses, while impulsives ignored twice as many alternatives. Kagan et al. (1964) observed that in the classroom impulsive children attended less to school tasks and spent more time looking away from the task; impulsives were more likely to display momentary lapses of attention or to orient to distracting sounds during a period when they were working on an academic task. Reflectives showed less distractibility and were capable of greater concentration and persistence. Keogh and Donlon (1972) suggested (but did not provide data) that in the severe learning disability group (the highly impulsive group) performance on the MFF and other tests deteriorated over trials, while the reverse was true for the comparison group. They further suggested that heightened anxiety, poor motivation or inability to maintain attention might be the contributing variables.

The relationship between R-I and observing responses, ignoring and not viewing all six alternatives on the MFF and reflection over alternative hypotheses is not clear. Conceptually, these are not the same operations. A child may move his eyes from one stimulus to another and not form a single hypothesis; he may scan all the alternatives but not attend to all relevant dimensions. It would be worthwhile asking the subject to verbalize aloud his mental operations while performing on the MFF, using an apparatus in which an active response will make stimuli available, one at a time. This would help to determine whether the difference between reflectives and impulsives is due to scanning, attention, hypothesis formation or reflection over hypotheses. Also such a procedure may serve as a basis for a modelling experiment in which the model displays reflection rather than delay.

Deficient attention was also implicated in schizophrenia (Paine, 1968), retardation (Zeaman & House, 1963) and minimal brain dysfunction (Cruickshank and Paul, 1971). It would be worthwhile determining how these groups perform on the MFF. Likewise, it would be of interest to examine the performance of impulsive children on various tasks which involve attention and/or distractability.

Perhaps at this point it would also be worthwhile reflecting on the MFF. One can conceptualize the standard as a compound stimulus having at least n distinctive features which the subject has to attend to, remember these features and scan each of the variants for absence of any of these features or match one of the variants to the standard on the basis of all features present. Suppose that the subject attends only to three dimensions (say, the number of portholes, the height of the smokestacks and the position of the anchor) and forms a hypothesis which takes into consideration only these three dimensions. He then reflects on the validity of his solution and responds accordingly. It seems that formation of hypotheses and reflection without attention to all the relevant distinctive features will result in error. MFF, then, is a complex matching to sample test and subjects with visual deficits, poor memory, deficient attention and those who are distracted by numerous irrelevant stimuli (as well as those who do not delay, scan and reflect) are expected to perform poorly on this test and to be classified as 'impulsives'. Clearly, what is required is the linkage of the construct to other significant and potentially related psychological variables.

<u>R-I and social class</u>. Yando and Kagan (1968) found no relation between socio-economic status and MFF scores. Schwebel (1966) found that lower class children responded

much faster on verbal and conceptual tasks compared to middle class children. Many did not listen to the directions and responded almost before the instructions were completed. Souch (1970) found that R-I is related to social class. A higher proportion of impulsive children came from lower socioeconomic homes. These findings were not replicated by Gupta (1970). The relationship between R-I and social class needs clarification. It would be of interest to find what relationships there are between socioeconomic class and other related variables such as child-rearing practices, parent-child interaction, parental expectation and attitudes and R-I, while controlling for variables such as IQ and comprehension of instructions.

R-I and sex differences. The relationship between sex and R-I is not clear. For example, Kagan (1965a) found that MFF errors correlated better with reading scores among girls, while MFF latencies correlated better with reading among boys. Also, Kagan (1965b) reported a significant correlation between intrusion errors on a recall task and MFF errors for boys, but not for girls. He did not offer an explanation for these findings. Of importance is the fact that in all other research surveyed there was not a single hypothesis regarding sex differences and no rationale was offered as to why sex was taken into consideration in statistical analyses.

R-I and personality variables. Gupta (1970) found that introversion, neuroticism, risk-taking attitude, internal-external locus of control, agreeing response set and anxiety level did not correlate with the R-I dimension. Of interest is the finding that Barratt's Impulsiveness Scale (Barratt, 1965) did not correlate with the R-I dimension. According to Barratt, the impulsive is characterized as one who "acts without thinking" and "lacks impulse control" (p. 250)--behavior much similar to Kagan's impulsivity. It is expected that because of the similarity of the definitions of Kagan's impulsivity and Barratt's impulsiveness, the two dimensions should correlate significantly. It would be worthwhile determining whether the relationship, over as wide a range of subjects as possible, between Kagan's R-I, Barratt's impulsiveness, Kipnis' (1971) impulsiveness, Cruickshank and Paul's (1971) impulsivity and concepts such as impulse control and delay of gratification is psychological or semantic in nature. For example, Mischel and Metzner (1962) hypothesized that the ability to delay gratification "... can be ranged on a continuum from uncontrollable impulsivity to compulsive postponement" (p. 425). Furthermore, they stated that "... learning to delay is intimately bound up with learning to think; i.e., the use of cognitive reality testing replaces the use of uncontrolled motor discharge in the attainment of needs" (p. 425). This idea much resembles

Kagan's (1966) who stated that the reflective child is "... more able to tolerate the delay between presentation of the problem and the offering of a solution" (p. 520). An additional significant contribution would be to determine whether Mischel et al.'s ability to delay immediate gratification is related to the R-I dimension.

Modification of R-I

Kagan, Pearson and Welch (1966) attempted to modify impulsivity. "The training procedure emphasized inhibition of impulsive answers, but placed no emphasis on more efficient visual scanning technique or on more analytic reasoning. The children were trained only to delay their answers" (p. 362). Results indicated that trained impulsive subjects increased their response time but error scores were not affected by such training. Debus (1970) demonstrated that watching a reflective model who showed latencies of 30 seconds led to slower response time, but errors were not changed. Yando and Kagan (1968) demonstrated that first-grade children who were taught by experienced (over eight years) reflective teachers showed a significant increase in response time, but again, there was no change in error scores. Messer (1970b) demonstrated that both reflectives and impulsives performed slower following induced anxiety. Induced anxiety was brought about by telling subjects that they had failed the previous test. Meichenbaum and Goodman (1969), using Luria's

(1961) procedure, demonstrated that when overt differential verbal responses were made in the presence of the positive and negative stimuli, impulsive children were able to inhibit their inappropriate motor responses. Duckworth et al. (1974) demonstrated that visual discrimination training, with or without verbal reinforcement over a period of seven weeks was sufficient to modify an impulsive tempo. In this study, both latency and error scores were improved after intensive visual discrimination training. Kagan (1967) reported about a prematurely-born child who responded impulsively on an embedded figure test and made numerous errors. However, when sitting on his mother's lap, he inhibited his impulsive behavior, reflected adequately before offering a solution and performed well even on difficult items. Drug therapy was recently used for the modification of impulsivity. Campbell et al. (1971) showed that while on the drug methylphenidate impulsive children performed slower and made less errors on the MFF compared with their scores on pretesting or while on a placebo. They suggested that the drug brings about a general increase in attention, response organization and impulse control.

The studies cited suggest that (a) some aspects of impulsivity can be modified and that (b) training subjects to inhibit their responses will not result in a decrease in errors. As Yando and Kagan (1968) stated "... it is obvious that specific training in scanning strategies is required" (p. 33). Heider (1971) who instructed a group of children to delay responding and to scan and compare all stimuli with the standard showed that this procedure was effective in bringing about change in both latency and error scores. It would be worthwhile finding out whether following training in scanning, changes in performance will occur on the MFF, Bender, DAF, and reading tests. The findings regarding teachers' R-I disposition and its relevance for behavior modification suggest that parents' R-I disposition and its relation to that of their children's should be investigated. It is possible that reflection and impulsivity are learned through the modeling behavior of the parents. Findings such as these, if proven significant, may have important implications regarding the origin and the modification of such behavior.

Antecedents and Dynamics of R-I

Kagan et al. (1964) speculated that extreme impulsivity might be "... a partial consequent of subtle cerebral insult early in life" (p. 33) and also that biological processes, "unrelated to CNS insult", could also account for large individual differences. (The nature of these biological processes was not specified). To account for Schwebel's (1966) data regarding the relationship between R-I and social class, Kagan (1967) speculated that the incidence of pre and perinatal trauma are greater in lower class children and this "... increases the risk of subtle damage to brain stem centers and therefore, insult to inhibition system" (p. 510). In the same article he offered an alternate hypothesis: "... Young preschool children who appear impulsive and incapable of inhibition are able to inhibit. However, their willingness or motivation to inhibit is weak" (p. 510). He further suggested that the parents had not tried to train their child to inhibit. Heider (1971) told a group of children that if they made few enough mistakes they would be rewarded by being allowed to play with toys at the end of the testing. Results indicated that this group performed slower on the MFF as compared to a control group but there was no significant difference between the groups on error scores. In this study no pretest measures were taken, subjects were not divided into reflectives and impulsives and the experimenter did not ascertain that playing with toys had an incentive value for the children. In the same experiment Heider instructed a group of subjects to scan and compare all stimuli and also to delay responding until they found the way in which every single figure but one was different from the standard. This group performed slower and made less errors as compared with the control group. Thus the hypothesis which attributes impulsivity to improper training received some support. Kagan et al. (1964) speculated that the degree of involvement with the task is an important variable. The child who has high standards of performance should be more likely to reflect over alternative hypotheses. The child who cares less about the quality of the product should be likely to adopt an impulsive trial-and-error strategy. Kagan and Kogan (1970) speculated that the greater the fear of making a mistake the more reflective and cautious the performance, while minimal anxiety over potential errors results in an impulsive performance. They also offered an alternative hypothesis: Reflection and impulsivity are the result of different sources of anxiety. Reflectives equate imcompetence with making errors; impulsives equate incompetence with slowness. In order to avoid social censure as a result of incompetence, they act according to their respective belief systems. A simpler hypothesis was offered by Messer (1970b). He stated that impulsives are characterized by a lack of anxiety or concern over error. Reflectives in contrast are more anxious or concerned about their intellectual performance. It should be noted that although two dimensions are implicated (carelessness and amount of anxiety over error) the definition of both is lacking. Ward (1968) showed that impulsives increased their latencies on the MFF following errors. According to him, impulsive children were more responsive to evaluational cues as compared with reflective children. This finding suggests that: (a) Impulsive's performance is being modified during the testing situation. (b) The 'avoidance-of-anxiety' hypothesis is incorrect, since it predicts that following errors, impulsives will perform even faster. (c) The 'minimal anxiety over error' hypothesis is also incorrect since it predicts that following errors impulsive's performance will not change. Cultural norms were also implicated "... since our culture generally equates speed of thinking with intelligence" (p. 1313), a child who doubts his ability, but wishes to deny this doubt, will act impulsively. Kagan and Kogan further speculated about the antecedents of R-I: If emphasis was placed on avoiding errors and praise delivered "for inhibiting asocial behavior" (P. 1314), the child would define adult approval and positive self evaluation in terms of inhibition of inappropriate behavior. The impulsive child, on the other hand, was reinforced for active accomplishment rather than for inhibition of the inappropriate.

The material presented raises the following questions:

1. Are impulsives brain damaged? Will they perform as MBD children on a neuropsychological test battery? Do they manifest more neurological signs, compared with reflectives? Is the frequency of pre and post natal trauma greater for impulsives? Do adults become more impulsive following brain damage?

2. MBD children manifest numerous behavioral deficits, such as poor impulse control and perceptual and perceptual-motor deficiency (Cruickshank and Paul, 1970). Are these deficits associated with the R-I dimension?

3. Is the performance of MBD children on figure-ground test (Strauss and Lehtinen, 1947) related to R-I? Furthermore, will the reduction in impulsivity, with no training in figure-ground perception, bring about change in the performance on such a task?

4. If impulsives are indeed capable of inhibiting, but their willingness or motivation to inhibit is weak, would a change in motivation enhance their deficient performance?

5. Is it true that the parents of impulsive children did not train their children to inhibit. If so, why?

6. Are reflectives more involved with the task and are their standards of performance higher?

7. Is there an interaction between R-I and different sources of anxiety? Is there an association between impulsivity and denial and self-doubt? Will relaxation and desensitization procedures bring about change in R-I?

8. If the impulsive child has doubts regarding his intellectual capacity, is the basis for this doubt a real or imaginary one?

9. Are there between-culture differences with respect to frequency of R-I and can these differences be predicted from cultural norms?

10. If indeed reflectives were reinforced for inhibiting inappropriate and asocial behavior and in contrast, impulsives were not, will the frequency of asocial behavior be smaller for reflectives? And of more importance--are delinquents impulsive? If yes, will a change in impulsivity bring about a better prognosis?

Implications of R-I

Kagan (1966b) stated that most teachers are not attuned to this behavioral aspect of the child and rarely do they notice whether the child is impulsive or reflective in his conceptual approach to problems. "Many teachers assume that this behavior (errors in reading textual material) is the consequent of low motivation, poor visual acuity or brain damage" (p. 159). He suggested that reading difficulties could be the result of an impulsive conceptual tempo and that remedial work might well include explicit practice in reflection. He also stated that "... there is a tendency to classify the reflective child as 'slow' and less bright than the impulsive, quick child" (p. 159). Furthermore, he maintained that the impulsive child of below average ability experiences more overt failure in the classroom because of his ill-considered answers. Teachers were asked not to punish such a response, since censure would create anxiety and apathy in such children. Kagan et al. (1964) suggested that "... the anxiety resulting from repeated failure, as consequent of impulsive reporting, could lead to generalized expectation of failure and withdrawal of involvement from intellectual tasks" (p. 13).

The literature reviewed suggests the following questions:

1. Are teachers aware of individual differences along the R-I dimension? Do they make the association "slow=dull"?

2. Are reading difficulties the result of impulsivity? Will training in reflection help poor readers?

3. Do impulsive children experience more overt failure? Do they anticipate failure more frequently than do reflectives? Of more importance, are school drop-outs impulsive?

R-I and the Mainstream of Psychology

Kagan et al. (1964) demonstrated that with age there is a decrease in error and increase in response time on various measures of R-I. This age-related process could be conceptualized as perceptual or even cognitive maturity. The young child does not adequately scan the stimulus array and does not form alternative hypotheses. This process much resembles Piaget's (1964) centration: The young's perception is caught and is held by one dominant aspect of the field. It was shown by Elkind (1969) that with age perception becomes more decentered and that perceptual decentration is related to figure-ground perception, scanning and reading. It would be of importance to find out whether R-I is related to the centration-decentration dimension and more specifically, whether reflectives matched for age and IQ with impulsives will perform better on tests of perceptual decentration.

Witkin, Dyk, Faterson, Goodenough and Karp (1962) introduced the field dependence-independence dimension to account for individual differences on various tasks such as the Rod and Frame and figure-ground tests. "Field dependence-independence dimension refers quite specifically to the ability to overcome an imbedding context" (p. 58). It is probable that this ability determines to a large degree the performance on tests of R-I such as the MFF. Indeed, Keogh and Donlon (1972) found a correlation of .37 between MFF error and Rod and Frame Test scores. (This correlation approached, but did not reach statistical significance). Further investigation of the relationship between these two dimensions might be fruitful.

Anderson's (1962) hypothesis about the relationship between motor inhibition and cognitive performance may serve as a link between R-I and stimulus generalization, perceptual closure, arousal, deficient corticoreticular control, child rearing practices and positive reinforcement of motor inhibition. It would be of interest to find out (a) whether impulsivity on the MFF is related to impulsivity on Anderson's test; (b) whether perceptual closure is reached more quickly by impulsives; (c) whether the R-I dimension is related to arousal level, and most importantly (d) whether positive reinforcement of motor inhibition (the delivery of verbal, tangible or token reinforcement contingent on adequate motor inhibition on a task such as the Draw A Line Test) will have a beneficial effect and whether this effect, if obtained, will generalize to the MFF and other tests of R-I.

Dragnus and Multari (1961) using a recognition task demonstrated that younger, as compared with older children tended toward early and often incorrect identification of blurred pictures. With age children became more cautious; they waited until more cues were added and they were more certain about the identity of the stimulus. The degree of cautiousness or subjective certainty about identity of stimuli might explain the developmental change along the R-I dimension (Kagan, 1966). Moreover, Kagan's (1965a) suggestion that "... the reflective child is a low-risk child ... the impulsive child prefers a high-risk orientation" (p. 155) much resembles a classification on a cautiousness dimension. It would be of interest to find out whether reflectives and impulsives matched on age will differ on tests of cautiousness.

According to Furneaux (1961) there are at least three relatively independent determinants of problem solving ability: Speed, accuracy and persistence. Gupta (1970) who investigated the relationship between R-I and performance on Furneaux's tests found that reflectives and impulsives did not differ on Furneaux's measure of mental speed. However, the groups differed on persistence, a finding which denotes that impulsives give up easily and are not as persistent in their efforts as are reflectives. Atkinson (1965) speculated that for subjects in whom the motive to avoid failure is dominant and who begin to fail on successive trials on a given task, there is a reduction in the total strength of the tendency to perform the task and they may quit the task very soon after their initial failures. Further studies should investigate whether the lower persistence of impulsives is due to the need to avoid failure.

Easterbrook (1959) hypothesized that emotional arousal acts consistently to reduce the range of cues that an organism observes, maintains an orientation toward and responds to. Siegleman (1969) found that the frequency of observing responses of impulsives was significantly lower than that of reflectives. It is possible therefore that the range of cue utilization of impulsives is narrower than that of reflectives as a result of higher arousal level. Further research should be conducted to determine whether the emotional arousal of impulsives (as measured by bioelectrical activity or by anxiety tests) is higher than that of reflectives.

In summary: The survey of the literature, by no means exhaustive, suggests that the R-I dimension can account for individual differences on numerous tasks. However, many questions remain unanswered and more research in the area of R-I is needed.

Purpose and Predictions

Before stating the hypotheses which are to be tested in this study, a brief summary of the problem areas from which these hypotheses were derived is needed. It will be recalled that the following issues were presented in the review of the literature.

Kagan and Kogan (1970) stated that R-I is independent of verbal ability, but Gupta (1970) and Souch (1970) found the contrary. It was suggested that the format of the tests used by these investigators might account for the disparities. While the tests which were used by Kagan et al. (1964) did not use a multiple choice format, the tests used by Gupta and Souch did. It was further suggested that multiple choices involve reflection over alternatives, a task which impulsives perform poorly. It follows that if verbal subtests, with a minimum of response alternatives (such as the WISC Vocabulary and Digit Span) will be administered, reflectives will not differ from impulsives on these measures. On the other hand, the Raven Progressive Matrices is a multiple choice test which demands reflection over alternatives. It was suggested that on this test impulsives will perform more poorly than reflectives and their performance will be faster than that of reflectives.

Kagan (1965) stated that poor scores on the Bender-Gestalt Test may arise from an impulsive disposition. It follows that on a similar perceptual-motor task (Rutgers), impulsives will perform poorer than reflectives and their performance on this test will be faster than that of reflectives. Meichenbaum and Goodman (1969) and Kagan (1966, 1967) suggested that impulsives are less capable of inhibiting irrelevant motor responses. It follows that on the Draw A Line Test, a test which requires motor inhibition (and not reflection over alternatives) impulsives will perform faster than reflectives. Kagan et al. (1964) showed that performance on the Draw A Face Test is related to the R-I dimension. Since this test is very similar to the Draw A Person Test, it was suggested that impulsives will perform more poorly than reflectives and their performance would be faster than that of reflectives on the DAP.

Kagan (1965b) showed that the R-I dimension is related to reading skills. Also, Gupta (1970) showed that on a scholastic achievement test impulsives performed poorer than reflectives. If the R-I dimension is related to academic achievement and also, if R-I is independent of verbal ability (as measured by WISC Vocabulary) it follows that multiple correlation between academic achievement as a criterion and vocabulary and R-I scores as predictors will be significantly larger than the correlation between the criterion and vocabulary alone.

Kagan (1967) suggested that children who appear impulsive and incapable of inhibition are able to inhibit, however "their willingness or motivation to inhibit is weak" (p. 510). It follows that an increase in motivation, as a result of incentives, will produce a change of impulsive behavior.

It was suggested that Mischel and Metzner's (1962) construct, the ability to delay gratification, much resembles Kagan's construct of impulsivity, in that Mischel et al. postulated that learning to delay is intimately bound up with learning to think, while Kagan (1966) suggested that the reflective child is more able to tolerate the delay between presentation of the problem and the offering of a solution. It was suggested that impulsives will be able to delay immediate gratification to a lesser degree as compared with reflectives and also that the latencies of their responses on the Preference for Delayed Reward Test will be shorter than those of reflectives.

The purpose of this research was:

1. To describe the four groups (fast-accurate, fast-inaccurate, slow-accurate and slow-inaccurate) in terms of performance on verbal, cognitive, scholastic-motor and

perceptual-motor tasks. In the majority of the studies reviewed, the fast-accurate and slow-inaccurate subjects were excluded and only reflective (slow-accurate) and impulsive (fast-inaccurate) subjects were compared. It was suggested that a description of the behavior of these two 'anomalous groups' is needed as very little data is available about their performance on various psychological tasks.

2. To investigate the relationship between R-I and performance on the Raven Progressive Matrices. Since reflection over alternatives is needed on this test, a task which impulsives perform poorly, and since this test is widely used in clinical settings, not taking impulsivity into consideration might lead to inadequate conclusions about a subject's abilities.

3. To investigate the effect of incentives on the performance of impulsive children.

4. To determine whether the relationship between R-I and preference for delayed reward is psychological or semantic in nature.

The following hypotheses can be logically derived from both theory and related research:

1. There is no relationship between R-I and the WISC Vocabulary and Digit Span subtests.

2. Performance on the Raven, Rutgers, DAL and DAP tests is related to the R-I dimension; reflectives as

compared with impulsives perform better on these tests and their performance is significantly slower.

3. Reflectives score higher than impulsives on tests of scholastic achievement.

4. Multiple correlation between academic achievement as a criterion and vocabulary and R-I scores as predictors is significantly larger than the correlation between the criterion and vocabulary alone.

5. Incentive motivation has the largest effect on the performance of impulsives whose willingness or motivation to inhibit is weak. By contrast, reflective subjects' motivation to inhibit is greater so that incentive motivation affects their performance to a lesser degree.

6. Reflective subjects can delay immediate gratification better than impulsive subjects.

CHAPTER III

METHOD

Subjects

The sample for this study consisted of 121 grade two students from four Edmonton Public School System schools. There were 64 boys and 57 girls in the sample. Mean age was 93.5 months with a standard deviation of 4.9 months. No attempt was made to make the sample representative of a predetermined population. The experiment was conducted during the months of May and June, 1973.

Tests and Rationale for Test Selection

Brief descriptions of the tests which were used in this study are given below. Also, reasons as to why these tests were selected are presented.

Matching Familiar Figures

This test has been most frequently used for the investigation of the R-I dimension (Kagan, 1965a, Yando & Kagan, 1968). The subject is shown a picture of a familiar object (the standard) and six stimuli only one of which is identical to the standard. The subject is told to select the one stimulus that is identical to the standard. A record is kept of the total number of errors for each item up to a maximum of six errors, and latency to first response to the nearest half-second. A silent stop watch not visible to the subject was used for timing. Scores are the number of errors and average latency. A double median split of latency and error scores results in classification of subjects into four groups: fast-accurate (F-A), slow-accurate (S-A, reflectives), fast-inaccurate (F-I, impulsives) and slow-inaccurate (S-I). Test-retest reliability after a short interval is high. In a pilot study conducted by this investigator split half reliability between even and odd numbered items, a procedure suggested by Downie and Heath (1965) was found to be .87 for latencies and .79 for error scores (n = 15 grade two pupils). It should be noted that the determination of reflective or impulsive responding is group specific because there are no absolute standardized cutting scores available on this test.

For the purpose of the present research the test was divided into two subtests with six items and two demonstration items in each test. One subtest was made up of odd-numbered items while the second test was made up of even numbered items.

WISC Vocabulary Subtest

On this subtest (Wechsler, 1949) the subject is asked to verbally define given words. The test was selected because according to Kagan et al. (1964) it does not correlate significantly with the R-I dimension. It correlates highly with verbal intelligence and it is easy to administer and score. Also, scores on this test aid in sample description. Raw scores were converted to scaled scores according to the WISC manual.

WISC Digit Span Subtest

On this subtest (Wechsler, 1949) the subject is asked to repeat a series of digits. Since no reflection over alternatives is needed on this task, it was expected that it would not be related to the R-I dimension. If, on the other hand, this intelligence subtest did correlate significantly with the R-I dimension, it would suggest that factors other than reflection over alternatives, i.e., memory and attention, are involved in this construct. Raw scores (sum of the scores on digit-span forward and backward) were converted to scaled scores according to the WISC manual.

Coloured Progressive Matrices

This cognitive test (Raven, 1960) was selected because its format resembles that of the MFF: The subject has to reflect over six alternatives only one of which fits in the matrix. It was suggested that because of the format of the test and not because of the capacity measured, impulsives will perform poorly on it and also, that impulsives will complete the test faster than reflectives. Scores on this test were (a) time to complete the test and (b) standard scores (SS--percentiles were converted to standard scores with a mean of 100.0 and a standard deviation of 15.0). The first four items on subtest A were used for demonstration and timing began after the completion of the fourth item.

Rutgers Drawing Test (Form B)

This percepual motor test (Starr, 1969) much resembles the Bender Gestalt Test (Bender, 1938). The child is asked to copy geometrical figures. However, the Rutgers test is more suitable for use with young children and it is easier to administer and score. Scores on this test were (a) time to complete the test and (b) Drawing Quotient (DQ--drawing age divided by chronological age). The first two items were used for demonstration and timing began after the completion of the second item.

Draw A Line Test

In this test (Kagan et al., 1964) the subject is asked to draw a line as slowly as he can. On a second trial he is told to do it again even more slowly than on the previous trial. This test was chosen because the role of perceptual and cognitive factors is at a minimum while the factor of motor inhibition is at a maximum. The score on this test was the sum of the time taken (in seconds) on both trials.

Draw A Person Test

This test (Goodenough, 1926) was chosen for the following reasons: (a) According to Kagan et al.'s (1964) formulation, performance on this test is expected to be differentially affected by the R-I attitude. Since this test (and also the Rutgers and the Raven) is widely used in clinical and educational settings as a measure of intellectual development, not taking impulsivity into consideration may lead to innaccurate expectation. (b) In a preliminary investigation this test was administered to two groups of fourth-grade pupils from a low socioeconomic level. After a period of three weeks, pupils in the first groups (the experimental group) were shown a large chocolate bar and were told that the pupil who drew the best picture would receive it. The control group on that occasion received the standard instructions. The results indicated that the experimental group's performance significantly improved as a result of incentive motivation (the means on the first and the second sessions being 80.3 and 91.8 respectively). The control group's performance significantly worsened on the second testing session as compared with the first testing session (means were 86.3 and 81.9 respectively). This effect was attributed to loss of interest. This being the case, the DAP can also serve as an adequate measure of induced motivation. The scoring system used was that of Goodenough (1926) rather than that of Harris (1963) because it was simpler and faster to use. Subjects were asked to draw a picture of a man and after this was completed they were asked to draw a woman. Raw scores were converted to MA and IQ (MA divided by chronological age). Scores on this test were (a) average IQ and (b) average time to complete the two drawings.

Preference for Delayed Reward

In this test situation (Mischel and Metzner, 1962) the subject is asked to chose between an immediate, smaller reward (Im. R) and a delayed, larger one (Del. R). The test was slightly modified in order to ascertain that the objects which were offered had an incentive value for each subject (after Zigler and De Labry, 1962). First a tray containing twelve objects (four brands of chocolate bars, a box of candies, two different combs, a toy car, a bag containing 15 marbles, a felt pen, a ball-point pen and a small doll at an average cost of 14.5 cents per item) was shown to each subject. The subject was asked to select the most preferred item and the time to make a selection was noted. In the preference test, the chosen item was placed beside two such items and the subject was asked to choose between Im. R and Del. R. The subject was told that he could have "the smaller prize now or the larger one next week". His choice as well as the time to make the decision were recorded.

Blishen's Canadian Occupational Scale

This measure of socioeconomic status (Blishen, 1968) which provides rank scores for various occupational groups was used primarily for sample description. The parent's occupation was obtained from the child's school record. In cases where both parents were working, only the father's occupation was used. If the parent's occupation could not be obtained from the record or the classroom teacher, this information was obtained from the child. One necessary modification was introduced. A score of 25.0, the lowest on the scale was assigned to families on welfare.

Stanford Reading Achievement Test

This standard test (Kelley, Madden, Gardner and Radman, 1964) measures vocabulary and comprehension. The three subtests which were administered were: Word Meaning, Paragraph Meaning and Word Study Skills. In all three tests the answer format is multiple-choice. Percentiles on each subtest were converted to standard scores with a mean of 100.0 and a standard deviation of 15.0.

Elementary School Mathematics Survey

This test was devised by the Department of Pupil Assessment of The City of Edmonton Public School System. It evaluates conceptual as well as computational skills. Percentiles were converted to standard scores with a mean of 100.0 and a standard deviation of 15.0.

The mathematics and reading tests were administered by the classroom teachers as part of the regular test program in the schools and the results in term of percentiles were made available to the experimenter.

Procedure

The subjects were tested individually in two sessions by two experimenters, a male and a female. In the first session one MFF subtest (odd numbered items), the WISC Vocabulary and Digit Span subtests, the Raven, Rutgers, DAL and the DAP were administered to all subjects in random order and under standard instructions. Following testing, subjects were divided into four groups using a double median split of the MFF latency and error scores. The four groups were: Fast-accurate (F-A, n = 20), slow-accurate (S-A, reflectives, n = 41), fast-inaccurate (F-I, impulsives, n = 40) and slow-inaccurate (S-I, n = 20). In the second session only two of these groups were tested--reflectives (slow-accurate) and impulsives (fast-inaccurate). These two groups were each divided into experimental and control groups. Twenty-one subjects were assigned to the reflective-experimental group (R-E), 20 to the reflective-control group (R-C), 20 to the impulsive-experimental group (I-E) and 20 to the impulsive-control group (I-C). Assignment of subjects to groups was random with one restriction, namely that the proportion of male:female in each subgroup was the same. Random assignment of subjects was a procedure preferred to matching because of the number of variables involved. Just before testing each of the subjects in the experimental groups was shown a tray containing the various incentives and was told to select a preferred item. After the selection was made, the subject was told that he could win that object as a prize if he performed well. The following instructions were given:

> Remember, last time we did some tests? This time we will do some more. See this tray? (E introduced the tray which contained the various incentives). Which one do you like best? (Timing started at this point and terminated when the subject indicated his choice). That's fine (after selection was made). You can win this one if, and only if you do your best on the tests today. Remember in order to win the prize you have to do your best.

In the second session the second MFF subtest, the Rutgers, DAL and DAP were administered in random order. At the beginning of each test, the subjects in the experimental groups were reminded that in order to win the prize they had to do their best. Subjects in the control groups were given the following instructions:

> Remember, last time we did some tests? This time we will do some more.

Because this experiment was not designed to test the effect of reinforcement or feedback or the role of specific instructions, no further cues were supplied to either groups.

After all testing were completed, each subject was thanked and told that he did well. Each subject in the control groups was shown the tray containing the prizes and was asked to select the object he liked best and the latency of that response was recorded. Preference for delayed reward was conducted with the control groups right after the selection of the reward and for the experimental groups after all tests were concluded. In this choice situation for both the experimental and control groups, the prize which was selected by the subject was placed on a table and beside it, at a distance of about one foot was placed a second prize, the same in quality but double in value and being perceived by the subject as such (for example, if the subject selected a bag of marbles, the larger prize was two bags of marbles, etc.). The following instructions were delivered:

> See these two? (E pointed to the prizes). I would like to thank you for your cooperation and fine performance. Which one of these things will you chose: The smaller one (E pointed to the smaller prize) now, or, the larger one (E pointed to the larger prize) next week?

The subject's choice (Im. R vs. Del. R) and the latency of his choice were recorded. All subjects were given the prizes they had chosen at the promised time.

In order to minimize communication between subjects regarding the incentives, all the control subjects from the classroom were tested first. Subjects who completed the task were kept occupied in an adjacent room until all the testing on the control subjects in that classroom was completed. The experimental subjects from that classroom were then brought for testing. They were kept occupied in an adjacent area and returned to their classroom immediately after individual testing was completed.

CHAPTER IV

RESULTS AND DISCUSSION

Sample Description

Means and standard deviations for age, socioeconomic status, the tests which were used in session one and the reading and mathematics tests are presented in Table 1. Inspection of the means suggests that the sample is slightly above average on the Vocabulary and the Raven and below average on the Rutgers. However, calculation of the 95 percent confidence interval (Downie and Heath, 1965) for each of these means revealed that the expected means (10.0 for Vocabulary and 100.0 for the Raven and the Rutgers) are within this interval. Digit Span, DAP and scholastic achievement means are very close to the expected means (10.0 for Digit Span and 100.0 for DAP and scholastic achievement). MFF mean latency is very similar to Souch's (1970) data for his grade two pupils (12.8) and to Kagan's (1966) data for the same grade level (12.6). Mean errors was approximately 13.0 in Kagan's sample and 13.3 in Souch's sample. Mean error for this sample (6.3) is not comparable because only half of the MFF was administered. There are no normative data available for comparison in the case of the Blishen Scale, DAL, Raven, Rutgers and DAP Time scores.

TABLE 1

'MPLE DESCRIPTION. MEANS AND STANDARD
.ATIONS OF DESCRIPTIVE VARIABLES AND
TESTS ADMINISTERED IN SESSION ONE

Variable	Unit of Measurement	Mean	SD
Age	months	93.5	4.9
Blishen		39.8	17.1
MFF Latency	seconds	13.3	7.2
MFF Errors		6.3	3.3
Vocabulary	scaled scores	13.3	2.5
Digit Span	scaled scores	10.0	2.6
DAL	seconds	54.5	11.1
Rutgers DQ		91.9	15.4
Rutgers Time	minutes	372.0	148.1
Raven SS		111.7	14.3
Raven Time	minutes	519.0	162.4
DAP IQ		98.8	16.4
DAP Time	minutes	154.9	90.1
Word Meaning	standard scores	98.8	15.7
Paragraph Meaning	standard scores	98.7	16.2
Word Study Skills	standard scores	99.0	15.8
Mathematics	standard scores	96.6	15.2

Reliability and Stability of Measurements

In order to determine the reliability of the tests which were utilized in this research, the scores of the control groups (S-A control, n = 19; F-I control, n = 20) which were obtained in the two testing sessions were correlated. Also, t tests for correlated samples (Downie & Heath, 1965) were performed in order to determine the significance of the differences between means which were obtained on the first and second session. Results are presented in Table 2. As can be seen, the DAL is the least reliable test. A correlation coefficient of .33 is statistically significant beyond the .05 level (df = 37) but it denotes little reliability. This unreliability might be due to two factors. (a) Only two trials were given on this test and it is possible that two trials are not a reliable measure of the behavior under investigation. It is suggested that if this test is to be used for research purposes, more than two trials should be given. (b) The behavior which the test samples is not stable over time. The differences between the means of MFF latency and error and Rutgers DQ were not significant. On the DAL second session (retest) the performance was significantly slower as compared with the first session. This too may be attributed to either or both of the factors which were mentioned above. On the DAP IQ significantly poorer scores were obtained on retest and the performance was significantly faster. Also Rutgers performance was significantly faster on the second session. It was noted that many subjects in the control groups responded with "Oh, no, not again" when they were asked to do the same tests the second time. In contrast, the children in the experimental groups seemed very enthusiastic. It is suggested that two factors, familiarity and boredom, might affect the retest scores of the control groups.

TABLE 2

CORRELATIONS BETWEEN SCORES OF R-C AND I-C GROUPS COMBINED (n = 39) ON SESSIONS 1 AND 2, MEANS FOR TESTS ON THE TWO SESSIONS AND SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS

Variable	Correlation	Session 1 Mean	Session 2 Mean	p*
MFF Latency	.92	13.8	13.8	N.S.
MFF Errors	.81	6.5	7.1	N.S.
DAL	.33	49.0	66.6	.02
Rutgers DQ	.84	90.6	91.2	N.S.
Rutgers Time	.79	395.2	313.6	.01
DAP IQ	.82	93.8	88.4	.01
DAP Time	.76	160.1	128.3	.02

*df = 38

The data presented indicates that the tests with the exception of the DAL are reliable. The means of the DAL, DAP IQ and Time and Rutgers Time on the second session appear to be influenced by the variables which were mentioned above.

Sex Difference on the MFF

In order to determine whether the performance of males and females differed on the MFF, t-tests for independent samples (Downie and Heath, 1965) were performed. Means of latency for males and females were 13.2 and 13.4 respectively. The difference between the means was found to be not significant (p = .8, df = 119). Means of error scores for males and females were 6.5 and 6.1 respectively. The difference between the means was not significant (p = .5, df = 119). These results are congruent with Souch's (1970) data. It was decided to ignore sex differences for the purpose of the present investigation. Sex however was taken into consideration when subjects were assigned to the experimental or control groups.

Description of the Four Subgroups: F-A, S-A, F-I and S-I

Median latency on the MFF was 10.9 seconds. Subjects who obtained this score or below were classified as "Fast" and those who obtained a score of 11.0 seconds and above were classified as "slow". Sixty-one out of 121 subjects obtained an error score of 6 or below and were classified as "Accurate". Subjects whose error score was 7 or above were classified as "Inaccurate". Table 3 depicts the frequency of subjects in each group.

TABLE 3

FREQUENCY OF SUBJECTS IN EACH
OF THE FOUR GROUPS

	F-A	S-A	F-I	S-I
Males	10	21	20	13
Females	10	20	20	7
Total	20	41	40	20

One-way analyses of variance for unequal sample sizes (Winer, 1962) were performed on the data in order to determine whether there were significant differences between the means of the four groups. The means of the four groups, F ratios resulting from the analyses of variance and probability values (p) associated with these ratios (df = 3, 117) are presented in Table 4. As can be seen from the table, significant differences (beyond the .05 level) were obtained for age, Blishen, Rutgers DQ, DAP Time and Mathematics. In order to determine the significance of the differences between pairs of means, the procedure suggested by Scheffé for making a posteriori test (Ferguson, 1966) was used. The comparisons revealed that S-A (reflectives) differed significantly ($p < .05$) from F-I (impulsives) on DAP Time and Mathematics. Also impulsives differed significantly from S-I on the Blishen and

Rutgers DQ. All other comparisons were not significant. It should be noted that the Scheffé method is more rigorous than other methods of comparisons and that it will lead to fewer significant results.

The finding that the S-I group did not differ significantly from the other three groups on verbal ability congruent with Souch's (1970) data. The high error score of this group on the MFF could not be attributed to a hasty performance or to poor verbal skill or to general dullness. The data of the Raven, Rutgers and DAP support this interpretation. Kagan (1966) attributed the long latencies of this group to extreme fear resulting from their inability to formulate appropriate solutions, but he gave no explanation as to why they could not formulate solutions. In the present study the children were closely observed and the anxious child was the exception. It is possible that the slow-inaccurate subjects were very cautious and consequently attended to minute and insignificant details, formed too many hypotheses or irrelevant ones which, in turn taxed their memory or produced interference thus hindering accurate evaluation of hypotheses.

The finding that fast-accurate subjects did not differ significantly from the other three groups on Vocabulary, Rutgers DQ, Raven SS, DAP IQ and scholastic achievement does not agree with Kagan's (1966) statement that this group is made up of 'bright subjects'. A possible

TABLE 4

MEANS OF THE FOUR GROUPS ON SEVENTEEN VARIABLES AND RESULTS OF ANALYSES OF VARIANCE

Variable	F-A	S-A	F-I	S-I	*F*	*p**
Age	91.8	95.3	93.3	92.1	3.28	.02
Blishen	40.5	40.1	35.0	48.4	2.82	.04
MFF Latency	8.0	19.5	8.2	16.2	43.50	.00
MFF Errors	3.9	3.5	9.2	8.8	79.20	.00
Vocabulary	12.8	13.9	12.6	14.0	2.53	.06
Digit Span	10.9	10.2	9.5	10.0	1.35	.26
DAL	54.7	58.3	46.1	63.4	1.89	.13
Rutgers DQ	87.7	94.9	87.3	99.1	3.86	.01
Rutgers Time	311.2	402.4	365.6	383.0	1.78	.15
Raven SS	113.4	114.5	107.4	112.6	1.88	.13
Raven Time	446.7	521.6	559.2	505.7	2.24	.08
DAP IQ	102.7	101.3	94.0	99.4	1.89	.13
DAP Time	140.5	189.8	129.8	147.9	3.46	.01
Word Meaning	97.9	101.8	95.3	100.8	1.28	.28
Paragraph Meaning	98.1	102.0	94.7	100.8	1.50	.21
Word Study Skills	100.9	102.8	94.8	98.0	1.84	.14
Mathematics	96.2	102.9	88.9	99.9	6.80	.01

**df* = 3,117

explanation of their performance on the MFF is that their visual discrimination and scanning strategies are more efficient.

Comparison of Reflectives and Impulsives

Ferguson (1966) makes a distinction between a priori and a posteriori comparisons. A priori comparisons are formulated prior to and apart from an inspection of the data and may be applied whether or not the F test has led to the rejection of the null hypothesis. Since the differences between reflectives and impulsives were hypothesized prior to data collection, the method advocated by Ferguson (1966) for a priori comparisons was used to test the significance of the differences. Means of the tests administered in session 1 for reflectives (S-A) and impulsives (F-I), F ratios resulting from the comparisons and probability values (p) associated with the F ratios (df = 1,117) can be seen in Table 5. Reflectives and impulsives did not differ with respect to age. This is contrary to expectation based on Kagan's (1966) finding that age is [illegible] the R-I dimension. Since only grade two pupils participated in the present investigation, these results might be due to the restriction of the range of age. The finding that the two groups did not differ on socioeconomic status (SES) does not support Kagan's (1967) and Souch's (1970) hypotheses regarding the relationship between R-I and SES. The apparent discrepancy between Souch's and the present finding may be attributed to sampling and procedural differences: His samples came from two distinct social classes (means of 32.1 and 65.7 on the Blishen Scale) thus increasing the likelihood that SES effects would be manifested. This finding is congruent with Gupta's (1970).

The first hypothesis predicted that reflectives' and impu[illegible]s' performance on the Vocabulary and the Digit Span [illegible]est would not differ significantly. This hypothesis was only partially supported: There is no significant difference between the groups on the Digit Span test. However, the finding that reflectives performed better than impulsives on the Vocabulary subtest contradicts Kagan and Kogan's (1970) statement that there is a slight and usually nonsignificant relationship between language skill and R-I. It is concordant with the data of Meichenbaum and Goodman (1969), Gupta (1970) and Souch (1970).

The second hypothesis predicted that reflectives would perform better than impulsives on the Rutgers DQ, Raven SS and DAP IQ and also, that reflectives would perform slower on the DAL and the other tests as compared with impulsives. This hypothesis was partially confirmed. The groups differed significantly on the Rutgers DQ, Raven SS and DAP IQ and Time. On the DAL, Rutgers Time and Raven Time there were no significant differences between the groups. The finding that the groups differed on the Rutgers DQ lends support to Kagan's (1965a) suggestion

TABLE 5

MEANS AND SIGNIFICANCE OF DIFFERENCES BETWEEN REFLECTIVE AND IMPULSIVE GROUPS

Variable	Reflectives	Impulsives	F	p*
MFF Latency	19.5	8.2		
MFF Errors	3.5	9.2		
Age	95.3	93.3	3.55	N.S.
Blishen	40.1	35.0	1.81	N.S.
Vocabulary	13.9	12.6	5.07	.05
Digit Span	10.2	9.5	1.44	N.S.
DAL	58.3	46.1	3.43	N.S.
Rutgers DQ	94.9	87.3	5.21	.05
Rutgers Time	402.4	365.6	1.26	N.S.
Raven SS	114.5	107.4	5.09	.05
Raven Time	521.6	559.2	1.11	N.S.
DAP IQ	101.3	94.0	4.15	.05
DAP Time	189.8	129.8	9.42	.01
Word Meaning	101.8	95.3	3.42	N.S.
Paragraph Meaning	102.[illegible]	94.7	4.10	.05
Word Study Skills	102.8	94.8	5.16	.05
Mathematics	102.9	88.9	19.18	.01

*$df = 1, 117$

that the performance on perceptual-motor tests is related to the R-I dimension. The finding that the groups differed on the DAP IQ is an extended replication of Kagan et al.'s (1964) finding regarding the DAP test and is congruent with Williams' (1970) finding.

The third hypothesis predicted that reflectives would perform better than impulsives on tests of scholastic achievement. This hypothesis was also partially supported. As can be seen from Table 5, on three of the four achievement tests reflectives' performance was superior to that of impulsives'. These results are congruent with Gupta's (1970) but not with those of Campbell (1968). In the present study as well as in Gupta's study reflectives had higher verbal scores as compared with impulsives while in Campbell's study, no significant difference was found.

It should be noted that on tests on which statistically significant levels were not reached the differences were large and in the predicted direction. This is true for all tests with the exception of the Raven Time.

The significant difference in verbal ability found in this study (and others) calls into question Kagan's (1966) and Kagan and Kogan's (1970) view that R-I is relatively independent of verbal ability. It also denotes that the results of the comparisons are confounded: They might be attributed to R-I or verbal intelligence, or to both. In order to remove the effect of verbal ability, two operations might be performed.

(a) Match reflectives and impulsives on verbal intelligence; exclude subjects which do not match and perform _t_ tests on the means of the other measures. This procedure is inadequate because only bright-impulsives and dull-reflectives will be included in the comparisons. The samples thus created will come from artificial populations so that the generality of the findings will be limited.

(b) Analysis of covariance might be used in order to statistically control the effect of verbal intelligence. This method has its limitations. Firstly, it was found that Vocabulary correlated significantly with the other tests (.27 with Rutgers DQ, .19 with Raven SS, .33 with DAP IQ and a median of .48 with scholastic achievement) as well as with the R-I dimension so that partialling out the effect of vocabulary might remove the effect of R-I on these tests. Secondly, it was argued by Wechsler (1949) that "... intelligence cannot be separated from the rest of personality" (p. 5). A stronger argument was advanced by Witkin (1963) who stated:

> With regard to IQ, I feel that cognitive styles are represented in performance on standard intelligence tests, and so 'controlling for IQ' is not an appropriate issue in studies of cognitive styles. (p. 122)

The issue of statistical control was summarized by Meehl (1970) who stated:

> In the matched-group method, the investigator physically constitutes a nonrepresentative

> 'artificial' subpopulation for study. In multivariate analysis, he concocts statistically, by the making of certain algebraic 'corrections', a virtual or idealized sample, the members of which are fictional persons assigned fictional scores. (p. 401)

The argument against statistical control for intelligence is substantial. For the reasons which were presented above matching or analysis of covariance was not performed on the data.

Correlates of MFF Latency and Errors

In order to determine the relationships between MFF Latency and Error scores and the variables which were investigated in this research, Pearson Product Moment Correlations (Ferguson, 1966) were computed. Results are presented in Table 6. Latency correlates significantly with Vocabulary, DAP Time and Mathematics but not with DAL, Rutgers Time and Raven Time. Error scores correlate significantly with age, Raven SS and Time, DAP IQ and Time, Paragraph Meaning, Word Study Skills and Mathematics. Of interest is the positive correlation between Raven Time and MFF Errors which denotes that children who performed relatively slowly on the Raven had relatively higher error scores on the MFF.

The absence of significant correlations between MFF Errors and Vocabulary and Digit Span is congruent with Kagan's statement regarding the independence of R-I and verbal ability. Also, the magnitude of the correlation between Vocabulary and Latency is small, as stated by Kagan and Kogan (1970) but contrary to expectation the correlation is statistically significant. Inspection of Kagan's (1966) data revealed that for young children the correlation between MFF Latency and verbal skill was .22 for girls ($n = 28$, $p > .05$) and .36 for boys ($n = 30$, $p < .05$). Likewise, a median correlation of .23 was found for the same variables (Kagan, 1965d). These coefficients are not smaller than the one found in this study ($r = .21$). It is suggested that Kagan's finding that only a few coefficients were statistically significant might be attributed to small-sample size.

The relatively large number of significant correlations between MFF Errors and the other tests lend some support to the second and third hypotheses. On the other hand, the absence of significant correlations between MFF Latency and the time factors on the DAL, Rutgers and Raven suggest that speed on the MFF is not related to speed on these measures. Thus, one cannot generalize from a hasty performance on the MFF to hasty performance on these tests. This is true for the DAL, Rutgers and Raven but not the DAP. This interpretation is congruent with Gupta's (1970) finding that speed of performing a cognitive task was not related to the R-I dimension.

The fourth hypothesis predicted that multiple correlations between academic achievement as a criterion and

TABLE 6

CORRELATIONS BETWEEN MFF LATENCY AND ERRORS AND THE OTHER SIXTEEN VARIABLES*

Variable	Latency	Errors
Sex	.015	-.048
Age	.177	-.216
Blishen	.122	.082
Vocabulary	.211	-.083
Digit Span	.025	-.157
DAL	.165	-.110
Rutgers DQ	.139	-.189
Rutgers Time	.155	.085
Raven SS	.100	-.276
Raven Time	.004	.210
DAP IQ	.092	-.249
DAP Time	.194	-.253
Word Meaning	.071	-.160
Paragraph Meaning	.095	-.239
Word Study Skills	.008	-.244
Mathematics	.232	-.381

*$\underline{p} < .05$, $\underline{r} = .194$
$\underline{p} < .01$, $\underline{r} = .254$
$\underline{df} = 119$

Vocabulary and R-I indices as predictors would be significantly greater than the correlation between the criterion and vocabulary alone. To test this hypothesis, first multiple correlations (Downie & Heath, 1965) were computed. Second, the multiple correlations and the correlations between vocabulary and achievement scores were converted to Fisher's z scores (Downie & Heath, 1965) and z tests were performed on the differences between these scores. No support was found for the fourth hypothesis. The largest multiple correlation was obtained between Word Meaning as criterion and Vocabulary and Error scores as predictors ($R = .60$). This correlation was not significantly different from that between Word Meaning and Vocabulary alone ($r = .58$). The largest increase in the proportion of explained variance was when Vocabulary and Errors were used to predict Mathematics. Vocabulary correlated .44 with mathematics. Adding Error scores as a second predictor resulted in a multiple correlation of .54. The difference between the two coefficients was not significant. ($z = 1.01$, $p > .05$). None of the multiple correlations between academic achievement scores as criteria and vocabulary and either of the R-I indices as predictors were significantly greater than the correlations between academic achievement and Vocabulary alone. This is due to the relatively small magnitude of the correlations between academic achievement and R-I scores.

Relation Between Speed and Accuracy

The R-I construct is defined by both speed and accuracy variables on tests in which reflection over alternative solutions is required. It was demonstrated repeatedly (Kagan et al., 1964; Kagan, 1966; Gupta, 1970) that latency and accuracy on the MFF are negatively correlated: The faster a person responds, the more errors he makes. This correlation by no means denotes causal relationship. To the contrary, it was demonstrated by Kagan et al. (1966) and Yando and Kagan (1968) that a change in response time did not bring about change in error scores.

Some of the tests which were utilized in the present research yield both speed and accuracy measures. In order to determine the relationship between speed and accuracy on each test, these scores were correlated. Results are presented in Table 7. As can be seen from the table, poor scores on the MFF and DAR are associated with hasty performance. On the Rutgers, adequate performance is independent of speed. Surprisingly, on the Raven the direction of the correlation is contrary to expectation: Children who scored low on this test took a longer time to complete the test. Thus, on this test low cognitive function cannot be attributed to a hasty performance. This finding resembles Loban's (1965). He reported that a group of children who were low on language ability had longer latencies and performed poorer on a verbal fluency test as compared with children whose language ability was average. The data presented suggests that the generalization "Slow=Dull" is misleading. On the MFF and DAP, fast performance is associated with poor scores while the reverse is true for the Raven.

TABLE 7

RELATION BETWEEN SPEED AND ACCURACY

	Variables	r	p*
MFF:	Latency and Errors	-.33	.001
Rutgers:	DQ and Time	-.05	NS
Raven:	SS and Time	-.20	.05
DAP:	IQ and Time	.38	.001

*df = 119

The results regarding the relationships between speed and accuracy corroborate and assist in the interpretation of previously presented data (Table 5). Impulsives performed poorer than reflectives on the Rutgers, Raven and DAP. While on the DAP poor performance might be attributed to haste, on the Rutgers and Raven speed is not a factor contributing to errors.

Effects of Induced Motivation

As was previously outlined, following the first testing session, the reflective (S-A, n = 41) and impulsive (F-I, n = 40) groups were each divided into experimental and control groups. Twenty one subjects were assigned to the reflective-experimental group (R-E), 20 to the reflective-control group (R-C), 20 to the impulsive-experimental group (I-E) and 20 to the impulsive-control group (I-C). In the second testing session three subjects were absent (one each from the R-E, R-C and I-E groups). In order to facilitate data analysis and interpretation the numbers of subjects in each group were equated: Two subjects, one from the R-E and one from the I-C groups were selected at random and their scores were excluded from the following analyses. This brought the number of subjects in each group to 19.

Three-way analyses of variance with repeated measures on the last factor (Winer, 1962) were performed on the data in order to determine whether induced motivation had an effect on performance and whether induced motivation had a differential effect on the performance of reflectives and impulsives. The three factors are: Factor A - Cognitive Style; Factor B - Experimental Condition; Factor C - Sessions. Each of these factors has two levels: reflectives-impulsives; experimental-control and session 1 and 2 for factors A, B and C respectively.

Means of the MFF latency scores of the four groups (R-E, R-C, I-E and I-C) for the two sessions are presented in Table 8. Summary of the analysis of variance of these scores is presented in Table 9. As can be seen from this table AC and ABC interactions are statistically significant. Comparison of the means of the R-E group on session one vs. session two revealed that the difference between the means was significant beyond the .05 level ($\underline{F} = 5.4$, $\underline{df} = 1,72$). The comparison of the means of the I-E group on session one vs. session two was also significant ($\underline{F} = 10.4$, $\underline{df} = 1,72$, $\underline{p} < .01$). These results denote that the I-E group performed slower, while the R-E group performed faster on the second session as compared with the first session following induced motivation. In order to determine whether R-E and I-E groups differ on the second session following induced motivation, the means of these two groups were compared. The difference between the means was found significant ($\underline{F} = 11.8$, $\underline{df} = 1,72$, $p < .01$). These findings suggest that impulsives who are motivated to perform better are able to slow down but their performance still differs from that of reflectives.

The means of the error scores on the MFF for the four groups on both sessions are presented in Table 10. Analysis of variance (Table 11), revealed that, with the exception of factor A, all main effects and their interactions were not significant. Induced motivation had no effect on

MFF errors.

The means of the four groups on both sessions on the DAL test are presented in Table 12. Inspection of the results of the analysis of variance (Table 13) reveals that the only significant effect is that of factor C, denoting that on the second session all groups performed more slowly as compared with the first session.

Means of the four groups on the two sessions for the Rutgers DQ scores are presented in Table 14. Results of the analysis of variance (Table 15) indicated that none of the main effects or interactions were significant. Induced motivation and practice had no effect on the Rutgers DQ scores.

Means of the Rutgers Time scores are presented in Table 16. Results of the analysis of variance are presented in Table 17. As can be seen from this table, the effect of factor C was significant, denoting that all subjects regardless of group and condition performed faster on the second session. The significant BC interaction denotes that this increase in speed depended on experimental condition: Control groups performed even faster than the experimental groups. Induced motivation had no differential effect on reflectives and impulsives as is suggested by the non significant ABC interaction.

The means of the DAP IQ scores for the four groups are presented in Table 18. Results of the analysis of variance are presented in Table 19. As can be seen from this table, the effect of factor B was significant, denoting that the experimental groups (regardless of R-I classification) scored higher than the control groups. Inspection of Table 18 suggests that R-E scored higher than R-C and that I-E scored higher than I-C on the first as well on the second session of testing. Since assignment of subjects to groups was at random, this effect was attributed to sampling error. The significant BC interaction denotes that induced motivation had an effect on the scores in the second session. In order to evaluate this effect a comparison of means of both experimental groups for the first vs. the second session was performed and found not significant ($F = 3.68$, $df = 1, 72$). For the control groups this comparison was found significant ($F = 10.2$, $df = 1, 72$, $p < .01$). Thus, on the second session the experimental groups performed better but insignificantly so as compared with the first session. The control groups on the other hand performed significantly poorer on the second session. The non-significant ABC interaction denotes that induced motivation had no differential effect on reflectives' and impulsives' performance on this test.

The means of the DAP Time scores are presented in Table 20. Results of the analysis of variance (Table 21) revealed that on the second session all groups performed faster as compared with the first session. Furthermore,

TABLE 8

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS:

MFF LATENCY

Group	Session 1	Session 2
R-E	19.4	16.4
R-C	19.6	20.0
I-E	7.8	12.0
I-C	8.3	8.1

TABLE 9

SUMMARY OF ANALYSIS OF VARIANCE FOR MFF LATENCY

Source	SS	MS	df	F	p
Bet Sub	6761.1		75		
A	3649.4	3649.4	1	87.97	.01
B	.1	.1	1	.00	.94
AB	124.5	124.5	1	3.00	.08
Sub WG	2986.8	41.4	72		
Within Sub	1384.5		76		
C	4.6	4.6	1	.30	.58
AC	96.9	96.9	1	6.16	.01
BC	2.2	2.2	1	.14	.70
ABC	147.0	147.0	1	9.34	.01
C x Sub WG	1133.5	15.7	72		

TABLE 10

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS: MFF ERRORS

Group	Session 1	Session 2
R-E	3.6	3.8
R-C	3.5	3.4
I-E	9.0	9.3
I-C	9.4	10.5

TABLE 11

SUMMARY OF ANALYSIS OF VARIANCE FOR MFF ERRORS

Source	SS	MS	df	F	p
Bet Sub	1853.0		75		
A	1350.0	1350.0	1	198.35	.01
B	3.4	3.4	1	.51	.47
AB	10.0	10.0	1	1.47	.22
Sub WG	490.0	6.8	72		
Within Sub	246.5		76		
C	6.3	6.3	1	1.96	.16
AC	4.7	4.7	1	1.49	.22
BC	.5	.5	1	.16	.68
ABC	2.9	2.9	1	.90	.34
C x Sub WG	231.9	3.2	72		

TABLE 12

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS: DAL

Group	Session 1	Session 2
R-E	57.7	92.0
R-C	57.2	77.0
I-E	52.7	76.8
I-C	40.0	56.2

TABLE 13

SUMMARY OF ANALYSIS OF VARIANCE FOR DAL

Source	SS	MS	df	F	p
Bet Sub	202196.3		75		
A	8000.9	8000.9	1	3.07	.08
B	5655.6	5655.6	1	2.17	.14
AB	755.2	755.2	1	.29	.59
Sub WG	187784.5	2608.1	72		
Within Sub	101058.6		76		
C	21178.8	21178.8	1	19.52	.01
AC	452.3	452.3	1	.42	.52
BC	1203.8	1203.8	1	1.11	.29
ABC	98.7	98.7	1	.09	.76
C x Sub WG	78125.5	1085.0	72		

TABLE 14

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS:

RUTGERS DQ

Group	Session 1	Session 2
R-E	96.1	96.2
R-C	94.0	93.3
I-E	87.5	91.9
I-C	87.9	90.0

TABLE 15

SUMMARY OF ANALYSIS OF VARIANCE FOR RUTGERS DQ

Source	SS	MS	df	F	p
Bet Sub	31808.0		75		
A	1177.0	1177.0	1	2.78	.09
B	106.0	106.0	1	.25	.61
AB	29.0	29.0	1	.07	.79
Sub WG	30496.0	423.5	72		
Within Sub	5120.0		76		
C	81.0	81.0	1	1.19	.27
AC	116.0	116.0	1	1.71	.19
BC	23.0	23.0	1	.34	.56
ABC	6.0	6.0	1	.09	.76
C x Sub WG	4894.0	67.9	72		

TABLE 16

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS:

RUTGERS TIME

Group	Session 1	Session 2
R-E	385.6	339.7
R-C	418.9	319.7
I-E	363.3	349.2
I-C	383.0	314.6

TABLE 17

SUMMARY OF ANALYSIS OF VARIANCE FOR RUTGERS TIME

Source	SS	MS	df	F	p
Bet Sub	228693.7.5		75		
A	6906.2	6906.2	1	.22	.64
B	12.5	12.5	1	.00	.98
AB	1862.5	1862.5	1	.06	.80
Sub WG	2278156.2	31641.0	72		
Within Sub	511018.7		76		
C	123131.2	123131.2	1	25.25	.01
AC	9300.0	9300.0	1	1.91	.17
BC	27468.7	27486.7	1	5.63	.02
ABC	31.2	31.2	1	.01	.93
C x Sub WG	351087.5	4876.2	72		

TABLE 18

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS: DAP IQ

Group	Session 1	Session 2
R-E	104.3	108.1
R-C	97.2	91.2
I-E	97.1	99.1
I-C	89.4	85.6

TABLE 19

SUMMARY OF ANALYSIS OF VARIANCE FOR DAP IQ

Source	SS	MS	df	F	p
Bet. Sub	42280.0		75		
A	2078.0	2078.0	1	4.23	.04
B	4843.0	4843.0	1	9.87	.01
AB	19.0	19.0	1	.04	.84
Sub WG	35340.0	490.8	72		
Within Sub	3762.0		76		
C	36.0	36.0	1	.83	.36
AC	.0	.0	1	.00	1.00
BC	568.0	568.0	1	13.10	.01
ABC	37.0	37.0	1	.85	.35
C x Sub WG	3121.0	43.3	72		

TABLE 20

MEANS OF THE FOUR GROUPS ON THE TWO SESSIONS:

DAP TIME

Group	Session 1	Session 2
R-E	185.7	145.9
R-C	189.6	145.0
I-E	130.0	121.6
I-C	117.2	111.3

TABLE 21

SUMMARY OF ANALYSIS OF VARIANCE FOR DAP TIME

Source	SS	MS	df	F	p
Bet. Sub	1194629.0		75		
A	82235.0	82235.0	1	5.33	.02
B	953.0	953.0	1	.06	.80
AB	1602.0	1602.0	1	.10	.74
Sub WG	1109839.0	15414.4	72		
Within Sub	211026.0		76		
C	23142.0	23142.0	1	9.46	.01
AC	11628.0	11628.0	1	4.75	.03
BC	12.0	12.0	1	.00	.94
ABC	124.0	124.0	1	.05	.82
C x Sub WG	176120.0	2446.1	72		

reflectives, regardless of experimental condition performed faster on the second as compared with the first session ($F = 13.7$, $df = 1, 72$, $p < .01$). This comparison was not significant for the impulsive group. It is possible that on the first session impulsives performed close to the lower limit of the scale. This being the case, they could not perform any faster on the second session. The difference between reflectives and impulsives on the second session was found to be still significant ($F = 6.5$, $df = 1, 72$, $p < .05$). Induced motivation had no effect on this measure.

It was expected that incentive motivation would affect performance on the MFF, Rutgers, DAL and DAP tests. The results which were presented suggest that induced motivation affects MFF Latency, Rutgers Time and DAP IQ scores. Induced motivation had no effect on MFF Errors, DAL, Rutgers DQ and DAP Time scores. With respect to MFF Errors and Rutgers DQ, one can speculate that the task itself presented much challenge to the subjects (intrinsic motivation) so that lack of motivation to perform is not a factor which affects these scores. With respect to the DAL, the unreliability of the scores and the instruction on the second trial "to perform slower" may have interfered with the effects of induced motivation. As to the DAP, it is not clear why motivation affected the score and not the speed with which the task was performed.

The hypothesis which stated that incentive motivation will have a differential effect on the performance of reflectives and impulsives received partial support. On the MFF Latency, following induced motivation impulsives performed significantly slower while reflectives performed significantly faster. This unexpected performance of the reflective group might be due to their interpretation of the instructions given on the second session. They might have inferred that to perform better means to perform faster. Heider (1971) also found that on a sentence construction task latencies were shortened following increased motivation. The finding that latency scores are more susceptible to change as compared with error scores is congruent with that of Kagan et al. (1966), Heider (1971), Debus (1968) and Yando and Kagan (1968). It might be that specific training in scanning, discrimination, attention and hypothesis formation and evaluation are needed to affect the error scores on the MFF.

Relation Between R-I and Preference for Delayed Reward

The frequencies with which reflectives and impulsives chose immediate, smaller reward (Im. R.) vs. delayed, larger one (Del. R.) are presented in Table 22. In order to determine whether delay of gratification is related to the R-I dimension 2 X 2 Chi Square tests (Downie & Heath, 1965) were performed on the data of the experimental, control and the two combined groups. The magnitudes of the chi square# (df = 1) were found to be .01, .26 and .21 for the experimental, control and combined groups respectively. Results of the three analyses showed that R-I is not related to preference for delayed reward.

TABLE 22

R-I AND PREFERENCE FOR DELAYED REWARD

Group	Preference: Im. R.	Preference: Del. R.	Total
Reflectives	24	15	39
Impulsives	22	17	39
Total	46	32	78

A one-way analysis of variance was performed on the Selection Time scores. The means for reflectives and impulsives were 11.6 and 11.5 seconds respectively. The difference between the means was found not significant ($F = 0.0$, $df = 1, 76$). The means of Choice Time for reflectives and impulsives was 11.4 and 9.3 seconds respectively. The difference between the means, although in the predicted direction, was found not significant ($F = 1.83$, $df = 1, 76$).

The sixth hypothesis which predicted the reflectives could delay immediate gratification better than impulsives was not supported. With respect to selection time, one may argue that each subject had his own hierarchy of preferred objects (i.e., one likes sweets, the other likes marbles) so that reflection is not a factor which determines selection time. One may also argue that on this test the child is given two alternatives (Im. R. vs. Del. R.) none of which is the "correct one" (as is the case on the MFF) and chosing between alternatives is not the same as choosing the correct alternative. Yet, the finding that reflectives did not differ from impulsives on Choice Time suggests that delay before responding is not a generalized trait. The findings previously reported, namely that reflectives and impulsives did not differ on Rutgers Time and Raven Time lend support to such an interpretation. Further research should determine on which tests and in which situations R-I is a contributing factor and on which tests and in which situations it is not.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study had three main objectives: a) to determine whether performance on verbal, cognitive, scholastic, motor and perceptual-motor tests is related to the R-I dimension; b) to determine whether incentive motivation will improve the performance of impulsive children, and c) to determine whether R-I is related to the ability to delay immediate gratification.

Subjects were 121 second-grade pupils who were tested on two sessions. In the first session, half the MFF test, WISC Vocabulary and Digit Span subtests, the Raven, DAP, DAL and the Rutgers tests were administered individually to all subjects. The time taken to complete the Raven, Rutgers and the DAP tests was recorded. Standard scholastic achievement tests scores were obtained from the pupils' school records. On the basis of double-median split of MFF errors and latency scores, four groups were identified: fast-accurate, fast-inaccurate, slow-accurate and slow-inaccurate. One-way analyses of variance and individual comparisons were performed in order to determine whether the groups differed on any of the above measures. Scores obtained in the first session were intercorrelated and multiple correlations between scholastic achievement, vocabulary and R-I scores were computed. In the second session of testing, the reflective (slow-accurate, n = 39) and impulsives (fast-inaccurate, n = 39) groups were each divided into experimental and control groups. Just before testing, each subject in the experimental groups was shown a tray containing various incentives, asked to select a prize and was told that he could win the object he selected if he would do his best on the tests. The second half of the MFF, the Rutgers, DAL and DAP tests were administered on the second session of testing. After testing was completed the subjects were offered a choice between a smaller, immediate reward and a delayed, larger one. The latency of the choice response and the subjects' preferences were recorded. In order to determine whether incentive motivation had a larger effect on the performance of impulsives as compared with that of reflective subjects, the data was subjected to three-way analyses of variance with repeated measures on the last factor. The relationship between R-I and delayed gratification was determined by chi-square tests.

The first hypothesis which predicted that the R-I dimension is independent of verbal ability was only partially supported. Reflectives and impulsives did not differ significantly on the Digit Span test. However, on the Vocabulary test, reflectives performed better than impulsives. This finding is congruent with those of Meichenbaum and Goodman (1969), Gupta (1970) and Souch (1970) and it does not lend support to Kagan and Kogan's (1970) statement that the R-I dimension is independent of verbal ability. This finding raises an important issue, namely, whether impulsives are cognitively different or cognitively deficient as compared with reflectives. A deficit hypothesis predicts that impulsives will perform poorly on all cognitive tests while a difference hypothesis predicts that impulsives will perform poorly only on tasks which require reflection and that the discrepancy between the performance of reflectives and impulsives will be proportional to the amount of reflection needed on any given task.

The second hypothesis which predicted that reflectives will perform better than impulsives on the Raven, Rutgers and DAP and that their performance on these tests as well as on the DAL would be slower was partially supported. Reflectives scored higher than impulsives on the Rutgers, Raven and DAP. Also, on the DAP their performance was significantly slower while on the DAL, Raven and Rutgers the groups did not differ with respect to the time taken to execute these tasks. The significant differences between the groups on the perceptual-motor and cognitive tests adds to the existing body of knowledge regarding the correlates of the R-I dimension. It cannot be determined with certainty whether conceptual style or conceptual deficit is the underlying factor which accounts for the differences between the groups. The findings that impulsives did not perform faster than reflectives on the Raven, Rutgers and DAL tests denotes that the generality of the construct 'impulsive conceptual tempo' is limited: One cannot generalize from a hasty performance on the MFF to a hasty performance on these tests.

The third hypothesis which predicted that reflectives will score higher than impulsives on tests of scholastic achievement was also partially supported. As is the case with the previously reported results, one cannot determine whether the differences between reflectives and impulsives are due to the format of the tests, to the cognitive attitude under investigation or to a cognitive deficit which might be reflected in poor verbal, perceptual-motor and cognitive ability. Likewise, as is the case with most correlational studies, it is impossible to determine cause and effect relations or to control for 'nuisance variables'. The relevancy of the R-I dimension to the educational process could be further explored by investigating the effect of modification of conceptual tempo on academic achievement.

The fourth hypothesis which predicted that the knowledge of the child's relative position on the R-I dimension will increase the ability to predict his scholastic achievement was not supported. None of the multiple correlations between academic achievement as criteria and vocabulary and R-I indices as predictors was significantly larger than the correlation between academic achievement and vocabulary alone. This was due to the small magnitude of the correlation coefficients between academic achievement and R-I scores.

The fifth hypothesis which predicted that incentive motivation will have the largest effect on the performance of impulsives whose willingness or motivation to inhibit is weaker as compared with reflectives received partial support. Impulsives' latencies on the MFF were significantly lengthened following induced motivation. Incentive motivation had no effect on MFF errors. Also, incentive motivation had no differential effect on the performance of impulsives on the Rutgers, DAL and DAP tests. These results suggest that poor motivation is not a factor which contributes to the poor performance of the impulsives subjects on these tests and also, that hasty performance is not the cause of MFF errors.

The sixth hypothesis which predicted that reflectives will be able to delay immediate gratification better than impulsives was not supported. Reflectives did not differ from impulsives with respect to the frequency with which they chose a delayed, large rewa_d over an immediate, smaller one. In addition, the groups did not differ with respect to the latencies with which these choices were made. These results suggest that caution should be used in generalizing from one trait to another on the basis of a few apparent characteristics.

Part of this research was devoted to gathering more information about the two 'anamalous groups', the fast-accurate and the slow-inaccurate groups in terms of their performance on verbal, motor, perceptual-motor and cognitive tasks. It was found that these two groups did not differ significantly from each other on any of these measures. It was suggested that the F-A group utilizes more efficient scanning and visual discrimination strategies while performing on the MFF. It was also suggested that the S-I group is more cautious and pays attention to minute and insignificant details which in turn interferes with adequate performance on the MFF.

To conclude, this study has served to clarify a number [illegible] derived from studies of reflection-impulsiv- [illegible] any of Kagan's research and theoretical [illegible] re confirmed, some observations received [illegible] pport. The major problem encountered in [illegible] s the interpretations of results. It was [illegible] sible to ascertain whether the superiority of reflective subjects on the Raven and the achievement tests could be attributed to differences in R-I, verbal or reasoning ability or to the format of the tests.

Future research into the area of reflection-impulsivity may develop along five lines. The first is to analyze the processes underlying the construct of R-I into more detailed components such as scanning, attention, distractability, visual discrimination, hypothesis formation and evaluation as well as cautiousness and persistence. Task analysis might prove a useful approach for this purpose. Secondly an attempt might be made to further relate the R-I construct to other psychological constructs by correlational studies. For example the relationship of the R-I dimension to Elkind's (1969) centration-decentration dimension, Witkin et al.'s (1962) field dependence-independence dimension and Bruner, Goodnow and Austin's (1956) concept formation strategies might be explored. A third line of investigation might be to examine possible antecedents of R-I such as child-rearing practices, specific parent-child interactions and biogenic factors. The fourth and perhaps the most important line of research is the investigation of the modification of impulsive behavior and the effect of modification on scholastic achievement. It is possible that not one single treatment but a combination of treatments such as instructing subjects to delay responding and scan and compare all stimuli (Heider, 1971), combined with prolonged training in visual discrimination (Duckworth et al., 1974) and heightened motivation may bring about a significant change in impulsive attitude which in turn will result in better scholastic achievement. Lastly, very little is known about the behavior of adult reflectives and impulsives as most if not all investigations of reflection-impulsivity were done with children or adolescents. It could be determined by future research whether impulsivity in adults is related to impulse buying, impulsive asocial behavior, occupational choice and lifestyles. These suggestions may be the basis of future inquiry.

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