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CONVERGENT-DIVERGENT ABILITIES OF STUDENTS & TEACHERS

The Convergent-Divergent Abilities of Students and Their Teachers

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A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Montreal

March 1975

ABSTRACT

Two cognitive abilities, convergent and divergent thinking, were examined with reference to previous studies and applied as possible predictors of academic achievement, student behaviour and classroom climate.

The study which incorporated an experimental design involving forty-eight grade 10 and 11 classes in a high-school and used primarily a multivariate regression analysis, yielded a number of interesting results.

The tests were found to be reliable but divergence was shown to be composed of two factors: verbal and figural ability. Using the two divergent factors and convergent ability, academic achievement was always predicted best by convergence although the divergent scores increased the prediction of achievement in seven of sixteen cases. Between and within class, analyses yielded a variety of results which in general demonstrated that individual students' behaviour and student perceptions of classroom climate were poorly predicted by the cognitive variables.

The between class results showed that convergence was still the more important factor although divergence was a good predictor in a few instances, and as hypothesized, interacted with convergence on two occasions.

These results were discussed and recommendations were made for further research in this area.

ABSTRAIT

Deux sortes de capacités cognitives, la pensée convergente et la pensée divergente furent examinées à la lumière des travaux précédents et ensuite elles se sont servies de prédiseur pour trois facteurs différents: le rendement scolaire, le comportement de l'étudiant et sa perception du milieu d'apprentissage.

Quarante-huit classes de dixième et onzième année ont participé à cette étude, dont l'analyse multidimensionnelle a produit des résultats intéressants.

Les tests se sont montrés fiables, mais la pensée divergente s'est décomposée en deux facteurs différents: la capacité verbale et non-verbale.

La mesure convergente a mieux prédit le rendement scolaire que les deux mesures divergentes, mais celles-ci ont amélioré la prédiction du rendement scolaire dans sept sur seize cas.

Les analyses inter et intra-classe ont produit de nombreux résultats, mais en général le comportement de l'étudiant et sa perception du milieu scolaire ont été mal prédits par les variables cognitives.

Les résultats de l'analyse intra-classe ont démontré qu'en général la pensée convergente était le facteur le plus important, bien que la pensée divergente était le meilleur prédiseur dans plusieurs cas. Par ailleurs, suivant les hypothèses énoncées, il y avait deux exemples d'intéraction entre les deux variables cognitives.

Une discussion des résultats fut présentées, ainsi que des suggestions pour d'autres projets de recherche dans ce domaine.

ACKNOWLEDGEMENTS

I am indebted to a number of people who provided me with the motivation and critical input which resulted in this thesis. I wish to thank my thesis advisor, Charles Pascal, whose appreciation of unstructured learning gave me the opportunity to test ideas without ideological constraints. Special thanks are extended to John Corson who for the last six years has been a constant source of encouragement and direction to me. To Dr. Jim Ramsay, Dr. Wallace E. Lambert and Dr. Bruce Shore many thanks for the considerable time spent on reading the many thesis drafts. Their numerous suggestions were so helpful in the organization and presentation of the final product.

No undertaking of three years duration is done in a vacuum and I would like to especially thank two of my fellow graduate students, Martynas Ycas and Bart Farell, who provided me with so much of the critical feedback in the early stages of the study.

Mr. Gamble, principal of Sir Winston Churchill High School, its teachers, and of course, the grade 10 and 11 students during 1971-72 school year deserve a special thanks. Without their extraordinary cooperation the study could never have been completed.

Also, with more than fifty testing sessions to coordinate, administer, and score, the task would have been most difficult if not for the help of a special friend, Sheridan Scott, and the other research assistants who helped with so many of the tedious tasks.

Finally, I would like to acknowledge my parents' contribution to this endeavour. Their appreciation of learning served as a most important model for an often struggling student.

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CHAPTER 1

INTRODUCTION AND OVERVIEW

The financing of education has traditionally been one of the major expenditures of most governments. Between 1960 and 1970, the total cost of education in Canada increased from 1.7 to 7.4 billion dollars (Statistics Canada, 1973). In an effort to increase the efficiency of the educational system, many different aspects of the process of education have been examined by researchers. Regardless of their approach, the main objective of educators has been to transmit information more effectively in the belief that each unit of knowledge would ultimately serve the learner as a saleable quantity or satisfy him for intrinsic reasons.

Large scale programs with massive injections of resources to buy books, build new schools and train teachers have characterized educational reform during the past decade. Unfortunately, in spite of the expense and the human effort involved, these programs have not been as successful as expected (Jencks, 1972).

At the same time, researchers working on a "micro" level have attempted to isolate factors which are "critical" for learning. The feeling is that whenever people with these types of factors, generally referred to as personality types or intellectual abilities, are matched with a specific type of learning environment or treatment, an optimal learning situation might eventually be identified. As a result, this approach, sometimes called Aptitude Treatment Interaction (ATI), posits that selected subgroups within the population benefit more from an ATI system than if no intervention had taken place.

As an expansion of these developments, researchers realized that learning was influenced by many environmental factors beside those attributed to the learner. In general, these variables characterized the "home" and "school" environment. The former included the socio-economic status of the family, the parents' education and attitudes, as well as those of the peer group. The "school" comprised teacher related variables and the resultant learning environment.

Although both types of influences are likely to be important, this thesis, like many other recent studies, focuses on the school environment by attempting to relate school learning to the characteristics of students and teachers and classroom environment. For example, Feather (1972a), in Australia, asked students to rank sets of values from the Rokeach Value Survey, first in order of importance for themselves and secondly in the order they thought the administrators of their schools would rank them. He studied these variables as they related to independent and state schools (Feather, 1972a), state and church schools (Feather, 1970), educational choice at the university level (Feather, 1971a) and school adjustment (Feather, 1972b). In all cases, he found when individual values were similar to the perceived values of the institution, students achieved better.

At the same time, Majasan (1972) examined student achievement at the college level relating achievement to congruence between students' and their instructors' beliefs. In his study beliefs were defined as the students' attitude towards the study of psychology, before and after having taken a psychology course. His results supported the hypothesis that achievement scores were lower the greater the distance between student and instructor beliefs.

Instead of value and belief systems the present study investigated the interaction of two cognitive variables of both students and their teachers. Two abilities, convergence and divergence, were chosen because of their usefulness as a predictor of student achievement and behaviour (Wallach & Kogan, 1965; Hudson, 1966; Cropley, 1967).

In chapter 2, a review of the current literature is presented that reveals the psychological relevance and the properties of these variables as indicators of classroom interaction and student learning. The review emphasizes the limitedness of divergence as a measure of "creative" ability. Moreover, the evidence demonstrates that although divergence is not always independent of convergence it is a suitable complementary ability as a predictor of student achievement. Also, since most classroom learning studies have traditionally neglected the importance of the teacher in the total context, a case is presented for the inclusion of the cognitive abilities of teachers as a useful predictor of classroom environment.

Chapter 3 provides a statement of the present problem and the hypotheses to be tested. Each hypothesis is followed by a brief rationale with a particular reference to previous studies.

In chapter 4, the procedures and test materials are described with their validity and reliability coefficients. In addition, the method of analysis is briefly outlined.

Finally in the last two chapters, the results and conclusions of the study are presented along with recommendations for further work in this area.

CHAPTER 2

REVIEW OF THE LITERATURE

1- Divergence and "Creativity"

Researchers interested in differences among people have tried for years to identify and explain the creative act, but it was not until the early fifties that psychologists seriously attempted to quantify creativity and the behaviour of the creative individual. These studies have been directed by two conflicting hypotheses. Some are convinced that creative ability is a dichotomous ability which some people have and others do not. To study the group which possesses creative ability these researchers have looked at persons nominated as being creative by their peers or chosen according to other presumed indices of creative accomplishment (e.g., number of publications). Among the best known studies of this type are the work of Roe (1952) and MacKinnon (1962) with eminent scientists and architects and the work by Csikszentmihalkyi and Guilford (1957) with rather less outstanding subjects. If this method were to be applied in academic settings, researchers would have to find some distinctive properties of demonstrably creative persons which would predict with a degree of success whether a given student is potentially creative. This method relies entirely on arriving at suitable and practical criteria that can be reliably generalized from eminent scientists to the normal population. Research in this area has indeed identified a number of important psychological variables characteristic of creative people. Unfortunately these predictors give us only a generalized profile of what

these people are like, which enables us, at best, only to state some necessary (but not sufficient) characteristics of the creative person.

Others have assumed that creative ability is a normally-distributed trait within the population at large. In studies using this normal-trait approach the most general and pressing problem has been the inability of researchers to derive a reliable and validated test of creativity.

Within these limits, two theories of "divergent" ability have proved to be most popular as testable models of creativity. The Guilford-type tests have relied heavily on factor analysis, trusting that tests reflecting a wide variety of independent factors would thereby describe the major features of the creative process (Guilford, 1967). Unlike the former, Mednick proposed an associative-process approach involving the production of divergent responses (Mednick, 1962).

To encourage a systematic study of creativity, Guilford (1967) used the structure-of-intellect model as a starting point. Guilford believes the productive aspects of creativity are most important, and that fluency and flexibility would be among the major factors in divergent production. Fluency refers to the steady flow of ideas and flexibility defines the ability to change direction or modify information. A number of factor analyses yielded three kinds of fluency factors, two types of flexibility factors and an originality factor (Guilford, 1967). Although the number of factors was somewhat surprising, there were sufficient precedents for explaining the fluency and originality factors. A fourth type of factor, elaboration, was extracted from another study (Berger, Guilford & Christensen, 1957).

These four factors now make up the present set of the Guilford divergent production tests.

As a factor analyst Guilford was primarily interested in devising a series of tests which were independent of one another but, when combined, would measure creativity in its entirety. Guilford was successful in his first aim, though subsequent research has not yielded such unique factors. However, users of the Guilford-tests have had considerable difficulty in substantiating the validity of the test as a measure of creativity.

Getzel's and Jackson's Creativity and Intelligence (1962) has probably drawn more attention than any other monograph to the problems of the potentially creative student in the classroom. The study is worth discussing in some detail because it inaugurated later investigation of the creative student and in the process brought to light a number of basic difficulties in this area of psychological research.

Getzels and Jackson chose students in a middle-or upper-class private school connected with the University of Chicago whose average IQ was 132. The creativity measures were pencil-and-paper tests which did not demand single responses, as did the IQ tests, but rather a number of novel responses to various stimulus tasks. These were of five distinct types, some adapted from Guilford tests and others specifically constructed for their study. The testing procedures closely approximated typical IQ testing situations of fixed time and quiet "examination" conditions.

By combining scores on the five subtests, Getzels and Jackson arrived at a creativity score that was used to form the two experimental groups. Those subjects in the top twenty percent on the creativity measures but not in the top twenty percent on the IQ measure (when compared with others of the same age and sex) were placed in the high creative category. The high IQ group was chosen similarly. They scored high on the IQ measures (top 20%) and in the lower four-fifths on creativity measures. The small resultant groups of twenty-eight high IQ's (average IQ of 150) and twenty-six high creatives (average IQ of 127) were then tested for a number of educationally relevant variables.

Despite the wide 23-point IQ difference between the two groups the High Creatives achieved as well as the High IQ's on standard subject matter tests, although they were more disliked by their teachers, had lower IQ's and came from "inferior" home environments. These findings placed them, as such phenomena were handled not in the category of "gifted children", but in the pejorative category of "over-achievers". The rest of the study attempted to find possible explanations for these results. Either there were other essential variables such as motivation in addition to the purely cognitive ones interacting to produce these differences, or certain cognitive traits were preferred by the teacher.

Since no differences were found between the two groups on McClelland's "need for achievement" measure, the authors concluded that the differences did not lie in motivational differences but in the predictive limitations of the IQ test.

Torrance (1962) attempted to replicate the Getzels and Jackson work in a variety of schools with mixed results. The findings were not

replicated in a parochial elementary school nor in a small town elementary school, where the high IQ group tended to do better than the high creatives on achievement tests. Yamamoto (1964a) conducted a similar study using the Lorge-Thorndike and the Torrance Tests of Creative Thinking (a series of Guilford divergent tests). He reported findings essentially similar to these of Getzels and Jackson.

Another important finding was that teachers appeared to prefer the high IQ group more than the high creatives. The authors considered this finding to be opposite to expectations since the high IQ's were only functioning at the level expected of them whereas the high creatives were achieving relatively more than what would be expected. Briefly, the high IQ group tended to converge on answers better, preferred more stereotyped behaviour in other people, agreed more with norms set by teachers, and tended more to choose careers that were expected of them. The high creatives tended to give more divergent, unexpected responses, disagreed often with what they thought teachers expected, and perceived success in more unorthodox ways. The two groups also differed in their fantasy productions to projective tests with the high creatives making significantly greater use of stimulus-free themes, unexpected endings, humour, incongruities, and playfulness. In addition, many of the high creative's stories reflected a general cynicism and an antagonism towards the "all American" youth.

The many critics of the Getzels and Jackson work concentrate on a few distinct points. The authors initially set out to study creative and intelligent adolescents. The early statements in the book suggest a trait approach which generally assumes that intelligence and creativity are normally distributed throughout the sample. That

is, it is assumed the variables are found in varying degrees in each individual student. In midstream, the authors changed to a typological approach by classifying the subjects into two dichotomous groups of high IQ's - low creatives and high creatives - low IQ's. The statistically more powerful trait approach was abandoned, excluding eight-ninths of the original sample from further study. Reviewers pointed out the weak reporting of the findings (DeMille & Merrifield, 1962) and the erroneous labelling of the key variables (Thorndike, 1963). From a psychometric point of view, Marsh (1964) maintained that failure to consider the ages of the students when assigning the creativity scores produces spuriously low correlations between IQ and creativity. Moreover DeMille et al. (1962) argued that neglecting the high IQ-high creative resulted in a faulty appraisal of the experimental effects. Finally, Dunnette (1964) pointed out some of the differences claimed to be important by the authors are not statistically significant.

In a sense most of the criticisms are trivial compared to the two major errors: Getzels and Jackson failed to develop adequate independent measures of creativity and intelligence and they were unable to provide any evidence for the validity of their "creativity" measures.

Considering the independence issue first, Burt (1962) took great exception to the authors' typological approach. In selecting the high IQ group the investigators relied on a single IQ obtained from the "records office of the school". Moreover, the tests were administered not at the time of inquiry but at different times when the students first entered the school. Hence the test results would not have been very reliable (Burt, 1962).

Unlike the IQ tests, the five measures of creativity were constructed specifically for the experiment. The correlations they present show that all five variables are positively related to IQ--two of them as high as 0.37 and 0.38. The authors would have us believe that the figures are low, but the intercorrelations among the creativity items are rarely much higher.

Marsh (1964) combined the boys' and girls' scores and applied both Gulliksen's (1950) method of explicit selection to account for the specialized sample, and Gulliksen's (1950) method of attenuation to examine the role played by the test unreliability. These calculations yielded very significant correlations between the IQ measure and creativity ($p < 0.001$). While the IQ test scores were corrected for age, the creativity scores were not. This produced a coefficient "that is only a partial index of the relationship involved" (Marsh, 1962, p. 92). A factor analysis yielded more evidence to suggest that if creativity is an ability different from intelligence, then Getzels and Jackson have failed to devise a test that distinguished between the two. The only reasonable conclusion is that the authors have devised a somewhat more diverse IQ test.

Avoiding some of the Getzels and Jackson errors, Hasan and Butcher (1966) studied a group of Scottish students with a wide range of IQ scores. Following DeMille's (1962) advice, they also included a third experimental group composed of those children who scored high both on creativity and IQ. Intercorrelations among the measures of creativity common to the Getzels and Jackson study were much higher in the original data. The authors indicate that the unselected nature of the Scottish sample which is more typical of children with average

abilities, yielded a more restricted range of ability than in the American study. With respect to school achievement, the high IQ's were better students but not as preferred by the teachers as were the high creatives -high IQ's.

Using Getzels and Jackson's work as a starting point, Wallach and Kogan (1965) set about to differentiate intelligence from creativity and then, if possible, to delineate other pertinent psychological correlates when both variables were studied separately or jointly. Since the traditional view of creativity was vague, Wallach and Kogan (1965) looked for basic psychological processes presumed to be associated with creative thought. The writings of Ghiselin (1952) suggested to them that creative output was related to skill in producing verbal associates, that is, one idea leads to, causes, or is associated with the next thought in such a way that a stream of cognitive units is produced, resulting in a creative product.

This approach was further elaborated by Mednick (1962), who noticed that supposedly creative people reported that in moments of great thought, ideas and images were in "associated play" (Ghiselin, 1952, p. 43). Poincaré described moments when he formulated mathematical concepts as involving ideas that "rose in crowds". (Ghiselin, 1952, p. 36). Drawing on themes in creative peoples' experiences, Mednick (1962) hypothesized that the creative individual is characterized by a flat rather than a steep gradient "regarding the likelihoods with which different associates will occur to him as he contemplates a task" (Mednick, 1962, p. 223). A shallow slope gradient represents a more deliberate choice of associations as well as a more extensive use of vocabulary while the short sloped gradient

represents fewer "cognitive elements", typically reflecting highly stereotyped responses. It then became the task of researchers in this area to construct standardized tasks which could encourage the elicitation of appropriate creative responses reflected in two modes of responding; in particular, the number of associative responses and the uniqueness of the associations. Wallach and Kogan (1965) saw two implications of this theory. First, responses of high stereotype are likely to be elicited first, while unique responses will, if they come at all, come later. Secondly, the steep gradient notion suggested that highly stereotyped responses are elicited at a very high rate and then rapidly fall off.

Mednick's work with associative gradients also suggested to Wallach and Kogan the importance of relaxed testing situations coupled with unlimited time limits. They hypothesized that stereotyped responses were more likely to be elicited early in the sequential emission of responses. Since both high and low creatives are likely to produce stereotyped responses early, insufficient testing time may artificially reduce the differences between the high and low creative group. A time constraint might also discriminate against those who are slow but nonetheless unique in their responses. In that case it would appear the rapid responders (with the steeper response gradient), having given a greater number of associations after a period of time, would be the more creative.

While Mednick feels the associative ability explains the creative process, there is only marginal evidence for the validity of his tests. He devised the Remote Associates Test (RAT) a highly complex verbal test which stresses the associativeness of items.

Neglecting his own caution of possible time constraints on creative thinking, the RAT is a timed test with specified correct answers. While it only superficially resembles the typical IQ test, the emphasis on a predetermined correct response limits the test's power to measure creative thought.

The evidence for the predictive validity of the RAT as a creative measure is slight. Mednick (1962) reported correlations of 0.38 between associative productivity and the RAT for a sample of college students, but this was not surprising, due to the test's heavy reliance on verbal fluency. He also reported correlations of 0.41 between the RAT and the Miller Analogies Test for graduate psychology students, while other studies reported significant and positive relationships between the RAT and traditional verbal IQ measures (Mednick, 1963; Rainwater, 1964; Mendelsohn & Griswald, 1966; Laughlin, 1967). In terms of academic achievement, most studies report zero-order negative correlations with the RAT (Mednick, 1962, 1963) while mixed results were obtained for occupational achievement (Andrews, 1965; Mednick, 1963). As a predictor of any of these variables, the RAT has not been impressive, particularly since it obviously shares a common variance with other verbal tests. While the RAT appears to be an inappropriate measure of creativity, Mednick has suggested an interesting explanation of divergent thinking processes. According to him, a unique response is the result of combinations of previous thoughts. The unique responder will therefore exhibit relatively few stereotyped associative responses.

The creativity measures of Wallach and Kogan (1965) continued to test those activities conventionally examined in creativity research. Five subtests were chosen, all closely related to

Guilford's model of divergent thinking: (1) Instances - "Name all the square things you can think of," (2) Alternate Uses - "Tell me all the different ways you could use a knife," (3) Similarities - "Tell me all the ways in which a grocery store and a restaurant are alike," (4) Pattern Meanings - "Here is a drawing. Tell me all the things you think this could be," (5) Line Meaning - "Here is a line. Tell me all the things you can about it." The responses were scored for the number of responses and the number of unique responses.

Unlike other "creativity" researchers, Wallach and Kogan were able to report high split-half reliability coefficients (eight of ten exceeding 0.80), similarly large item-sum correlations, and substantial intercorrelations. In other words, their items were internally consistent, they clustered into five subtests as expected, and collectively they measured a single cognitive dimension.

While the ten intelligence tests were highly interrelated, correlations between the IQ and creativity measures were low. Some nineteen of the one hundred correlations were significant at the 0.05 level although no correlation exceeded 0.23. For the total sample the mean correlation of the creativity measures (45 correlations) was 0.41, of intelligence measures (45 correlations) 0.51, and between creativity and intelligence measures (100 correlations) 0.09. It appears that researchers had finally isolated two types of measures producing scores independent of each other and relatively coherent among themselves. Evidently Wallach and Kogan's tests have isolated a dimension of individual differences that possesses generality and yet is distinct from intelligence (as measured by IQ). Unfortunately, the authors referred to the newly discovered variable as "creativity",

without providing any evidence of its validity as a measure of creativity in the real world. Nonetheless, Wallach and Kogan found interesting differences between groups who scored high and low on the critical dimensions. With the independence of the two dimensions, the investigators formed four groups of boys, and four of girls, fitting the established following scheme: High intelligence--high creativity, low intelligence--low creativity, high intelligence--low creativity, low intelligence--high creativity. Behavioural differences between these groups were studied by observing behaviour in school environment, measuring their categorizing and conceptualizing ability, and studying the importance of anxiety and defensiveness in social situations.

Though Wallach and Kogan examined males and females separately, a subsequent reanalysis of their data using a more sophisticated statistical technique (normalizing the data and applying regression methods) revealed that "where Wallach and Kogan reported a result as significant for one sex only, we find it significant for sexes pooled" (Cronbach, 1968, p. 501). In these instances, Cronbach concluded that it is more parsimonious to accept the more general interpretation unless an interaction involving sex is apparent. Cronbach summarized the Wallach and Kogan results by stating that overall the intelligence factor generally proved to be the best predictor. The high-intelligence student tended to be diligent and successful, though rather surprisingly, IQ scores accounted for only 14% of the "confidence" variance. Differences with regard to defensiveness and anxiety showed the high-intelligence groups were more self-assured and generally excelled on all variables dependent on quality of performance. The "creativity" scores did not predict much of the variances of any of the dependent variables. In general, the highly "creative" students

tended not to hesitate in giving responses or seeking attention, and they were more test-anxious in the classroom.

Although the creativity results provided few surprises, the intelligence-creativity interaction produced a number of interesting results. Students in the high-intelligence and high-creative group showed the least doubt and hesitation of all the groups, showed the highest level of self-confidence, and displayed the least tendency towards deprecation of one-self and one's work. The high-highs were also most conspicuous in seeking and receiving companionship. In the classroom, they had the highest level of attention span, concentration, and interest in academic work. Still, this group occasionally had a disruptive influence in the classroom which Wallach and Kogan (1965) ascribe not to deliberate disruptive behaviour but rather to "a strong drive toward verbal self-expression which cannot be inhibited" (Wallach & Kogan, 1965, p. 89).

2- Divergence

Although it appeared Wallach and Kogan had isolated a robust measure which might measure creativity, other researchers were not so convinced. Cronbach's careful reanalysis of the original data led him to conclude:

> My final impression is that the F[1] variable has disappointingly limited psychological significance. It can scarcely be considered a measure of ability or creativity; there is no evidence that high F children produce responses of superior quality in any situation. It is correlated with other measures of social responsiveness, but not strongly. (Cronbach, 1968, p. 509).

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[1] In order not to perpetuate the labelling problem, Cronbach (1968) substituted the term F for "divergence".

Since Cronbach's work, however, other studies have provided some convincing evidence. Using an older sample of entering college students, Wallach and Wing (1969) reported significant differences in academic achievement between high and low Scholastic Aptitude Test (SAT) scorers, but not in non-academic behaviour. When participation in such areas as leadership, music, art, drama, and science were assessed, the high-SAT student could not be distinguished from the low-SAT student. However, high-divergers (high scorers on the Wallach-Kogan tests) were more likely to participate in activities related with leadership, art, writing, and science, though not music, drama, or social services than were low divergers. In a similar study Haddon and Lytton (1968) failed to support the Wallach and Wing claims but did report significant relations between student divergent ability and teacher nominations for creativity. Finally, Cropley (1972) found that divergent test results taken during grade seven correlated 0.51 with the students' participation in art, drama, literature, and music over the next five years.

While this evidence can be interpreted as supportive of claims for validity, the work of Hudson indicates that these examples are insufficient to maintain that divergent tests are creativity measures. In his study of English schoolboys, Hudson (1966) found that he could almost always predict students' areas of particular interest by examining their skill on divergence and IQ tests. Reexamining a series of traditional IQ tests, Hudson discovered that cognitive bias, the relative ability to perform on the verbal or numerical portion of an IQ test, was a better predictor of student choice of major study than absolute ability. For instance, the typical historian or modern

linguist had a rather low IQ, high verbal bias of intelligence, was a rather erratic worker, and tended to be more cultural than practical. The young physical scientist often had a high IQ, a non-verbal bias in ability, was an accurate worker and was more interested in practical and out-door activities.

When divergent tests came to Hudson's attention he incorporated them hoping that the open-ended tests would cut across the art/science dichotomy and give a better indicator of students' abilities, brightness, and the like. Instead, he found that divergent tests were a better predictor of the arts/science distinction. The arts student, in general, excelled on the divergent tests, while the science student performed well on the convergent measures.

These results clarify to some extent the validity claims of the "creativity" tests. What Wallach and Wing (1969) and Cropley (1967) have identified as creative output and correlated with results on creativity tests can simply be interpreted as the characteristic and predictable productivity of arts students. Hudson has shown that these tests are measures of a cognitive bias towards arts-like endeavours and that high-convergent science students are therefore equally capable of creative output.

Other studies support this contention. Ycas (1972) while studying convergent and divergent abilities of under-graduates found that the highly divergent students were predominantly in the arts and tended to be more involved in campus wide activities.

Roe (1952) in her study of eminent physical and social scientists makes a similar point.

> The biologists and physical scientists manifested a quite remarkable independence of parental relations and were without guilt feelings about it, while the social scientists showed many dependent attitudes, much rebelliousness and considerable helplessness. Whereas the characteristic pattern among the biologists and physicists is that of the shy, lonely, over-intellectualized boy, among the social scientists the picture is very different. They got into social activity and intensive and extensive dating at an early age. They were often presidents of their classes, editors of the yearbooks and literary magazines, frequently big shots in college. This contrast between the natural and social scientists was still evident after they grew up. (Roe, 1952, p. 25)

Creative scientists, undergraduates, or English school boys cannot be differentiated by their performance on a divergent test. In terms of testing conditions, the highly creative scientists must have been bored when confronted with typical creativity tests. These scientists, famous for their critical and precise thinking probably found such problems trivial and wastefully time-consuming. As Hudson (1966) has previously remarked, creative output is the result of intense concentration which ultimately results in a product that is novel and appropriate. From this definition, there is only circumstantial evidence that tests which ask the subject to provide as many uses of a "brick or barrel" as possible are measures of creativity.

3- Divergence and Academic Achievement

Since divergent scores are generally independent of convergent scores and since convergence alone is a limited predictor of achievement, it might prove interesting to investigate the divergent test's value as a predictor of academic achievement. Feldhusen, Treffinger

and Elias (1970) state that divergent thinking and creative-self ratings made significant contributions to the prediction of school achievement among adolescents over a four year period. Cline, Richards, and Abe (1962) found that the "creativity" tests did have considerable validity as a predictor of academic performance and a large portion of the criterion variance accounted for by the "creativity" tests was not accounted for by the convergent measure.

Considering the relationships among the convergent and divergent measures and achievement, Feldhusen, Denny, and Condon (1965) found that the verbal and quantitative ability measures and tests of originality, flexibility, and fluency predicted achievement in a number of subjects. However, using the Torrance creativity tests, Circirelli (1964) found a limited usefulness for "creativity" measures as a predictor. This contradictory finding probably demonstrates the uncertain nature of testing conditions and the importance of an appropriate choice of divergent and convergent measures.

Feldhusen et al. (1971) felt divergent testing conditions might have a substantial effect on the test's predictive effectiveness. With a sample of elementary school children under four testing conditions, they concluded that divergence did predict achievement; its contribution varying with the test conditions and the course content. For instance, for mathematics and English language arts achievement, the multiple correlations with the divergent scores under a game-like situation were lower than multiple correlations for three more structured methods of testing. Unfortunately no convergent measures were used as rival predictors.

As noted, Getzels and Jackson found that students who scored high on divergent tests achieved as well in school as the high

convergers. Similarily, Wallach and Wing (1969) found that the high divergers and convergers were both equally superior relative to the sample form which they were drawn, while Hasan and Butcher (1966) demonstrated those high on both convergence and divergence scored highest of all in English language arts and had similar scores in arithmetic compared to those high only in convergence.

Yamamoto (1964a) using the TTCT found the high-divergent group did as well on the Iowa Test of Educational Development as the high convergers despite a large IQ difference between the groups. When the IQ factors were covaried Yamamoto found that the high "creatives" outperformed the low "creatives" demonstrating the importance of the relationship between divergence and achievement (Yamamoto, 1965).

Cropley (1967), using a Canadian sample and an improved experimental design, predicted that he could discriminate between the high and low achievers on the basis of divergent scores even with IQ removed. The findings substantiated his claims since students high on both abilities performed better than the high convergers. The low convergent-high divergent and low convergent-low divergent groups followed third and fourth in ranking, indicating that high divergent ability substantially aided the student in his scholastic achievement.

Maslany (1973) set out to determine the extent of prediction of convergent and divergent abilities in academic and non-academic activities after a delay of seven years. His results added little to the argument that divergence would be a good predictor of non-academic achievement which incidentally supplied further evidence for the poor validity of divergence as a measure of creativity. Overall, convergence was consistently the better predictor although divergence did significantly contribute to the prediction of one academic (first year GPA) and of one non-academic activity (music).

4- The Influence of the Learning Environment

The unexpected finding in the Getzels and Jackson (1962) study that despite a twenty-three IQ point difference the two groups achieved equally well in school provoked several replication studies. These studies only partially substantiated earlier claims (Torrance, 1962; Palm, 1959; Yamamoto, 1964). Torrance (1962) suggested a few explanations for his discrepant results. One difference is situational. The two schools where he was unable to confirm the earlier results was a rural elementary school and the other, an urban parochial school. Both these schools have been characterized as more rigid and structured.

Haddon and Lytton (1968) noting the limited evidence for the divergent test as a measure of creativity, felt convergent and divergent thinking should be considered two different but complementary thinking styles. They remarked that school experience, particularily in the early years, was especially crucial to child development and subsequently examined the learning environment of the classroom. Two hundred and eleven children were drawn from groups with different learning environments. One group was the product of a "formal", traditional system with great emphasis on convergent thinking, while the other had been taught in a system characterized by "informal" child-initiated learning. Four years after their leaving the different environments, comparisons were made of students matched for verbal IQ and the socio-economic status of their parent's IQ. As expected the students from informal schools scored significantly higher on tests of divergent thinking even though both the groups had been exposed to a relatively uniform learning environment for four intervening years. Haddon and Lytton concluded that the early experience of different

learning environments helped develop various attitudes toward learning and a preference for a particular type of environment. The authors did not think that secondary school had much impact on cognitive development.

While restudying this issue, Yamamoto (1963, 1964) pointed out that there was another critical variable aside from student bias which affected academic achievement. He contended that the teacher's "creative" abilities might interact with the student's own cognitive style. In his study, he examined the "creativity", measured by the TTCT, of grade five teachers. One result showed a significant interaction between student and teacher "creativity" when arithmetic skills were the dependent measure. With low divergent teachers, the high divergent students did worst of all, while the combination of low divergent teachers and low pupil divergence resulted in the highest level of achievement. In addition, high divergent students performed poorly when the teachers were high or low divergers.

Although Yamamoto was cautious about making generalizations, he did conclude that there was sufficient evidence to demonstrate that classroom achievement was partly dependent on the cognitive style of the teacher. From this and other evidence Freeman, Butcher, and Christie (1971) concluded that interactions between teachers and students are complex and are not always advantageous to the learner.

Within an Aptitude Treatment Interaction (ATI) paradigm, MacDonald and Raths (1964), conducted a study where a group of children was given twelve tasks, three each of four different types--frustrating, open, closed, passive. Raters judged the group involvement and the pupils rated each task for liking. The authors concluded that low

"creatives" tended to dislike frustrating curriculum assignments and performed poorly on open and frustrating tasks while high "creatives" tended to dislike closed tasks.

Barker-Lunn (1970) continued to study the effects of learning environments on divergent production. She predicted the schools and teachers preferring a less formal approach to curriculum would do more to encourage divergent thinking than those who indicated a preference for more accepted standards of achievement. The teachers were divided into two groups—those who had progressive and informal attitudes toward learning and those more conservative and interested in the traditional methods.

Findings indicated that the divergent scores of students with "progressive" teachers tended to show a definite improvement while the "formal" teachers appeared to have a negative effect on their students. It was also reported that the progressive teachers spent more time with high divergers than with the low scorers. The teachers apparently had more trouble developing the divergent skills of their students.

The highly divergent students tended to be less environment-bound and demonstrated more initiative and motivation than the low divergers. These results support the earlier Haddon and Lytton (1968) claim that self-initiated learning is the most crucial variable in student "creativity".

In a secondary school sample, using the same testing material, Lytton and Cotton (1969) found contradictory evidence to support their earlier finding that divergence was a function of school "informality". They attributed these results to a number of intervening variables all pointing to the complexity of the learning situation and a need for a greater understanding of the classroom environment.

To better describe this phenomenon an exhaustive series of experiments were conducted by Anderson and Walberg where "multivariate studies determined the relationship between the student's perception of the class environment and class learning" (Anderson & Walberg, 1968), individual perception and individual learning (Walberg & Anderson, 1967), teacher personality as a predictor of classroom climate (Walberg, 1969), classroom climate as a predictor of individual achievement (Anderson, 1969, 1970), and course content and teacher sex on the social climate of learning (Anderson, 1971). All their published reports present significant findings.

5- Student-Teacher Interaction

Using a more mature sample, Joyce and Hudson (1968) investigated the interaction of the personalities and intellectual styles of students with those of their teachers, with observations made in a statistics class of medical students. One hundred and fifty-four students and four teachers took part in the experiment over three successive class periods. Students were asked to complete two rating forms; one to judge their own divergent - convergent ability and the other to estimate the cognitive style of his own particular teacher. The teachers also rated each of their students and their own ability. An observer also submitted ratings of the teacher.

The results showed a consistent relationship among the teachers' own ratings of themselves, the students' ratings and the observers' opinions. Student estimates of their own cognitive bias were significantly related to the teachers' estimates. An analysis of final examinations suggested that certain types of students obtained better

marks if taught by particular teachers. For example, students who had low convergent or high divergent scores tended to do well when taught by the most divergent teacher.

Although the overall hypotheses were confirmed, some of the findings did suggest that while learning is affected by the similarities between cognitive styles of teacher and student these interactions are not always advantageous. In some instances, convergers as well as divergers are better taught by divergers.

Important interactions have also been found using the abstract belief systems of teachers as the predictor variable. Harvey, Prather, White and Hoffmeister (1968) found that the most abstract teachers expressed a greater warmth toward children, were more encouraging of creativity and less structure bound. The concrete teachers were less resourceful and more punitive than abstract teachers while their students were more involved with their work, higher in achievement and less concrete than their counterparts.

Since the importance of interactions was obvious, a methodology capable of measuring this effect was needed. The suggestion that, in general, teachers prefer the converger to the diverger had wide spread acceptance. Experimental errors aside, this argument was surprising as various studies had shown convergent and divergent students achieved equally well (Getzels & Jackson, 1962) and desirability ratings apparently are affected by a halo effect which is largely influenced by achievement (Holland, 1959). Wallach & Kogan (1965) felt since the difference in ratings was not due to achievement, teachers had different value systems regarding student behaviour, thus making it difficult for them to objectively judge student classroom behaviour. They concluded, therefore, that ratings were not useful in creativity

research (Wallach & Kogan, 1965, p. 169).

In essence, the authors were challenging the ability of teachers to perceive students independently of their academic achievement and more specifically whether teachers were biased against the diverger.

Studies by McIntyre, Morrison and Sutherland (1966) and Biggs et al. (1971) demonstrated that teachers' ratings were associated with several factors; verbal ability of the student, attainment, motivation and interest, and the method by which he was taught. Biggs suggested that certain methods of instruction would encourage more original or flexible responses which were reflected in the teachers' ratings. Since rating forms favor convergers, (Guilford, 1967) the results strongly indicate that teachers were able to distinguish students exhibiting divergent behaviour and react favorably to them.

In a follow up study, Biggs, Fitzgerald and Atkinson (1971) measured student convergent and divergent abilities and asked teachers to rate the students' conceptual and mechanical performance. Results indicate that when convergent ability is held constant, teachers rate positively behaviours associated with divergent behaviour. In fact, contrary to Getzels and Jackson's claim that teachers do not like divergers or Wallach and Kogan's argument that ratings are worthless, it seems more plausible to conclude that teacher ratings also measure non-convergent behaviour. Biggs and his colleagues feel their results are valid although one very important source of variance had been excluded from these studies. Except for a study by Brody (1970) the cognitive style of the rater has been ignored in teacher rating studies.

In addition to this methodological shortcoming, Shulman (1966) feels that most human characteristic testing takes place in a rigid and

structured situation. While it is acknowledged that task content considerably affects test results, the effect of task content is less well known. In the Wallach and Kogan (1965) study, the divergent measure was administered in a relaxed, game-like atmosphere while the convergent test was given in a structured, timed-test situation. These two conditions made it "unclear whether the differences reported were a consequence of the associational contents of the tasks representing the two domains or simply a function of the differences in instructions and time limits for the two sets of tasks" (p. 308). Shulman suggested that a convergent and discriminate analysis be done to account for the variance due to the content and context.

6- Problems of Methodology

Many of the studies that have investigated trait-treatment interaction have suffered from a number of research design and statistical errors.

Some studies of cognitive style and academic achievement have pooled subjects from different grade levels to increase the sample size (Yamamoto, 1965). This method is inappropriate as it incorrectly assumes that achievement is independent of grade level. Achievement scores have also been pooled to present an overall indicator of a student's general scholastic ability although different dependent scores were used for each student. Yamamoto, having used this method, later admits his inability to defend the procedure.

Analysis of variance as a statistical tool has been criticized because of the untenability of its major assumptions. Also, "blind application of the analysis of variance technique under such circumstances to the kind of data employed would seem to have little to

recommend it. A judicious use of a multivariate procedures seems instead to be indicated" (Yamamoto, 1965, p. 372). The multivariate paradigm receives further support from educational researchers who have noted the complex nature of classroom interaction.

In addition, many studies have relied on extreme group scores (Getzels & Jackson, 1962; Wallach & Kogan, 1965). This technique, though useful in exploratory research, often excludes a large part of the sample and relies entirely on differences between top and bottom groups. This method often suggests significant relationships where a more careful approach, using the whole sample or a number of other less extreme groups might not reveal quite the same result (Punch, 1971).

7- Summary

Claims that divergent tests are measures of "creativity" have stirred a controversy which has drawn attention from possible use of divergence as a complement to the popular IQ (convergent) measure. The multiplicity of possible criteria for measuring a creative act and complexity of the associated cognitive processes are so great that a paper-and-pencil test indicates at best a simple relation between the variables. Divergent ability on the other hand when used in conjunction with convergence has been demonstrated as a useful predictor of classroom achievement.

In terms of research design, most of the studies involving student characteristics and achievement have neglected the important influence of the teacher on these dependent variables. While the appropriate teacher variable is difficult to determine and partially dictated by the objectives of the study, the most parsimonious approach

is to use the same predictor (independent) variables as those used for the students. In addition, this approach also permits an analysis of interaction between teacher and student.

CHAPTER 3

PURPOSE OF THE PRESENT STUDY

1- Purpose

Referring to the multiplicity of general IQ test variables, McNemar (1964) states that "...despite the diversity of definitions the same function or process is being measured" (p. 871). Realizing that most of these tests reflect a traditional concept of intelligence testing (convergent thinking) McClelland (1973) feels such tests reveal a weakness in "that they structure the situation in advance and demand a response of a certain kind from the test taken" (p. 11). He states that tests such as divergent thinking partially satisfy the need for measures that allow the individual to respond with a number of alternatives.

The controversies surrounding intelligence testing suggested to Hudson (1966) and others that such a sterile approach only reopened new issues as to the dimensionality of intelligence. Traditional work rarely investigated the importance of response mode, the effectiveness of cognitive bias as a predictor of achievement, and the low validity of IQ tests judged in terms of success in later endeavours.

It was probably this dissatisfaction with intelligence tests that prompted researchers such as Torrance (1959), Taylor (1960), and Guilford (1950) to conduct more novel investigations. By and large the new tests that resulted from these studies were structurally different from IQ measures, required a different response mode and

purported to measure an ability equally as important as intelligence. Creativity research was born as an alternative to IQ testing, which in part explains the preoccupation of creativity researchers with comparing "creativity" with IQ.

Unfortunately, the new "creativity" tests often became an appendage to the intelligence tests. They most often measured the same cognitive abilities as IQ tests, and were also poor predictors of the behaviour they supposedly measured. While the results were at times discouraging, researchers such as Hudson (1966) and Wallach and Kogan (1965) were able to demonstrate that convergent and divergent ability were useful delimiters of human behaviour.

The purpose of this study is to investigate the relationship of these cognitive abilities to one another and their usefulness as predictors of school achievement, student behaviour and classroom climate.

2- Hypotheses

Each hypothesis will be stated in the direction of the expected results. These will be followed by a brief rationale explaining the expected contribution and importance of each hypothesis.

i) Divergent Tests

Hypothesis 1 There are no sex differences in divergent or convergent ability.

Cronbach (1968) points out that many studies treat data for each sex separately without first demonstrating the presence of an interaction. Within sex analysis cuts the degrees of freedom in half

thereby removing much of the power of the investigation. Significant relationships for one sex often suggests various sex differences where no real difference exists.

Hypotheses 2 and 3 The Cropley version of the Wallach and Kogan tests is highly intercorrelated (Hypothesis 2) and independent of the convergent measure (Hypothesis 3).

Earlier evidence with individually administered Wallach and Kogan (1965) measures and Cropley's group administered tests (1966) yielded the predicted results with younger students and not as large a sample. The reason for testing these hypotheses is to verify the high clustering properties of the divergent measure and its relative independance from convergent tests.

ii) Academic Achievement

Hypothesis 4 Divergent test scores will significantly improve the prediction of academic achievement.

While evidence is confused (due to divergent tests' shared common variance with convergent measures, and the content specificity of the dependent variables), it is hypothesized that by using a large sample with more diverse achievement variables and independent measures this unresolved issue should be clarified.

iii) Divergent Processes

Hypotheses 5 and 6 The responses to a given stimulus will be progressively more original (Hypothesis 5) and the originality gradients of high and low divergers will interact as hypothesized by Mednick (Hypothesis 6).

Mednick's (1962) contention that originality is the result of associative processes suggests that divergence can also be explained in a similar manner. Using this principle Wallach and Kogan (1965) devised their divergence tests, but unfortunately neglected to investigate the validity of the Mednick theory.

iv) Student Behaviour

Hypotheses 7 and 8 After accounting for student and teacher (when applicable) convergent ability, divergence will increase the predictability of student behaviour as measured by the TRF (Hypothesis 7). However, the predictability of student behavior will significantly increase when the teacher related cognitive variables interact with the same student variables (Hypothesis 8).

The Getzels and Jackson (1962) contention that convergers are generally preferred was confounded by uninvestigated teacher cognitive abilities bias. Recent evidence that most teachers are convergently biased (Axelrod, 1968) and theories of interpersonal attraction (Feather, 1971) clearly do not support Getzels' and Jackson's findings. This study has set out to investigate whether students, in general, are perceived as a function of their teacher's cognitive ability.

v) Classroom Climate

Hypotheses 9 and 10 After accounting for student and teacher (when applicable) convergent ability, high divergent teachers will conduct classes that conform to the traditional expectation of divergers; that is, the classes will be more diverse, more informal, less goal directed, more democratic, more disorganized and less

competitive than those of low divergent teachers. In operational terms, teacher divergence will significantly predict classroom climate as measured by the LEI (Hypothesis 9). No hypotheses are stated about the remaining dependent variables which are included for speculative purposes. However, in spite of the importance of teacher divergence students will more positively perceive the classroom environment when taught by teachers of similar cognitive style (Hypothesis 10). The learning environment in each classroom is partially the product of teacher's cognitive abilities and the overall abilities of the class. From the evidence provided by studies in classroom interaction it is hypothesized that students with cognitive styles in accordance with those of their teachers' will perceive the class in a more positive manner.

3- Experimental Design

The highly interactive nature of the learning process needs a research design which measures the interaction of teacher and student characteristics and their subsequent effect on student behaviour, learning environments, and classroom learning. This particular philosophy has only recently been articulated and applied by Siegel and Siegel (1968). More recently, Cronbach and Snow (1969) have proposed a general methodology for the study of individual differences, aptitudes and learning outcomes.

In the following study, all grade ten and eleven students and teachers in a typical Canadian high school were subjected to a series of cognitive tests. Aside from collecting the usual achievement

indices, each student was asked to complete a rating form of the classroom climate for each of his teachers. Similarly, every teacher was asked to fill out a student behaviour questionnaire for each student. While this technique requires an unusual amount of time to execute and necessitates a good rapport with the teachers, the extra effort is obviously worthwhile. In the simplest case, one has a teacher's rating of a student and the student's evaluation of the teacher. In the more complex situation, each student has been rated by a number of teachers while the teachers are often evaluated a number of times by their different students.

Each student and teacher interaction serves as a data unit which will permit both within and between class analyses. In addition, this technique facilitates the use of regression analysis, a method which has received considerable support in recent years as a general analytic instrument for educational studies (Cohen, 1968; Darlington, 1968).

4- Method of Analysis

This section summarizes the analytical link between theory and results. The discussion will only cover a brief summary of the major statistical methods employed and a rationale for their use.

Most important, this study has been designed for use in a multivariate multiple regression analysis. Whenever possible the data will be analysed using this technique, because of its simplicity and superiority as a tool for analysis.

The essence of regression analysis is as follows: An equation is made up of criterion scores (e.g., achievement) on one side of the

equation and a series of selected predictor variables (e.g., convergent and divergent scores) on the other. The correlation between the criterion variable and predictor variables are computed and taking the intercorrelations between the predictors into account, a set of weights are derived. These weights when linearly combined in an equation gives an approximate prediction of the criterion variable. Obviously, criteria that are well predicted by the equation are more useful than poorly predicted variables. The statistics involved in determining the significance of this prediction is the multiple correlation, R and the multiple correlation squared, R^2. This statistics reflects the relationship between the predicted (or estimated criteria) and the actual criteria. It also indicates the amount of variance of the criteria that has been accounted for by the predictor. The R^2 can be tested for significance with the F distribution (Kerlinger & Pedhazur, 1973).

A forward type of regression solution will be used in order to select the smallest number of variables which statistically predict the dependent variables. This procedure should yield the most parsimonious solutions. At each stage of the analysis the change in R^2 attributed to the new additional variable will be tested according to the following equation:

$$F = \frac{(R^2_1 - R^2_2)/(k_1 - k_2)}{(1-R^2_1) / (N-k_1-1)}$$

where R^2_1 = the squared multiple correlation of the additional variable

R^2_2 = the squared multiple correlation of the original variables

k_1 = the number of independent variables of R^2_1

k_2 = the number of independent variables or R^2_2

N = the total number of cases

A significant F ratio indicates that the change in R^2 is statistically significant.

Like all statistical techniques, the regression method has several assumptions which are usually associated with testing the significance of a finding. First, in regression, it is assumed that the predicted scores are normally distributed at each value of the predictors. While this assumption is not needed to calculate the correlation or beta weight, it is essential to test the F ratio. The second assumption is that all the Y variances are equal at each value of X.

Methodologically, most studies of divergence have a major flaw of not considering any convergent data in their analysis when studying divergent abilities (Yamamoto, 1964; Torrance, 1969) or else have added the convergent measure to the stepwise analysis after the divergent scores. (Cropley, 1966)

Cronbach (1968) strongly opposes this method of analysis and argues that the convergent measure being more familiar and better understood should be used as the first predictor followed by divergent scores. His rationale for this approach is to place "the burden of proof on the newly proposed psychological variable". (Cronbach, 1968, p. 497). Maslany (1973) agrees with Cronbach but for a different reason. He feels that since divergent tests are cumbersome to use and take an inordinate amount of time to score, they should be placed in the regression equation last for the sake of economy.

Statistically this issue is of prime importance; if two predictors are correlated, then the order in which they are placed in the regression formula will produce different results. This effect is due to the shared common variance of the predictor variables. If two predictor variables are highly correlated, then one will be a good

predictor, and the other not. The higher the correlation between the two predictors, the more redundant one of the variables will be, and hence not apparently as important.

One note of caution is needed. The set of weights of any regression equation are designed to yield the highest possible correlation between the independent variables and the dependent variable with the underlying assumption that the zero-order correlations are error free. For this reason it is always advisable, as previously mentioned, to order the independent variables in which they enter the regression, thereby reducing one source of spuriously produced significant relationships. However, if the derived weights from a regression equation are applied to the predictor scores of another sample and then resulting correlations between these predicted scores are correlated with the observed dependent variables, the predicted scores and the actual observed scores will almost always yield correlations lower than the original R. This occurrence is typically referred to as the shrinkage effect.

Although shrinkage will not be considered in this study it is important to test the results on other samples to test the stability and generalizability of the results. Probably the best method for estimating the degree of shrinkage is to perform a cross-validation (Lord and Novick, 1968, pp. 285). This is done by using two samples. A regression equation and R^2 are derived from the first sample which is subsequently applied to the second sample, thus yielding a Y^1 for each subject. A simple $\underline{r}$ is then computed for the criterion dependent variables of the second sample and the Y^1. The difference in the R^2s of the two samples represent the shrinkage effect which can be small or large depending on the usefulness of the predictors.

In spite of the ability of the multiple regression technique to measure the relative contribution of each source of variance, a research design which controlled for external sources of variance was obviously still necessary. One such set of variables which might have confounded the analyses was the effect of the between and within class variance.

As both student behaviour and classroom climate are determined by activities within individual classes, and since these behaviours, which are unique to each class are hypothesized to be determined by cognitive abilities of students and teachers, it was imperative that differences between classes be kept independent of those observations within a class.

To permit analyses of individuals from different classes, the scores were standardized around the class means and of the scores pooled. In this way, the between class variance was controlled and the analyses could proceed using the individual as the basic unit of analysis.

As an alternative method, it was also possible to run separate analyses of the dependent variables for each class and then inspect the average contributions of the predictors or the outliers. Although this method has considerable merit, the formidable cost of running 48 regression equations for each of the 24 dependent variables would have been too great.

However, to test the difference between these two methods, analyses for six randomly chosen dependent variables were done using both methods of analysis. The similarity between the two results indicated that the cost effectiveness of the first method was superior without any apparent loss to the value of the results.

While regression analyses based on individuals are intuitively interesting, they often do not provide meaningful enough results; that is, the results tend to explain a very small proportion of the variance. In anticipation of this occurence and the knowledge that the classroom is often the unit for administrative and teaching purposes, the standardized mean independent and dependent variable values for each of the forty-eight classes were used in a series of analysis comparing the differences between classes. This series of analyses were called "between class" analyses.

5- Summary

To clarify the analytical sequence of this study, a schematic diagram has been prepared to represent the ordering of the hypotheses and the corresponding analyses used.

INSERT FIGURE 1 ABOUT HERE

The initial analyses are primarily concerned with descriptive presentations of the data and the testing of simple relationships between various subgroups within the sample (e.g., sex, grade).

Next, a number of hypotheses concerning the properties of the convergent and divergent measures are investigated. Once completed, the study is broken down into three different but related areas. The first investigates the prediction of academic achievement. Second, the associative process theory which provides the underlying basis of the Wallach and Kogan tests will be studied. Finally, the effect of the interaction of cognitive abilities of teacher and student on student behaviour and the learning environment will be tested.

FIGURE 1

DIAGRAM OF HYPOTHESES AND STATISTICAL ANALYSES

Hypothesis	Statistical Techniques
Descriptive	Means Histograms
Differences Sex, Grades, Sex and Grades (1)	T-Tests
Convergent-Divergent Tests - Intercorrelations (2) - Independence (3)	Correlations Principal Component Analysis
Prediction of Achievement (4)	Multivariate Regression Analysis
Associative Processes (5)+(6)	Analysis of Variance
Classroom Interaction - Student Behaviour (7) + (8) - Classroom Climate (9) + (10)	Multivariate Regression Analysis

CHAPTER 4

PROCEDURE

1- Subjects

All the grade ten and eleven students in a high school of the Protestant School Board of Greater Montreal were included in the present study.

INSERT TABLE 1 ABOUT HERE

Of the 490 students in the school, some were not eligible for testing (i.e., English language difficulties) while a few others did not complete all the tests, due to absences, sickness or dropping out. In addition to the thirty-five dropouts and chronic absentees who did not write both the divergent and convergent tests, thirty-one others did not write one of the two tests because of sickness or scheduling problems.

The final group was comprised of 209 males and 209 females (total 418) representing 85% of the male population and 88% of the female population in grades ten and eleven.

The eighteen teachers to take part in the study were volunteers who taught all of the required academic subjects. Due to scheduling problems, the three non-academic (i.e., typing, drafting) teachers were not included in the sample.

2- Method of Data Collection

Early in the school year, the students were administered the convergent test. Although the students were under no time constraints they were encouraged to complete the test in the normal

TABLE 1

BREAKDOWN OF THE GRADE 10 AND 11 SAMPLE BY SEX, ELIGIBILITY AND RESPONSE RATE

	MALES	FEMALES	TOTAL
Total Sample	251	239	490
Language Problems	4	2	6
Eligible Sample	247	237	484
Missing two tests	21	14	35
Missing one test	17	14	31
Complete Sample	209	209	418
% of the Eligible Sample	85%	88%	86.5%

class period. As testing conditions have received a lot of attention in studies of divergent thinking (Wallach & Kogan, 1965; Laith, 1972) every effort was made to ensure the testing procedures and conditions were similar for all the tests and classes. Two months later, the divergent tests were given in a similar manner to the students.

INSERT FIGURE 2 ABOUT HERE

In January and February when the students and teachers had become familiar with their classes, a classroom climate questionnaire was distributed to each student in every class. More than one thousand completed Learning Environment Inventories were collected in the forty-eight classes. At the same time, the teachers were asked to fill out a behavioural rating form for each of the students they knew well. Again, more than one thousand completed forms were returned.

Toward the end of the school year (June) the participating teachers were also administered convergent and divergent tests. The same divergent test completed by the students was used but a more difficult version of the convergent test was chosen in order to avoid possible ceiling effects.

Finally, achievement test results were collected on exams administered annually by the provincial department of education. As a rival predictor of student achievement, teachers' personal predictions of individual student achievement were also obtained. These predictions were based on classwork and participation as well as previous exam results.

FIGURE 2

TESTING TIMETABLE FOR THE DEPENDENT AND INDEPENDENT VARIABLES

NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.
convergence (student)		divergence (student) classroom climate convergence student retest	classroom climate student behaviour	classroom climate retest	divergence student retest student behaviour retest	convergence (teacher)	divergence (teacher)	teacher prediction	achievement (student)

3- Measures

a] Divergence

i. Test Administration

Students and teachers received the Cropley version of the Wallach and Kogan divergent tests. (Wallach & Kogan, 1965; Cropley, 1967). Each booklet included instructions noting the untimed test procedures and encouraging subjects to produce as many quality responses as possible. The divergent tests comprised four subtests: uses, similarities, pattern meanings, and line meanings (See appendix A). Twenty-seven stimuli were presented in a prearranged order. The subjects worked at their own rate in a group setting and those who needed more than the forty-five minute class period were invited to complete the test at a later date. The four test administrators made every effort to present the divergent tests in exactly the same manner to each subject and to present both the convergent and divergent tests in the same mode so as to reduce a bias in favour of the divergence measure (Yeas, 1972).

In order to reduce scoring time to manageable proportions, a stratified random sample of fifty-four tests (approximately 10% of the sample) were selected and all of the twenty-seven items were scored. This sample was selected by sex and grade in proportion to their representation in the student population. From this sample the two items from each section which together accounted for the highest amount of the total fluency and mean originality variance were retained for the subsequent analyses.[1]

[1] Henceforth all references to the "divergent test" will refer to the shortened eight item test and not the Cropley version of the Wallach and Kogan tests.

INSERT TABLE 2 ABOUT HERE

It. Test Scoring

Since divergent tests do not have "correct" answers, the question of how to score these items has received some attention in the literature. Both the Torrance Tests of Creative Thinking and the Wallach and Kogan test users have traditionally scored their tests along four dimensions: "fluency" - the number of responses. "originality" - the number of unique responses, "elaboration" - the number of embellishments on responses, and "flexibility" - the number of different categories of responses. Subsequent analyses have yielded high intercorrelations among these dimensions for the Torrance (Merz & Rutherford, 1972) and the Wallach and Kogan tests (Kogan & Morgan. 1969) indicating that some of these dimensions may be unnecessary. While scoring keys are available, Vernon (1971) feels they are inappropriate for different cultural groups and probably for different age groups as well.

Based on the original suggestions of Wallach and Kogan (1965) and Cropley (1967), both fluency and originality (based on the statistical infrequency of the responses) were used. Inappropriate responses that is, responses considered bizarre and irrelevant were eliminated. Every effort was made to insure the scoring was as objective as possible. No attempt was made to judge a response; the sole task of the scorer was to decide whether a response was appropriate and to which general category

TABLE 2

ITEM-TOTAL AND MULTIPLE CORRELATIONS OF THE FLUENCY AND ORIGINALITY DIVERGENT TEST SCORES WITH THE COMPLETE CROPLEY TEST OF DIVERGENT THINKING[1]

	ITEM-TOTAL CORRELATION		MULTIPLE CORRELATION	
	FLUENCY	ORIGINALITY	FLUENCY	ORIGINALITY
Uses				
Item 01	(.85)[2]	(.87)		
Item 03	(.65)	(.70)	(.91)	(.93)
Similarities				
Item 08	(.71)	(.76)		
Item 11	(.62)	(.64)	(.87)	(.85)
Pattern Meanings				
Item 15	(.79)	(.80)		
Item 17	(.76)	(.77)	(.92)	(.91)
Line Meanings				
Item 25	(.74)	(.76)		
Item 22	(.73)	(.72)	(.90)	(.92)

Note: [1] The items in Appendix A marked with an asterisk (*) signify the eight items used in the remainder of this study.

[2] The correlations are enclosed in parentheses to denote that the expected value of the correlations are not zero. Hence the scores are not tested for statistical significance.

it belonged. The data were not normalized, as in Cropley's sample. Instead a logarithmic transformation was used to preserve the general distribution of scores while narrowing the range of extreme scores; however, untransformed scores were used to test the Mednick hypothesis (discussed on pp. 107-122).

iii. Testing Conditions

Recent studies on divergent production under different testing conditions have revealed that although scores varied considerably from one condition to another the ranking of individuals was fairly constant (Feldhusen et.al., 1971). These findings indicate that as long as the testing conditions are consistent across all classes, it is probably valid to assume that the tests sampled typical student ability in the classroom.

The divergent measures themselves, were administered in the same order as in the Cropley study (1967). While it makes comparisons with his results justifiable other statements about the test's properties which might prove interesting were not possible. For example, one interesting argument by Mednick (1962) that divergent responses are associative may be confounded by the stimulus ordering or a fatigue factor. Randomizing the items would have been a better approach.

iv. Test-Retest Reliability

A random sample of thirty students (fifteen males and females) took the divergent test a second time after a three month interval. The combined sex test-retest reliability

correlations presented in Table 3, ranged from 0.73 to 0.92 with a median value of 0.86. The lower correlation for "line meanings" might indicate a fatigue factor on the later stimulus items.

INSERT TABLE 3 ABOUT HERE

Using a correlated t-test, the divergent scores of those taking the measure a second time significantly increased in five of the ten instances. In only one case, total, did both the originality and fluency scores concomitantly and significantly increase. Without stating any hypotheses one might have

INSERT TABLE 4 ABOUT HERE

expected both originality and fluency to increase more often together but judging from these results it appears that fluency can be more easily influenced than originality although the small sample size and the uncontrolled experimental design renders this result purely speculative.

The uniform testing conditions, the high test-retest reliability, the satisfactory alpha coefficients (presented in Table 7), the relatively small although significant changes in performance, and the precedence of numerous other studies only using one testing session indicated that the one set of divergent scores would be sufficient. In any case, due to school policy a second test could not have been administered to the students.

TABLE 3

THE TEST-RETEST RELIABILITY OF THE DIVERGENT TEST AFTER A THREE MONTH INTERVAL

	FLUENCY	ORIGINALITY
Uses	0.92**	0.94
Similarities	0.88	0.90
Pattern Meanings	0.83	0.81
Line Meanings	0.73	0.73
TOTAL	0.86	0.87
	N = 30	N = 30

**Critical value at 0.01 level of significance = 0.45

TABLE 4

TEST SCORE DIFFERENCES IN DIVERGENT FLUENCY AND ORIGINALITY AFTER A THREE MONTH INTERVAL

	1ST TEST ADMINISTRATION		2ND TEST ADMINISTRATION			
FLUENCY	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{d}$	t
Uses	7.520	3.170	8.721	4.367	1.201	0.423
Similarities	6.113	2.807	7.330	4.882	1.217	2.434*
Pattern Meanings	4.117	3.330	4.262	3.227	1.45	0.046
Line Meanings	3.720	2.760	4.997	4.453	1.270	2.309*
Total	21.470	8.440	25.310	11.770	3.840	3.339**
ORIGINALITY	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{d}$	t
Uses	21.976	12.744	25.780	13.116	3.804	4.696**
Similarities	11.772	8.762	13.123	9.226	1.351	1.689
Pattern Meanings	17.337	10.337	17.774	9.212	0.437	0.416
Line Meanings	15.762	11.272	18.264	10.001	2.502	1.787
Total	66.847	28.115	74.941	30.996	8.094	3.193**

Note: Critical value at 0.05 level of significance = 2.045
Critical value at 0.01 level of significance = 2.756

b) Convergence

i. Test Administration

The Raven Progressive Matrices were chosen to measure the convergent ability of the teachers and students (Raven, 1958). This test loads heavily on "g" and demands a highly convergent response mode which must be applied progressively to more difficult items. The last thirty-six items of the standard test were used in this study. The test was virtually untimed since these tests rarely take any longer than the regular forty-five minute class period. The three students who had not completed the test in forty-five minutes were asked to hand in their incomplete answer sheets. The participants were told that the tests were measures of a type of thinking style, the results of which would be confidential. They were instructed to do their best and not spend too much time on items that were unusually difficult.

ii. Test-Retest Reliability

Another group of thirty students wrote the convergent measure a second time after an interval of two months. The test-retest reliability was .88 for the convergent measure with no significant change in performance.

c) Student Behaviour

i. Test Administration

Some aspects of students' behaviour were measured by an eleven item, seven point bipolar scale (See Appendix B).

Teacher Rating Forms (TRF) were completed by all the academic teachers for each of their grade ten and eleven students. In this way, every student was rated at least once and as often as six times.

The TRF was specifically designed for this study to measure those forms of behaviour believed important for this type of cognitive abilities research (Getzels & Jackson; 1962; Sutherland & Goldschmid, 1971). The items measured the teachers' opinion of their students' attentiveness, achievement, how often they sought praise or encouragement, and if they were a discipline problem. In addition, it asked whether the students voluntarily participated in class, whether their contributions were original and if they worked independent of supervision. Finally, it solicited information on the students' attendance and the teacher's desire to teach a particular student again. The complete questionnaire was pretested to check on its clarity of wording, ease of presentation and the usefulness of the scales.

ii. Test-Retest Reliability

Although the original teacher rating form had undergone considerable reliability testing (one month interval reliability coefficient was 0.88) a reliability estimate was also collected for the present sample. A random group of thirty-five students was selected and rated twice by one of their teachers, the second time being two months after the initial test administration. The correlations are in general accordance with those previously

reported by Sutherland and Goldschmid (1971). The median correlation for the rating form is 0.86, ranging from 0.92 to 0.75.

INSERT TABLE 5 ABOUT HERE

The most stable ratings were Attention and Achievement and the lowest was Class Participation.

d) Learning Environment (Classroom Climate)

i. Variables

A shortened version of the Learning Environment Inventory (LEI) was used to measure the classroom climate (Anderson, 1971). This measure, originally developed at Harvard University and later validated in Montreal area high schools was ideally suited for the sample. In the present study, the best three items from each of the fourteen dimensions based on a pilot study were included in the forty-two item questionnaire.

The fourteen scales of the Learning Environment Inventory describe the classroom climate as perceived by the pupils along fourteen dimensions that measure the relationship of the pupils to the physical environment, to the subject matter, to the organizational climate in the classroom and to one another. No reference is made to the teacher in the questionnaire in order to emphasize "the socio-emotional characteristics of the class and to facilitate the administration of the instrument" (Anderson, 1969, p. 318). The respondent demonstrated his reaction to the forty-two statements by rating each item on a four-point scale. The summation of the three items for each of the fourteen scales made up the students' score. In the case of the between class

TABLE 5

TEST-RETEST RELIABILITY OF THE TEACHER RATING FORM AFTER A TWO MONTH INTERVAL

Attention	.90
Achievement	.92
Praise	.80
Discipline	.88
Participation	.75
Interest	.87
Originality	.87
Independence	.83
Preference	.84
Attendance	.85
Median Reliability Index	.86

N = 35

comparisons, the mean of all student ratings in each class provided the estimate of the collective students perception of their classroom climate.

A description of the fourteen variables are presented below (Anderson, 1971) (See Appendix C).

1- Cohesiveness (Previously called Intimacy) - This variable differentiates between members of a class which belong or feel that they belong to a group. "Cohesive classes sanction only goal directed behaviour; if the group norm including learning, cohesiveness contributes to increased learning; for non-learning oriented classes, cohesiveness acts against those pupils who want to learn".

2- Diversity - measures the extent to which a particular class provides for a diversity of student interests and activities. The variable has not shown a strong relationship with learning possibly because of its low reliability.

3- Formality - "measures the extent to which behaviour within the class is guided by formal rules". Again this scale does not appear to relate to pupil learning.

4- Speed - indicates how well the teacher presents material and the rate at which the work is covered. Speed is negatively correlated with the mean IQ of the class (Anderson, 1970a) while it is not related significantly to pupil learning (Anderson, 1970b).

5- Friction - This scale measures, from the students' viewpoint, the three behavioural categories, "shows disagreement", "shows tension", and "shows antagonism", of Bales' (1950) interaction process analysis. Friction is highest in mathematics classes (Anderson, 1970a) and when the class contains a large number of boys (Walberg & Ahlgren, 1970). It has a high negative correlation with measures of classroom learning, both individually (Walberg & Anderson, 1968b) and for groups (Anderson & Walberg, 1968).

6- Goal Direction - "If the assumption underlying the behavioural objective movement are correct, students in highly goal directed classes can be expected to reach the goal more often than students in classes where the goals are unspecified". This was supported when scores on goal direction were higher in traditional courses than in the more individually streamed Harvard Project Physics course (Anderson, Walberg & Welch, 1969).

7- Favouritism - This scale measures the students negative affect toward their teacher. In a sense it indicates a student's "academic self concept".

8- Difficulty - This variable measures the difficulty of the subject matter and the manner in which it is presented. In general, mathematics classes are perceived as more difficult than other classes (Anderson, 1970a) and larger classes are rated as less difficult than are small ones (Anderson & Walberg, 1971). Pupils generally learn most in classes that are rated

more difficult than those that are not. (Anderson, 1970b; Walberg, 1969b).

9- Apathy - This variable measures the students feeling of belonging to his class and also complements the Cohesiveness scale.

10- Democratic - This scale taps the students perception of the locus of control of the class. It essentially samples the student's perception of his ability to change the direction or organization of the class.

11- Cliqueness - "Subgroups, or cliques within a class can lead to hostility among members of various parts of the class. These cliques offer protection to those who are failures in the group at large and provide alternate norms which presumably lead to less than optimal group productivity". As Anderson points out, in some instances cliqueness may lead to increased learning for certain types of students.

12- Satisfaction - This variable measures how much students like the subject, the teacher and their classmates. A negative evaluation will probably lead to less than optimal learning performance.

13- Disorganization - "The extent to which pupils consider the class disorganized is related to the subject studied". Also, studies have shown that high disorganization inhibits pupil learning (Anderson & Walberg, 1968; Walberg, 1969b (manual)).

14- Competitiveness - This newly added variable is so far unrelated to the subject studied but correlates negatively with the proportion of girls in the class.

ii. Test-Retest Reliability of LEI

Sixty-five students from three randomly selected classes completed the LEI questionnaire a second time after an interval of one month in order to establish the instrument's stability. The correlations were all significant although it is important to note that the "speed" dimension is not high enough to be considered stable.

INSERT TABLE 6 ABOUT HERE

By way of explanation, "speed" refers to the teacher rate of presentation which undoubtably varies according to the nature of the content being taught. It is conceivable that the material covered during the two periods of test administration was sufficiently different to obtain such diverse results. In any case, thirteen of the fourteen stability coefficients were judged sufficiently high to continue using the complete measure.

4- Alpha Reliability of the Cognitive Variables

Finally, the reliabilities of the independent variables are contained in Table 7. Internal consistency estimates are not available for the Teacher Rating Form as the single item for each dependent

TABLE 6

TEST-RETEST RELIABILITY OF THE LEARNING ENVIRONMENT INVENTORY AFTER AN INTERVAL OF THREE WEEKS

	TOTAL SAMPLE	MEAN WITHIN-CLASS TEST-RETEST CORRELATION
Cohesiveness	.81	.79
Diversity	.67	.64
Formality	.77	.73
Speed	.42	.41
Friction	.87	.83
Goal Direction	.79	.76
Favouritism	.92	.90
Difficulty	.80	.80
Apathy	.88	.83
Democratic	.74	.71
Cliqueness	.77	.76
Satisfaction	.88	.82
Disorganization	.88	.81
Competitiveness	.75	.74
Median correlation	.795	.780

N = 65 N = 3 classes

variable does not provide any variance. The reliability of the other

INSERT TABLE 7 ABOUT HERE

variables have proved to be reasonably good and of comparable magnitude.

5- Limitations of the Study

The structure of the high school made it impossible to manipulate the interaction between the teachers and their students. Pupils were not randomly distributed among the classes and, in addition, teachers could not be randomly assigned to these pupil groups. This unfortunately restricted the experimental interaction of pupil and teacher characteristics.

Fortunately, the school policy toward teaching permitted individual teachers the opportunity to set up their own unique learning environment. Each teacher who participated in the study reported no restrictions had been placed on their teaching styles while the testing had taken place.

Aside from this methodological problem one other major source of error existed. With all studies involving human subjects, individual levels of motivation cannot be controlled. The pupils were aware they were subjects in a research project where individual scores would not be reported and confidentiality assured. They were, therefore, under no obligation to perform at their best and as the testing sessions progressed it became obvious that a very small number (four) of the students were not trying. While the behaviour of these

TABLE 7

ALPHA RELIABILITIES OF THE CONVERGENT AND DIVERGENT TEST SCORES[1]

	GRADE 10	GRADE 11	GRADE 10 & 11 COMBINED
Convergent	.71	.66	.68
Divergent (fluency-total)	.74	.78	.75.
Divergent (fluency-verbal)	.79	.80	.79
Divergent (fluency-figural)	.60	.63	.61
Divergent (originality-total)	.64	.77	.66
Divergent (originality-verbal)	.55	.63	.60
Divergent (originality-figural)	.64	.63	.64
	N = 214	N = 204	N = 418

[1] The breakdown of the divergent test scores into two component, verbal and figural, will be explained in the second section of the results chapter.

individuals did not alter the results, it points out the limitation of all studies involving human subjects.

In most of the analyses, the scores were standardized to aid in the interpretation of the results.

Two types of analyses were carried out. In the first, the class means were standardized using the overall class mean and the standard deviation of the class means. This procedure will be termed the between class analysis.

In order to remove the effect of class variation, individual scores were also standardized using the class mean and the class standard deviation. Analyses of these scores will be referred to as the within class analysis.

As a consequence of this procedure, the scores were no longer independent of each other, thus violating the underlying assumptions of the F test. In spite of this limitation the large sample size and the robustness of the parametric tests more than compensated for the problem and should not have affected the value of the results.

CHAPTER 5

RESULTS

1. SEX AND GRADE DIFFERENCES

Hypothesis 1 There are no sex differences in divergent or convergent ability.

a) Descriptive

Univariate and bivariate distributions of convergent and divergent fluency scores are presented for each grade level (See Appendix D). T-tests of sex and grade differences for the predictor variables, fluency and mean originality for all subtests of the divergent measure and the convergent scores, were performed. This was done to determine whether the sexes should be treated separately or combined some studies have found sex differences in convergent

INSERT TABLES 8 AND 9 ABOUT HERE

and divergent performance (Ycas, 1972) while others have concluded that such differences are often reported on the basis of less than conclusive evidence (Cronbach, 1968). In this study, no significant differences were found.

Achievement criterion scores were similarily analyzed and achievement differences between the sexes were found in three cases

INSERT TABLE 10 ABOUT HERE

where interestingly enough, the females were the better performers. In light of the few instances of sex differences, it was decided to

TABLE 8

SEX DIFFERENCES OF GRADE 10 STUDENTS ON THE DIVERGENT AND CONVERGENT MEASURES 1/

	FEMALES	MALES	t	P
DIVERGENCE				
FLUENCY				
Uses	7.52 2/ (3.41) 3/	7.75 (3.20)	0.50	.61
Similarities	5.86 (2.91)	6.17 (3.00)	0.84	.39
Pattern Meanings	4.14 (2.22)	4.33 (2.11)	0.65	.52
Line Meanings	4.02 (2.55)	3.59 (1.96)	1.54	.13
TOTAL	21.30 (7.51)	21.77 (7.22)	0.46	.64
TOTAL ORIGINALITY				
Uses	18.74 (12.02)	19.64 (12.02)	0.54	.59
Similarities	12.52 (10.10)	12.86 (9.30)	0.26	.80
Pattern Meanings	16.31 (10.47)	16.36 (10.18)	0.03	.98
Line Meanings	14.06 (8.75)	13.39 (9.08)	0.53	.59
TOTAL	61.34 (26.55)	62.25 (26.09)	0.23	.82
MEAN ORIGINALITY				
Uses	2.27 (0.62)	2.37 (0.67)	1.14	.26
Similarities	1.92 (0.95)	1.98 (1.00)	0.44	.66
Pattern Meanings	3.89 (1.14)	3.57 (1.04)	1.76	.08
Line Meanings	3.27 (1.15)	3.42 (1.48)	0.84	.41
TOTAL	2.77 (0.48)	2.77 (0.57)	0.11	0.91
CONVERGENCE	26.58 (4.70)	26.92 (4.29)	0.62	.54
	N = 110	N = 104		

1/ Fluency scores are a count of the number of responses. Total originality is a logarithmic transformation of the statistical infrequency of a response. The mean originality is derived from the division of originality by fluency.

2/ Mean Score.

3/ Standard Deviation.

TABLE 9

SEX DIFFERENCES OF GRADE 11 STUDENTS ON THE DIVERGENT AND CONVERGENT MEASURES[1]

	FEMALES	MALES	t	P
DIVERGENCE				
FLUENCY				
Uses	8.40[2] (3.48)[3]	8.33 (3.01)	0.17	.86
Similarities	6.60 (3.48)	6.36 (3.39)	0.50	.61
Pattern Meanings	5.05 (2.60)	5.15 (2.79)	0.27	.78
Line Meanings	4.63 (2.53)	4.22 (2.21)	1.23	.22
TOTAL	24.42 (8.56)	23.87 (8.04)	0.48	.63
TOTAL ORIGINALITY				
Uses	20.78 (12.84)	21.00 (11.79)	0.13	.89
Similarities	14.67 (9.96)	14.78 (11.21)	0.07	.94
Pattern Meanings	21.46 (13.34)	21.71 (14.97)	0.12	.90
Line Meanings	16.82 (11.57)	15.36 (9.49)	0.98	.33
TOTAL	73.68 (36.07)	72.73 (33.73)	0.19	.85
MEAN ORIGINALITY				
Uses	2.35 (0.58)	2.42 (0.66)	.80	.42
Similarities	2.10 (1.00)	2.13 (1.02)	.19	.85
Pattern Meanings	4.09 (0.92)	3.87 (1.21)	1.41	.16
Line Meanings	3.29 (1.33)	3.32 (1.45)	0.15	.88
TOTAL	2.91 (0.53)	2.94 (0.58)	.36	.72
CONVERGENCE	28.21 (4.64)	27.80 (6.17)	0.56	.58
	N = 99	N = 105		

1/ Fluency scores are a count of the number of responses. Total originality is a logarithmic transformation of the statistical infrequency of a response. The mean originality is derived from the division of originality by fluency.

2/ Mean Score.

3/ Standard Deviation.

TABLE 10

SEX DIFFERENCES FOR GRADE 10 AND 11 STUDENTS ON ACADEMIC ACHIEVEMENT

	FEMALES	MALES	t	p
GRADE 10				
Composition	67.12[1] (203)[2]	65.13 (205)	1.77	.08
Literature	66.95 (196)	62.49 (203)	3.68	.00
French (Written)	63.82 (189)	59.12 (182)	2.72	.01
Algebra	68.29 (163)	67.17 (184)	0.68	.49
History	60.91 (131)	63.21 (154)	1.27	.20
Biology	56.9 (20)	56.3 (22)	0.82	.53
GRADE 11				
Literature	68.60 (105)	64.20 (120)	2.50	.01
Composition	69.07 (106)	67.41 (120)	1.00	.31
French (Written)	63.11 (98)	59.91 (106)	1.55	.12
French (Oral)	67.72 (97)	64.84 (104)	1.47	.14
Geometry	66.94 (143)	67.87 (175)	0.45	.65
Biology	59.57 (84)	63.99 (75)	1.80	.08
Chemistry	63.86 (64)	65.97 (98)	0.77	.43
Mathematics	68.44 (36)	66.63 (60)	0.49	.59
Physics	64.13 (16)	60.90 (44)	0.77	.40
History	62.02 (98)	64.15 (111)	1.06	.28

[1] Mean Score

[2] Sample Size

pool the sexes and analyse the results without sex as a moderator variable although there is some possibility that sex interactions might exist with the other dependent variables.

Significance tests were also performed comparing divergent and convergent abilities of grade 10 and 11 students. While no sex differences were found, the grade 11 students performed at a significantly higher level on all the cognitive variables.

INSERT TABLE 11 ABOUT HERE

Inter-item fluency correlations of the divergent measure for both grade levels were uniformly high for grade 10 students ranging from 0.60 to 0.72 with the total scores, and 0.16 to 0.47 for all items. The grade 11 pattern was similar, the correlations between items and total scores were between 0.65 to 0.78 while the inter-correlations were from 0.15 to 0.47.

INSERT TABLES 12 AND 13 ABOUT HERE

When scored for mean originality the divergent items displayed a similar pattern. The item total score correlations ranged from 0.63 to 0.75 for grade 10 students and 0.66 to 0.81 for grade 11 students. The inter-item correlations ranged from 0.00 to 0.28 in grade 10 and 0.03 to 0.30 for grade 11. All these correlations are substantially lower than those presented by Ycas (1972), somewhat less than those of Wallach and Kogan (1965) but in general accord with those of Richards (1973). This discrepancy possibly reflects differences in the testing conditions. Both Ycas (1972) and Wallach and Kogan (1965) used relatively relaxed testing conditions for the

TABLE 11

DIFFERENCE BETWEEN GRADE 10 AND 11 STUDENTS ON THE DIVERGENT AND CONVERGENT MEASURES

	GRADE 11	GRADE 10	t	P
DIVERGENCE				
FLUENCY				
Uses	8.35 1/ (3.24) 2/	7.64 (3.26)	2.26*	.03
Similarities	6.47 (3.42)	6.01 (2.93)	1.49	.13
Pattern Meanings	5.10 (2.69)	4.22 (2.16)	3.69**	.00
Line Meanings	4.42 (2.38)	3.82 (2.06)	2.76**	.01
TOTAL	24.14	21.59	3.36**	.00
TOTAL ORIGINALITY				
Uses	20.90 (12.28)	18.98 (11.79)	1.63	.10
Similarities	14.73 (10.60)	12.68 (9.51)	2.07	.04
Pattern Meanings	21.59 (14.17)	16.38 (10.24)	4.33**	.00
Line Meanings	16.07 (10.55)	13.74 (9.22)	2.41	.02
TOTAL	73.19 (34.80)	61.78 (28.08)	3.70**	.00
MEAN ORIGINALITY				
Uses	2.39 (0.62)	2.32 (0.65)	1.03	.30
Similarities	2.11 (1.01)	1.95 (0.97)	1.65	.10
Pattern Meanings	3.98 (1.09)	3.70 (0.08)	2.57**	.01
Line Meanings	3.30 (1.39)	3.35 (1.32)	0.33	.74
TOTAL	2.93 (0.56)	2.77 (0.52)	2.96**	.00
CONVERGENCE	27.99 (5.51)	26.74 (4.19)	2.71	.01
	N = 204	N = 214		

1/Mean Scores

2/Standard Deviation

TABLE 12

INTERCORRELATIONS OF THE DIVERGENT AND CONVERGENT TEST SCORES FOR GRADE 10 STUDENTS

	USES	SIMILARITIES	PATTERN MEANINGS	LINE MEANINGS	TOTAL DIVERGENCE	CONVERGENCE
DIVERGENCE						
Uses		.30**	.35**	.16*	.71**	.19*
Similarities	.25*		.35**	.25**	.71**	.24**
Pattern Meanings	.11	.00		.47**	.72**	.15*
Line Meanings	.24*	.08	.28**		.60**	-.02
Total Divergent	.74**	.64**	.75**	.63**		.23**
CONVERGENCE	.09	.07	.13	.06	.20*	

N = 214 ** $p < .01$; * $p < .05$

Note: Fluency correlations - above the diagonal

Mean Originality correlations - below the diagonal

TABLE 13

INTERCORRELATIONS OF THE DIVERGENT AND CONVERGENT TEST SCORES FOR GRADE 11 STUDENTS

	USES	SIMILARITIES	PATTERN MEANINGS	LINE MEANINGS	TOTAL DIVERGENCE	CONVERGENCE
DIVERGENCE						
Uses		.41**	.47*	.33**	.78**	.21*
Similarities	.30**		.34**	.15*	.70**	.21*
Pattern Meanings	.21*	.17*		.35**	.72**	.17*
Line Meanings	.03	.15	.12		.65**	.14
Total Divergent	.77**	.69**	.81**	.66**		.26**
CONVERGENT	.08	.13	.17	.03	.23**	

N = 204 ** $p < .01$; * $p < .05$.

Note: Fluency correlations - above the diagonal

Mean Originality correlations - below the diagonal

divergent tests and a timed, test-like environment for the convergent tests. In this study, however, subjects were given both types of tests under identical informal classroom conditions.

b) Summary

As hypothesised, there were no differences between males and females in convergent ability and divergent productivity although, females did outperform the males in three instances when their achievement scores were significantly different. As significant grade differences were noted, the scores were standardised using the grade means and standard deviations in order to aid in the subsequent analyses.

2. DIVERGENCE AND CONVERGENCE

> Hypotheses 2 and 3 The subtests of the Cropley version of the Wallach and Kogan tests are highly intercorrelated (Hypothesis 2) and independent of the convergent measure (Hypothesis 3).

a) Intercorrelations of Convergence and Divergence

In all but one instance, the correlations between the convergent and divergent measures were positive and consistently low. The one exception was a negligible negative correlation of -0.02 between the line patterns scored for fluency and convergence (See previous Tables 12 and 13 and Appendix E). Again, due to the large sample size, most of the correlations were statistically significant although the correlations were as low as those reported in other studies (Richards, 1973).

While a certain amount of controversy surrounds the validity of using significance tests for correlation coefficients, a careful inspection of the two correlation tables does indicate that convergence is relatively independent of the other divergent variable. In all likelihood the similar conditions under which both tests were administered explains why these results were less dramatic than those reported by Wallach and Kogan (1965).

b) Principal Component Analysis of Convergence and Divergence Scores

In order to examine how the predictors were related, a separate principal component analysis was performed on the divergent fluency, mean divergent originality and convergent scores for the grade 10 and 11 samples. Mean divergence was used in place of total originality to remove the fluency effect in the originality score. As originality scores are greatly determined by the total number of responses to a divergence test, an analysis of total originality with fluency on the same items would yield erroneous results.

According to common practice (Harman, 1967), eigenvalues of unity were used as the criterion for obtaining the principal components, although in the grade 11 sample one of the eigenvalues was less than unity. This factor was included because its eigenvalue was close to one and there was a priori evidence for the existence of another factor (Cropley, 1966; Wallach & Kogan, 1965).

Harman (1967) also points out that a principal axes solution is, in mathematical terms, a unique solution whose components can be used as they emerge. However, in some cases, he suggests that a rotation of the factors may be carried out when mathematical or

psychological principles are involved. In the present context, with the major emphasis on the characteristics of two cognitive tests, the rotated factor loadings are presented below.

i) Grade 10 Scores

In the grade 10 sample, three factors emerged from the analysis accounting for 56.9 per cent of the total variance. Using Thurstone's (1947) criteria of regarding any loading of less than 0.20

INSERT TABLE 14 ABOUT HERE

as having zero projection, the three factors may be interpreted as follows:

F_1 - VERBAL DIVERGENCE

The highest loading on this factor was produced by original Uses which measured the mean originality of the Uses divergent items. As expected this loading was closely followed by the fluency scores for the same item (.767). Loadings three and four were made up of the two forms of the Similarities items while a fifth but weak loading on the original pattern meanings was also noted. Clearly this first factor with an eigenvalue of 2.688 explained Verbal Divergence, scored by two different but redundant methods.

TABLE 14

PRINCIPAL COMPONENT ANALYSIS OF GRADE 10 CONVERGENT AND MEAN ORIGINALITY AND FLUENCY DIVERGENT SCORES

Principal Components	1	2	3	Communality
Eigenvalues	2.688	1.363	1.067	
Percent of Variance	29.9	15.1	11.9	
Cumulative Variance (%)	29.9	45.0	56.9	
Rotated Factor Loadings				
Divergence-Fluency				
Uses	.767	.138	.223	.658
Similarities	.362	.103	.614	.542
Line Meanings	.195	.498	.496	.532
Pattern Meanings	.062	.792	.060	.635
Divergence-Mean Originality				
Uses	.842	.136	-.031	.729
Similarities	.577	-.036	.139	.354
Line Meanings	.079	.662	.259	.512
Pattern Meanings	.225	.682	-.232	.571
Convergence	.039	-.060	.763	.587

F_2 - FIGURAL DIVERGENCE

In contrast to factor 1, the second factor was heavily weighted on the divergent Meanings items. In this case, the factor was pure without any overlapping with the other variables. Fluency Pattern Meanings was the highest loading variable (0.792), followed by original Pattern Meanings and Fluency Line Meanings. This second factor simply measured "figural" divergence.

F_3 - CONVERGENCE

This third factor was statistically more complex than the other two with a substantial amount of the variance shared with the other variables. The factor was labelled convergence since the factor loading was highest with the convergent test although it is obvious that this factor was not pure. Like convergence, Fluency Similarities also had a high loading on this factor and low loadings on the others.

ii) Grade 11 Scores

For the grade 11 scores the same three factors are reported as in the grade 10 group, although the factor loadings were not as simple as those first reported.

INSERT TABLE 15 ABOUT HERE

F_1 - VERBAL DIVERGENCE

As with the grade 10 group, the first factor emerged as a factor of verbal divergence. Both verbal measures of divergence, Uses and Similarities, scored for Mean Originality and Fluency correlated well with this first factor. Compared to the grade 10 sample, this first factor was composed of a larger proportion of the variance attributed to Similarities and Meanings with a concomitant decrease in variance due to Uses.

F_2 - FIGURAL DIVERGENCE

Unlike the second factor found in the grade 10 group, this factor was not as clearly defined. Mean original Line Meanings fell below the criterion for acceptance and originality Similarity scores were higher than before. In spite of these differences, this factor was still labelled Figural divergence due to the heavy weighting of the two measures of Pattern Meanings.

TABLE 15

PRINCIPAL COMPONENT ANALYSIS OF GRADE 11 DIVERGENT AND CONVERGENT SCORES

Principal Components	1	2	3	Communality
Eigenvalues	3.013	1.310	0.987	
Percent of Variance	33.5	14.6	11.0	
Cumulative Variance (%)	33.5	48.1	59.1	
Rotated Factor Loadings				
Divergence-Fluency				
Uses	.702	.040	.331	.604
Similarities	.661	.119	.245	.512
Line Meanings	.337	.327	.602	.583
Pattern Meanings	.300	.777	.215	.740
Divergence-Mean Originality				
Uses	.784	.085	.035	.623
Similarities	.603	.321	-.001	.467
Line Meanings	.142	.140	.721	.560
Pattern Meanings	-.097	.849	-.004	.731
Convergence	.048	.074	.694	.490

F_3 - CONVERGENCE

This factor is a radical departure from the one of the grade 10 sample and confirms the difficulty experienced in defining the third factor in the grade 10 group. This time, Line Meanings scored for mean originality had the highest factor loading, closely followed by those of convergence. At the same time, both these variables' factor loadings were low on the other items. Based on the grade 10 results, and the expectation of a convergence factor, this third factor was cautiously labelled "convergence".

As a possible hypothesis, the non-verbal properties of the Line and Pattern Meaning items in the divergent test may have indicated that the link between convergence and divergence is described in terms of verbal and non-verbal skills; a relationship which has already been predicted by Vernon (1973).

As the factor loadings for the fluency and mean originality scores were very similar and two divergence factors emerged from the analyses of each grade, it was decided to use two types of divergent fluency scores (verbal and figural) in addition to the convergent

score in the prediction of achievement and student-teacher interaction. Although factor scores could have been used as an alternative to the two divergent and one convergent measures it was felt that using the simple variables would be a more parsimonious method.

As fluency scores are easier to determine than originality scores and are less subject to problems of scaling, the fluency scores were chosen over those of originality for the subsequent analyses. Verbal divergence was defined as the summation of the fluency scores on the Uses and Similarities items. This same procedure applied to the Figural scores with the addition of the fluency scores from the Line and Pattern Meanings items.

As a final note, the non-specificity of the convergent factor may have made it difficult for the divergent test scores to demonstrate their ability to predict the dependent variables. Consequently, the suggestions of Cronbach (1968) and Maslany (1973) referred to earlier took on added importance. As convergence shares a moderate amount of the variance with the divergent tests, particularly the non-verbal (Meanings) items, the predictor variables were ordered, assuring that all the common shared variance between convergence and the two divergent scores would be attributed to convergence.

c) Related Studies

The unexpected results that the two types of cognitive variables were made up of three factors prompted a reexamination of the original Wallach and Kogan (1965) data to discover whether a similar factor structure existed. To examine this question, their correlation matrix of the ten divergent and the ten "IQ" variables was subjected to a rotated principal component analysis (Wallach & Kogan, 1965, pp. 46, 47, 49).

The results of the analysis yielded four factors with an eigenvalue of greater than one which accounted for 67.4 per cent of the total variance.

INSERT TABLE 16 ABOUT HERE

Factor 1 was clearly an achievement or "IQ" factor accounting for 40.8 per cent of the variance. It was extremely consistent reflecting the high intercorrelations among the IQ measures. The second principal component (Factor 2) was also quite distinct. Although Wallach and Kogan called it "creativity", divergence was used in this case to avoid confusing the terminology. Unfortunately, the unitary nature of this second component did not confirm the findings of this study where two divergent factors were found. In addition, judging from the third and fourth principal components, which accounted for only 7.1 and 5.4 per cent of the variance respectively, and which appeared to be item specific, there is little historical precedence to predict the emergence of the two divergent factors found in this study.

How can these results which occurred with similar student populations be explained? As had been mentioned earlier, the most obvious and therefore most reasonable explanation is the general influence of the testing conditions on divergent production. In the Wallach and Kogan study the authors felt that "creativity" tests should be administered in a gamelike manner to enhance "creative" output. While the convergent test was administered in a traditional testlike manner. In the present study, the possibility of obtaining convergence-divergence independence was made more difficult as the measures were administered under similar testing conditions. With this procedure it

TABLE 16

PRINCIPAL COMPONENT RE-ANALYSIS OF THE WALLACH AND KOGAN INTELLIGENCE AND CREATIVITY SCORES FOR SEXES POOLED

Principal Components	1	2	3	4	Communality
Eigenvalues	6.57	4.19	1.42	1.07	
Percent of Variance	32.8	22.1	7.1	5.4	
Rotated Factor Loadings					
Instances-Uniqueness	-.104	.308	.848	-.154	.85
Instances-Number	.042	.303	.861	.215	.88
Alternate Uses-Uniqueness	.001	.841	.146	-.078	.73
Alternate Uses-Number	.114	.788	.111	.174	.68
Similarities-Uniqueness	-.028	.830	.025	-.215	.74
Similarities-Number	.115	.874	.113	.024	.79
Pattern Meanings-Uniqueness	.099	.611	.099	.259	.46
Pattern Meanings-Number	-.046	.342	.109	.734	.67
Line Meanings-Uniqueness	.183	.643	.227	.158	.52
Line Meanings-Number	.045	.702	.120	.407	.68
WISC-Vocabulary	.618	.151	.154	-.422	.61
WISC-Picture Arrangement	.227	.044	.364	.061	.19
WISC-Block Design	.476	-.061	.283	-.122	.33
SCAT-Verbal	.875	.113	-.004	-.044	.78
SCAT-Quantitative	.855	.045	-.058	.149	.76
STEP-Mathematics	.829	.123	.080	-.174	.74
STEP-Science	.844	.076	.128	-.001	.73
STEP-Social Studies	.882	.099	.121	-.078	.81
STEP-Reading	.847	.036	-.002	.101	.73
STEP-Writing	.879	.056	-.053	.174	.81

Note: The analysis was based on correlations reported in "Modes of Thinking in Young Children" by Wallach and Kogan (1965, pp. 46, 47, 49).

was felt that any differences between the measures would be exclusively due to the actual test content and independent of the testing conditions. If this in fact was the essential difference between the two studies, it is important to note that the testing conditions had a differential effect on the divergent scores. While the verbal test results resembled the convergent scores more closely when similar testing conditions were used, figural divergence remained independent under both conditions.

One other study which used similar divergent tests but unfortunately different convergent measures was conducted with 483 navy recruits as subjects (Richards, 1973). In this study the factor analysis using thirteen divergent and nine convergent measures yielded five factors; three of these were clearly divergent, one was convergent and the fifth was test specific.

Unlike the present findings the first factor in the Richards study was convergent and the second was divergent relying a large extent on the Wallach and Kogan Line Meaning and Guilford Fluency Uses items. This factor structure is in direct contrast with the present study where the first factor was divergent and the second factor largely convergent with a high loading from the verbal divergent items. Like the Wallach and Kogan findings, the differences in the ordering of the factors can probably be attributed to the relative number of divergent and convergent variables while the discrepancy between factors may be explained by the test content, timing, scoring procedures or the different reliabilities of the tests.

d) Summary

The two hypotheses were confirmed although the actual relationship between the cognitive variable was unexpected. Using a principal component analysis three factors emerged from the separate analyses of both grades. These cognitive findings demonstrated that divergence might be viewed as a dichotomous variable made up of verbal and figural abilities with convergence as the third factor. In addition, the similar factor loadings of the fluency and the mean originality scores demonstrated that the fluency scores would be sufficient to serve as a measure of divergent thinking.

3. PREDICTION OF ACADEMIC ACHIEVEMENT

> Hypothesis 4 Divergent test scores will significantly improve the prediction of academic achievement.

Hypothesis 4 was concerned with the usefulness of convergent and divergent test scores in the prediction of academic achievement as opposed to a measure of convergence alone.

To establish a bench mark or means for comparison, two regression models were tested and the additional variance accounted for by the complete model which included the divergent items was compared with the restricted model which did not. The restricted model (1) used the convergent scores as a predictor while the complete regression model (2) used both the convergent and the two divergent scores as the predictors:

$$Y = a + bX_1 + e \quad (1)$$

$$Y = a + bX_1 + cX_2 + dX_3 + e \quad (2)$$

where Y = the achievement dependent variable

a = constant

X_1 = the convergent score

X_2 = the verbal divergent score

X_3 = the figural divergent score

b, c, d = beta coefficients

e = error

The achievement tests were typical of most measures of academic performance. They were timed, based on material taught in the classroom, and required a convergent response mode. Sixteen types of achievement scores were collected although few students were eligible to write all the exams. A summary of the achievement tests, the average scores (based on a ceiling of 100), standard deviations and sample size are presented in the following table.

INSERT TABLE 17 ABOUT HERE

Since some persons took the tests over a two year interval only those exams written during the 1971-72 school year were used in the analysis. This procedure prevents the effects of maturation and practice from confounding the results.

Step-wise multiple regression analysis was performed on the data. This procedure, described above, is well suited for studies of prediction as it permits the investigator the opportunity to use a priori

TABLE 17

ACHIEVEMENT MEANS, STANDARD DEVIATION AND SAMPLE SIZES FOR GRADE 10 AND 11 STUDENTS COMPLETING THE DIVERGENT AND CONVERGENT MEASURES

	MEAN	S.D.	N
GRADE 10			
Composition	66.66	11.12	182
Literature	65.36	13.39	180
French (Written)	58.40	19.82	182
Algebra	68.16	14.92	149
History	62.86	15.70	175
Biology	56.41	8.57	42
GRADE 11			
Literature	68.02	13.00	176
Composition	69.95	12.19	176
French (Written)	63.13	14.00	167
French (Oral)	66.62	13.02	165
Biology	63.71	16.45	118
Chemistry	67.14	16.84	138
Mathematics	68.75	17.09	88
Physics	61.85	14.75	54
History	65.07	14.49	163
Geometry	66.80	18.89	131

Note: Sexes are combined.

evidence by ordering the predictor variables. Following the recommendations of Cronbach (1968) and Maslany (1973), the better known convergent measure was entered first in the regression equation followed by the verbal and figural divergent measures.

a) Convergence as a Predictor

For both grade levels the convergent measure significantly predicted achievement although the degree of predictability varied greatly depending upon the discipline. Using the restricted model, the best predicted variable, English Composition, had a simple correlation of 0.47 while the poorest predicted achievement variable, French speaking ability, had a correlation of only 0.20. The mean correlation coefficient for the grade 11 students was 0.365 and a mean value of 0.315 was found for the grade 10 students.

INSERT TABLE 18 AND 19 ABOUT HERE

The usefulness of convergence as a predictor of academic achievement is presented below. Two of the grade 11 subject areas, English writing ability and Physics, grouped together as relatively well predicted variables. A second group comprised of Literature, French writing ability, Mathematics, Geometry, Chemistry and Biology clustered at a median value of 0.38 while a distant third group of History and French speaking ability had correlations of 0.31 and 0.20 respectively. As noted above, all of the simple correlations were statistically significant.

The grade 10 sample generally had lower simple correlation coefficients than the grade 11 group. Three dependent variables,

TABLE 18

CONVERGENCE AND DIVERGENCE AS PREDICTORS OF ACADEMIC ACHIEVEMENT FOR GRADE 10 STUDENTS[1]

	CONVERGENCE		CONVERGENCE AND DIVERGENCE[2]	
	r	F	R	F
History	.39[3]	31.47**	.40[4]	10.90**
N = 175		1,173		3,171[5]
Literature	.31	19.34**	.34	7.71**
N = 180		1,178		3,176
French	.27	14.57**	.28	5.17**
N = 182		1,180		3,178
Composition	.35	24.69**	.36	8.68**
N = 182		1,180		3,178
Algebra	.35	21.15**	.36	7.37**
N = 149		1,147		3,145
Biology	.22	19.98**	.50	13.00**
N = 42		1,40		3,38

*P 0.05

**P 0.01

Note: [1] Asterisks beside the F ratio indicate whether the regression equation is statistically significant. The asterisks beside the multiple correlation (R) indicate that the increase in R^2 is statistically significant.

[2] Divergence includes both verbal and figural fluency scores.

[3] Simple correlation.

[4] Multiple correlation.

[5] Degrees of freedom.

TABLE 19

CONVERGENCE AND DIVERGENCE AS PREDICTORS OF ACADEMIC ACHIEVEMENT FOR GRADE 11 STUDENTS[1]

	CONVERGENCE		CONVERGENCE AND DIVERGENCE	
	r	F	R	F
Physics N = 54	.45	13.31** 1,52	.51	5.90** 3,50
History N = 163	.31	16.78** 1,161	.39**	9.60** 3,159
French (Oral) N = 165	.20	6.77* 1,163	.25	3.52* 3,161
Literature N = 167	.38	28.65** 1,165	.42	11.93** 3,163
Composition N = 176	.47	49.92** 1,174	.56**	26.15** 3,172
French (Written) N = 164	.38	28.65** 1,162	.42*	11.93** 3,160
Mathematics N = 85	.39	15.60** 1,83	.45	7.14** 3,81
Geometry N = 131	.38	22.19** 1,129	.40	8.11** 3,127
Chemistry N = 138	.35	19.32** 1,136	.43**	10.34** 3,134
Biology N = 118	.34	15.21** 1,116	.48**	11.68** 3,114

Note: See notes for Table 17

*p 0.05
**p 0.01

History, Composition and Algebra had relatively high correlations with the predictor while a second group composed of English, Literature, French speaking ability and Biology made up the rest of the grade 10 achievement tests. Once again, as in the previous grade, the convergent tests significantly predicted the achievement scores.

In summary, for the grade 11 results, English Composition was predicted the best and second language speaking skills the worst. While the English results were expected, the French scores were not. Most studies of second language learning have reported difficulty in finding good cognitive predictors of second language acquisition and, in general, the most consistent results have demonstrated that motivation and length of time exposed to the second language are the most important criteria for success (Lambert and Gardner, 1971). From these findings it is most probable that high performance on cognitive tests such as convergence are a necessary but not a sufficient skill for second language learning.

On the other hand within the restricted model, English Composition, that is, the ability to write good essays, interpret poetry, and understand sentence structure, was the best predicted of all the academic subjects. Judging from this result it appears the ability to perform well on a test traditionally requiring a divergent response mode is largely dependent on convergent ability.

b) Convergence and Divergence As Predictors

As described earlier, one way of establishing the potential usefulness of divergence is to observe how well it helps predict the dependent variable after the better known convergent scores have been

used. To test its potential, both the figural and verbal divergent fluency scores were added to the regression equation after the convergence measures. The additional variance accounted for by their inclusion was tested (See Tables 17 and 18).

To this end, the results are mixed. Of the sixteen different achievement tests, seven of them were significantly better predicted with the addition of the divergent variable. Six of the cases were in the grade 11 set and the remainder came from the grade 10 sector. This lopsided representation in favour of the grade 11 sample does not appear to have any obvious explanation.

The mean multiple correlation of 0.441 represents an average increase of 6.2 percent of the variance accounted for by the addition of the divergent variables. Due to the poor predictability of divergence for achievement in grade 10, the average variance accounted for by the inclusion of divergence increased by only 4 per cent and this was almost entirely a result of the Biology marks. In fact, achievement in Biology appeared to be the variable most affected by the inclusion of divergence and consequently moved from the eighth best predicted score to the third best predicted in the grade 11 test series and from the poorest to the best predicted variable in the grade 10 series.

While there is no a priori reason to expect this result, it may be an indication of the versatility of the divergent measure and its lack of content specificity. From previous research, one would have concluded that divergence would be a better predictor of the arts related subject areas such as English Literature, and History (Hudson, 1966). Instead it improved the prediction of achievement for all academic subjects.

The interaction of convergence with divergence as a predictor of achievement was also tested. To remove the effect of the single predictors the deviation product was used as the interaction term producing two regression equations expressed as follows:

$$\hat{Y} = a_1X_1 + a_2X_2 + a_3X_3 + a_4(X_1 - \bar{X}_1) \cdot (X_2 - \bar{X}_2) + e \quad (1)$$

$$Y = a_1X_1 + a_2X_2 + a_3X_3 + a_4(X_1 - \bar{X}_1) \cdot (X_3 - \bar{X}_3) + e \quad (2)$$

where Y = achievement dependent variable

X_1 = convergent score

$\bar{X}_1$ = mean convergent score

X_2 = verbal divergent score

$\bar{X}_2$ = mean verbal divergent score

X_3 = figural divergent score

$\bar{X}_3$ = mean figural divergent score

$a_1 \ldots a_4$ = regression coefficients

e = error

Of the sixteen dependent variables for both grades only the Biology achievement test scores for the grade 10 sample significantly increased the prediction with the addition of the interaction term. The simpler model of only the convergent and divergent scores had a multiple R of 0.50 but the addition of both interaction terms in the two separate

INSERT TABLE 20 AND 21 ABOUT HERE

cases increased the multiple R by 0.11 in the case of convergence and divergent fluency and 0.10 in the case of the divergent figural by convergence interaction.

To demonstrate these interactions, the convergent scores of all those students (42) who wrote the Biology exam in grade 10 were divided at the mean and two separate regressions were run for each group.

TABLE 20

THE PRODUCT OF CONVERGENCE AND DIVERGENCE AS A PREDICTOR OF ACADEMIC ACHIEVEMENT FOR GRADE 10 STUDENTS

	CONVERGENCE AND DIVERGENCE (additive)	CONVERGENCE X VERBAL DIVERGENCE		CONVERGENCE X FIGURAL DIVERGENCE	
	R	R	F	R	F
History	.40	.40	8.14**	.40	8.23**
Literature	.34	.34	5.79**	.36	6.47**
French	.28	.28	3.87**	.28	3.87**
Composition	.36	.36	6.47**	.36	6.47**
Algebra	.36	.37	5.56**	.37	5.67**
Biology	.50	.61*	12.46**	.60*	12.45**
			df = 4,N-5		df = 4,N-5

*P $\leq$ 0.05

**P $\leq$ 0.01

Note: The Ns are the same as those in Table 18 and 19.

TABLE 21

THE PRODUCT OF CONVERGENCE AND DIVERGENCE AS A PREDICTOR OF ACADEMIC ACHIEVEMENT FOR GRADE 11 STUDENTS

	CONVERGENCE AND DIVERGENCE (additive)	CONVERGENCE X VERBAL DIVERGENCE		CONVERGENCE X FIGURAL DIVERGENCE	
	R	R	F	R	F
Physics	.51	.51	4.33**	.53	14.77**
History	.39	.40	7.40**	.40	7.34**
French (Oral)	.25	.25	2.76*	.25	2.68*
Literature	.42	.51	15.34**	.53	14.77**
Composition	.56	.56	19.50**	.57	20.69**
French (Written)	.42	.43	8.99**	.43	8.97**
Mathematics	.45	.47	5.87**	.49	6.50**
Geometry	.40	.40	6.11**	.40	6.11**
Chemistry	.43	.44	8.01**	.46	8.82**
Biology	.48	.48	8.68**	.49	8.70**
		df = 4,N-5		df = 4,N-5	

One regression equation used the divergent fluency scores as a predictor and the other used the figural divergence scores, thus yielding two different interactions.

INSERT FIGURE 3 ABOUT HERE

In this one case, figural divergence did not act as a complementary cognitive ability but instead functioned as a strong simple predictor when used alone and as inhibitor or facilitator when used in conjunction with convergence. Among those students with convergent scores lower than the mean, increasing fluency ability predicted high achievement. For the remaining group quite the opposite took place as high convergent students appeared to do less well in Biology as their figural divergent scores increased. This particular relationship was completely unexpected and subject to only tentative conclusions.

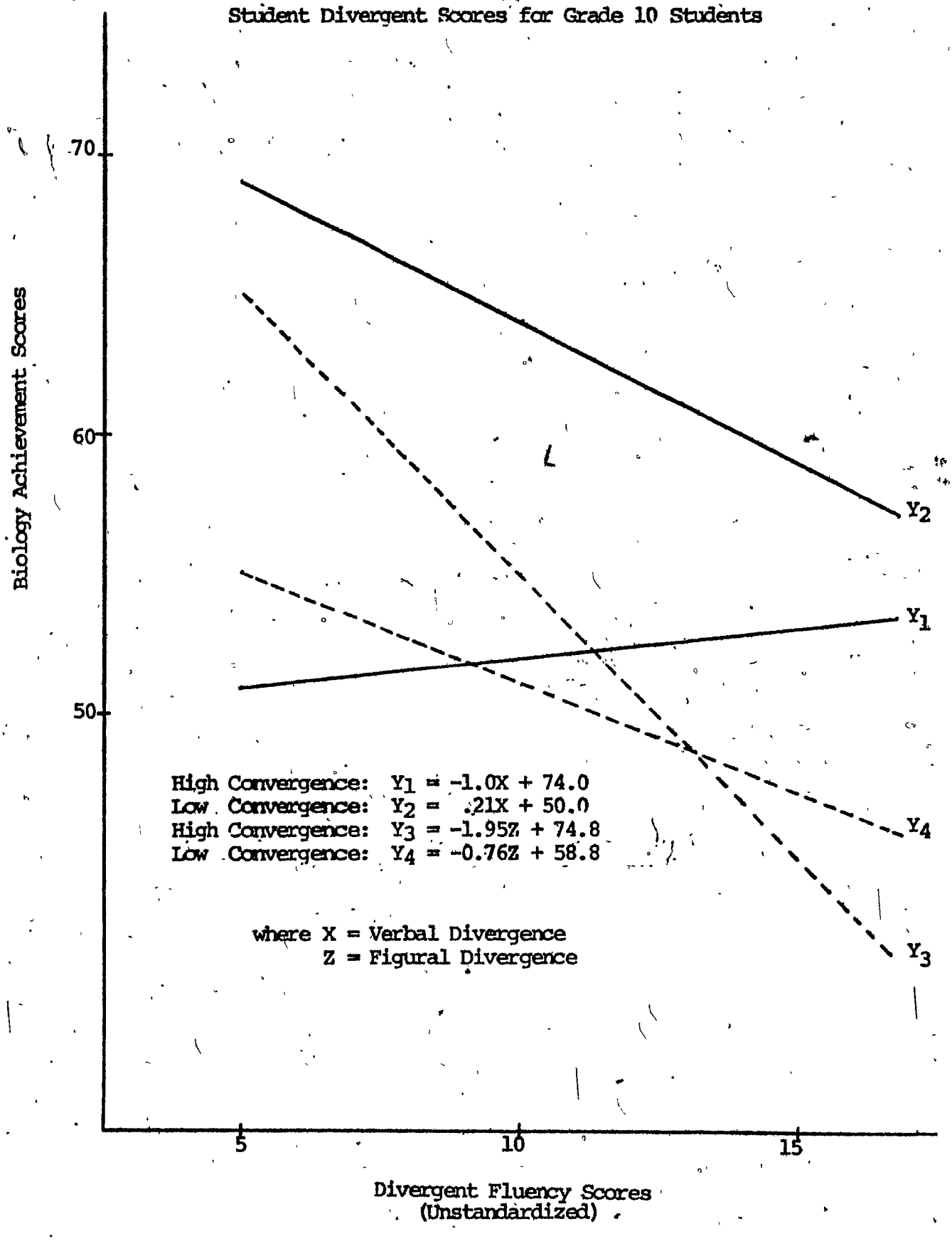
The possibility of spurious results, particularly since the sample size was relatively small and a considerable number of regression equations were used to test this hypothesis, makes it imperative that these interaction results be interpreted with some caution. Furthermore, comparable results were not obtained from the grade 11 sample which aside from being slightly more convergent and divergent than the grade 10 group differed very little from their counterparts.

This evidence casts doubts as to the generalizability of the interaction findings and serves mainly as an example of the potential importance of these types of study.

As an illustration, the two tables containing the beta weights also gave a clear indication of the importance of the convergent test scores in the prediction of academic achievement. In only one case,

FIGURE 3

The Interaction of Biology Achievement Scores and Student Divergent Scores for Grade 10 Students



High Convergence: $Y_1 = -1.0X + 74.0$
Low Convergence: $Y_2 = .21X + 50.0$
High Convergence: $Y_3 = -1.95Z + 74.8$
Low Convergence: $Y_4 = -0.76Z + 58.8$

where X = Verbal Divergence
Z = Figural Divergence

Biology, was the interaction term larger than the other beta weights and as indicated earlier there is some evidence that these results may

INSERT TABLES 22 AND 23 ABOUT HERE

be spurious. In all other instances the convergent beta weights were larger than or equal to the divergent beta weights.

Considering just the two divergent beta weights, the verbal beta weights were eight times out of ten larger than the figural weights for the grade 11 group although a reverse trend was noted with the grade 10 sample when four of the six beta weights favoured the figural test scores. In fact, in the cases where the subject matter content was comparable, (ie. History, Literature, French, Composition, and Algebra) the relative importance of the divergent subtests appears to have been reversed. What was a good predictor in grade 10 was no longer so in grade 11. Like the differential effect of the grades on the addition of the divergent score in the prediction of achievement, these grade differences were most unusual.

c) Rival Predictors of Academic Achievement

Although the cognitive variables appeared to be relatively good predictors of some of the subject areas, there was always the possibility that other types of variables might be better predictors. To be more effective, an alternative method should predict the dependent variables better and with less cost, in terms of time and money to the researcher and respondent, than other readily available methods. To test the predictive value of the two cognitive variables, two different and easy to administer methods of predicting student achievement were used.

TABLE 22

BETA COEFFICIENTS OF THE COMPLETE MULTIPLE REGRESSION PREDICTION MODEL OF GRADE 10 ACADEMIC ACHIEVEMENT SCORES[1]

GRADE 10	CONVERGENCE	DIVERGENCE		INTERACTION
		VERBAL	FIGURAL	CONVERGENCE AND VERBAL
History	.35	.03	.14	.06
Literature	.30	.07	.17	.00
French	.31	-.02	.10	-.05
Composition	.33	.04	.12	.02
Algebra	.38	-.03	.01	-.05
Biology	1.18	2.68	-.37	-2.97

[1] The verbal scores are presented in this table to demonstrate the relative importance of the predictors. Similar results were obtained with the figural interactions and these beta weights are not presented.

TABLE 23

BETA COEFFICIENTS OF THE COMPLETE MULTIPLE REGRESSION PREDICTION MODEL OF GRADE 11 ACADEMIC ACHIEVEMENT SCORES

GRADE 11	CONVERGENCE	DIVERGENCE		INTERACTION
		VERBAL	FIGURAL	CONVERGENCE AND VERBAL
Physics	.60	-.01	.25	-.16
History	.26	.26	.04	-.04
French (Oral)	.17	.17	.10	-.05
Literature	.38	.21	.10	-.10
Composition	.38	.25	.08	.04
French (Written)	.33	.21	.09	-.04
Mathematics	.52	.40	.08	-.27
Geometry	.40	-.06	.14	-.03
Chemistry	.46	.23	.16	-.18
Biology	.27	.28	.20	-.05

Note: $^{**}P < 0.01$

i) Teacher Predictions

Teachers taking part in the study gave a general assessment of each of his or her students and predicted their final year-end individual achievement scores on the basis of their classroom performance. A simple Pearson Product Moment correlation between actual achievement scores and teacher predictions was computed for each discipline and in both grades 10 and 11. Based on the results, it is clear that the teacher estimates were better predictors of achievement than the cognitive variables.

INSERT TABLE 24 AND 25 ABOUT HERE

For grade 11 subjects, the best predicted variable was French speaking ability which, it should be recalled, was the worst predicted dependent variable when using the cognitive variables. The poorest teacher-predicted disciplines were Geometry, Biology, and Physics. The low correlations of these particular courses possibly indicated that the problem-oriented method used to teach science subjects made it more difficult for teachers to estimate achievement than in the more verbally demanding areas of French and English. Though it was difficult to ascertain the criteria used by teachers to predict student achievement, written comments from some of the teachers indicated that verbal skills and personal contact may have played an important role.

The grade 10 predictions were also consistently high, adding further support for the validity of teacher predictions. Though the sharp dichotomy between the arts and science predictors were not as evident as with the grade 11 sample, this might be explained by the teachers' lack of familiarity with their students who, at this time, had spent one less year in the school.

TABLE 24

THE CORRELATION OF TEACHER PREDICTIONS OF STUDENT ACHIEVEMENT AND ACTUAL ACHIEVEMENT FOR GRADE 10 STUDENTS

	r
History N = 170	.81**
Literature N = 156	.66**
English Composition N = 163	.73**
Algebra N = 135	.81**
Median Correlation	.77
Mean Correlation	.75

**p < 0.01

TABLE 25

THE CORRELATION OF TEACHER PREDICTIONS OF STUDENT ACHIEVEMENT AND ACTUAL ACHIEVEMENT FOR GRADE 11 STUDENTS

	r
Literature N = 186	.79**
Physics N = 55	.67**
History N = 174	.75**
French (Oral) N = 172	.83**
Composition N = 185	.79**
French (Written) N = 171	.76**
Mathematics N = 90	.74**
Geometry N = 48	.61**
Chemistry N = 142	.76**
Biology N = 110	.62**
Median Correlation	.755
Mean Correlation	.732
Mean Correlation for Both Grades	.738

**$p < 0.01$

ii) Past Performance

Prior achievement was also used as a rival predictor. In several instances, students wrote achievement exams in one or more of four different subject areas, once in grade 10 and once at the end of grade 11. Though the specific content of the two courses was quite different, the type of exam and the methods of teaching were very similar in each case. Indeed, in many cases, the same teachers taught both levels. For those grade 11 students whose grade 10 results were available, simple Pearson Product Moment correlations were computed. Biology scores were not involved due to the small sample size.

As a predictor, this method lies somewhere between the teacher predictions and the cognitive predictors.

INSERT TABLE 26 ABOUT HERE

The Mathematics results were the most stable ($r = 0.71$) while literature scores were better predicted by the convergent-divergent abilities than by previous achievement. The median correlation between earlier and later achievement was 0.61, somewhat below the median teacher predictions of 0.77. Both these indices are considerably better predictors than the median value of the abilities' multiple correlations.

d) Summary

As expected, the convergent scores were the most consistent and significant cognitive predictors of achievement. In all of the sixteen achievement dependent variables, convergence significantly predicted the scores with varying degrees of success. Based on earlier evidence,

TABLE 26

CORRELATION OF ACHIEVEMENT SCORES WITH PREVIOUS ACHIEVEMENT IN THE SAME SUBJECT AFTER A ONE YEAR INTERVAL

	r
History N = 74	.69**
Literature N = 199	.46**
Composition N = 203	.61**
French (Written) N = 177	.58**
Mathematics - Algebra N = 95	.71**
Median Correlation	.61
Mean Correlation	.61

**P< 0.01

it was not surprising that second language acquisition was poorly predicted by the cognitive variable although a traditionally "divergent" subject area, English Composition, was relatively well predicted.

With the inclusion of divergence, predictability significantly increased in seven of the sixteen cases although the improvement was primarily with the grade 11 sample. This finding did not lend itself to a simple interpretation and no attempt was made to explain this occurence.

In light of these results, divergence appears to provide a relatively independent measure of a cognitive ability which, at times, is needed in school achievement. Divergence does not act as a substitute ability for convergence but instead it functions as a complementary cognitive skill working in tandem with convergence. In only one case, Biology, was an interaction noted and since the sample size was small and the result inconsistent with the grade 11 sample, the finding must serve only as an illustration.

While the two cognitive abilities appear to be relatively good predictors, two other variables that are easier to collect were used as rivals. Both teacher predictors and past performance predicted a higher proportion of the variance indicating the superiority of the simpler methods. Of the three methods of predicting achievement, teacher estimates yielded the highest correlation.

4. ASSOCIATIVE PROCESSES

> Hypotheses 5 and 6 The responses to a given stimulus will be progressively more original (Hypothesis 5) and the originality gradients of high and low divergers will interact as hypothesized by Mednick (Hypothesis 6).

To test Mednick's associative gradient theory, three different analyses were performed. In all cases, the eight divergent items (two from each section of the complete divergent test) used in the previous analyses were included.

a) Original Responses

Each response given on the divergent test was scored for originality. The mean originality score for each of the first twelve responses on all eight items is presented along with the number of students responding. High scores represent stereotyped responses and low originality while low scores indicate infrequent answers and consequently original responses.

As explained earlier, originality was scored for the statistical infrequency of the responses. In operational terms, each response was coded on tally sheets for all students. Obviously, in the most original case only one tally was recorded for a response but in the most common, "uses for a newspaper", 709 responses were given for the use "to read". Thus a high score indicated an unoriginal response while a low value signified high originality.

In all other references to originality scores not including those in this section, a composite score was calculated. Using 709 as an arbitrary numerator and the number of responses for each stimulus as the denominator, an originality score was derived for each stimulus item by summing the scores of each response to an item. Consequently, the range of the originality scores was reduced by a logarithmic transformation of the data. This procedure was designed to reduce the extreme range of originality scores particularly at the most original end of the distribution.

INSERT TABLE 27 ABOUT HERE

Two observations should be made about the results presented in this table. In every case, there is a steady decline in the number of individuals responding to succeeding items which was likely due to the inability of respondents to continually produce divergent answers or to the onset of fatigue. This may also explain the smaller number of individuals responding to item 8 (n = 361) than to item 1 (n = 418). Since items were always presented in the same order, it was difficult to determine whether the fall off in performance was due to the aforementioned fatigue or some unspecified item characteristics.

Secondly, the pattern of original response elicitation was varied and difficult to generalize. In some cases, item 4 for instance, the earliest responses were highly stereotyped and unoriginal while opposite results were obtained for items 6 and 7 where early responses were relatively original at the start. Based on these two observations, it was decided that subsequent analyses should be done separately with each item serving as its own control.

To better understand the associative process and at the same time eliminate the confounding effect of poor and lazy responders, only those individuals who gave more than four responses to an item were included in the subsequent analysis.

b) Linear Trends

An analysis of variance testing for the anticipated linear trends was performed on each of the eight items. In six of the eight

TABLE 27

RELATIVE ORIGINALITY AND THE NUMBER OF RESPONSES TO SUCCESSIVE RESPONSES ON THE DIVERGENT TEST

ITEM 1	N	418	410	374	313	222	138	78	52	26	16	8	8
	O	209.7	105.8	89.3	71.9	76.2	63.4	64.8	70.0	68.6	71.0	53.6	45.0
ITEM 2	N	416	360	257	133	62	24	7	4	1			
	O	300.7	103.3	74.3	47.5	39.0	28.4	29.3	56.3	83.0			
ITEM 3	N	399	351	275	198	127	84	52	28	15	9	4	2
	O	255.5	225.1	235.6	246.0	259.9	280.8	282.6	310.6	177.9	270.8	377.3	33.0
ITEM 4	N	403	308	185	89	34	19	6	1	1			
	O	408.0	134.7	73.2	51.8	73.1	69.7	60.2	9.0	3.0			
ITEM 5	N	398	268	144	61	24	6	3					
	O	116.0	53.3	47.3	23.1	17.0	1.2	5.3					
ITEM 6	N	401	299	182	84	37	17	3	2				
	O	24.7	20.1	18.7	16.2	17.2	12.5	11.0	1.5				
ITEM 7	N	369	263	158	63	24	8	2					
	O	30.2	27.5	25.8	27.6	33.3	5.1	19.0					
ITEM 8	N	361	241	116	45	13	6	3					
	O	104.4	50.7	42.1	38.6	58.5	39.8	8.7					

N = Number of responses

O = Mean originality score

cases the between group variance was significant and subsequently a

INSERT TABLE 28 ABOUT HERE

significant linear trend was also present. Further inspection showed that three of the deviations "from the linear" were also statistically significant, suggesting that further analyses might be warranted. The analysis of variance was repeated for the three outstanding cases and significant quadratic relationships were found for items one and three. Although a cubic analysis was also indicated the limited number of groups (4) made this type of analysis impossible. As an illustration, the four figures that follow diagram the originality output of these

INSERT FIGURES 4 TO 7 ABOUT HERE

subjects. As indicated in the earlier section using the complete sample, originality seems to be an associative process where each response to the item stimulates a more original response. In some cases (item 1 and 3) the effect is striking and most convincing while in other cases the results need added interpretation.

Basically, the hypothesis was confirmed. For productive divergent thinking to take place, an environment which encourages the respondent to provide as many solutions as possible is necessary. In some instances only a few responses are needed, as evidenced by item 8, while in other situations (item 1) the more opportunity the subject has to respond the more original his responses become. Interestingly, in all but one instance (item 7) there were no more responses once the most original response was elicited. Perhaps subjects reach a kind of

TABLE 28

ONE WAY ANALYSIS OF VARIANCE FOR LINEAR TRENDS OF RESPONSES TO EIGHT DIVERGENT ITEMS

	DF	SUM OF SQUARES	MEAN SQUARES	F
1. Between Groups	3	3337557.0	112517.0	163.4**
Linear Term	1	2702222.0	2702222.0	369.8**
Quadratic Term	1	519976.6	519976.6	75.4**
Deviation from Quadratic	1	115353.3	115353.3	16.9**
Within Groups	1240	8439360.0	6805.9	
2. Between Groups	3	4357901.0	1452633.0	118.5**
Linear Term	1	3446314.0	3446314.0	247.5**
Quadratic Term	1	739334.1	739334.1	58.9*
Deviation from Quadratic	1	172252.9	172252.9	14.04*
Within Groups	532	6522723.0	12260.8	
3. Between Groups	3	41728.0	13090.3	0.334
Linear Term	1	1267.2	1267.2	0.03
Deviation from Linear	2	40460.8	20230.4	0.49
Within Groups	784	32663280.0	41662.3	
4. Between Groups	3	6275913.0	2091971.0	72.08**
Linear Term	1	5417599.0	5417499.0	173.33**
Quadratic Term	1	856929.9	856929.9	29.6*
Deviation from Quadratic	1	1484.1	1484.1	0.05
Within Groups	356	10330993.0	29019.6	
5. Between Groups	3	152812.5	50937.5	7.90**
Linear Term	1	129262.7	129262.7	19.9**
Deviation from Linear	2	23549.8	11774.9	1.82
Within Groups	240	1547564.0	6448.2	
6. Between Groups	3	6369.4	2123.1	5.58**
Linear Term	1	5569.4	5569.4	14.63**
Deviation from Linear	2	400.0	400.0	1.05
Within Groups	332	126334.1	380.5	
7. Between Groups	3	2513.4	837.8	1.48
Linear Term	1	537.0	537.0	0.95
Deviation from Linear	2	1976.3	988.2	1.75
Within Groups	244	137776.9	564.7	
8. Between Groups	3	79171.0	26390.3	5.21**
Linear Term	1	46670.9	46670.9	8.99**
Deviation from Linear	2	32500.1	16250.0	2.21
Within Groups	176	891314.6	5064.29	

Figure 4

Relative Originality of Succeeding Responses to Items 1 and 2

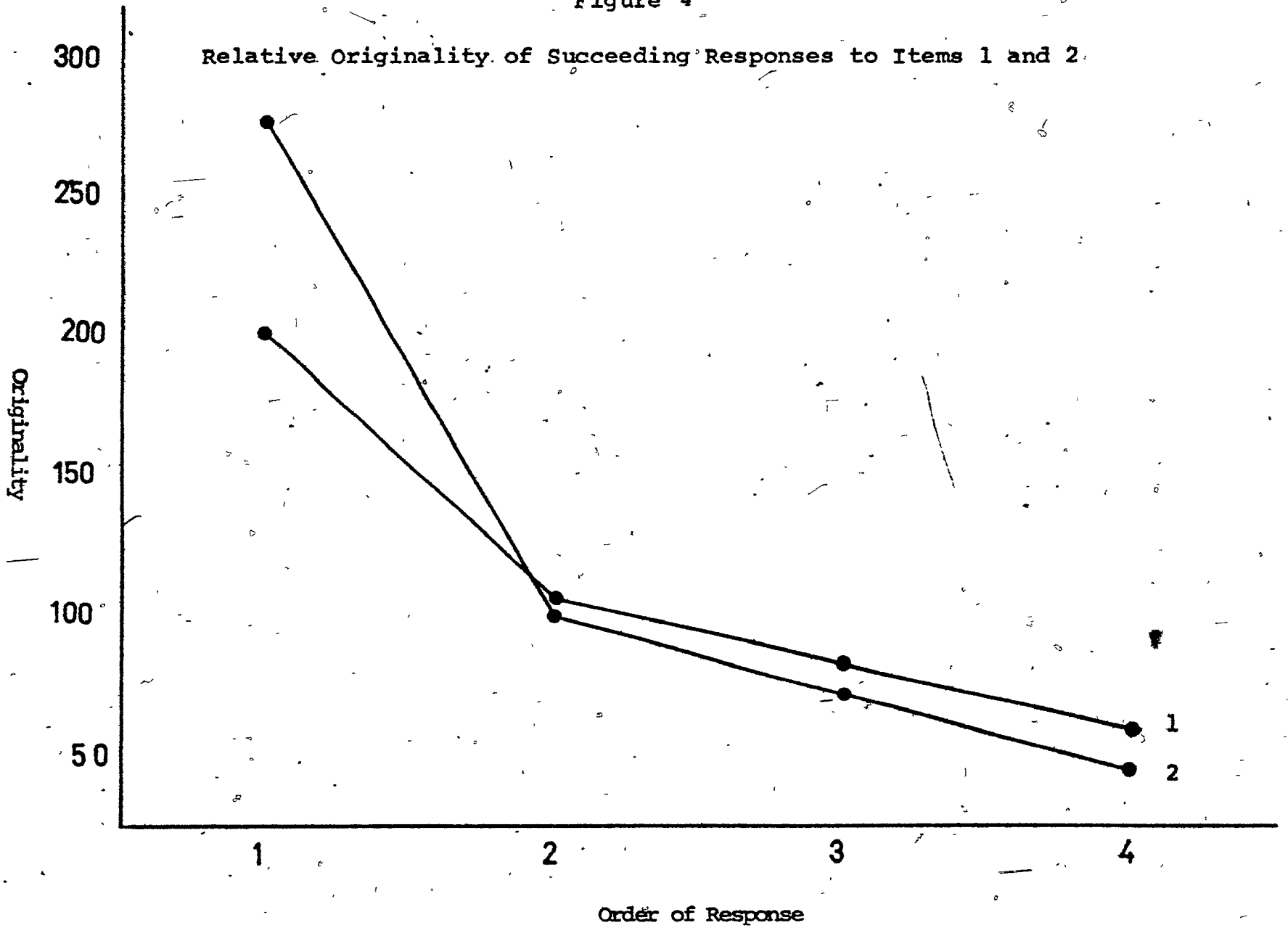


Figure 5

Relative Originality of Succeeding Responses to Items 3 and 4

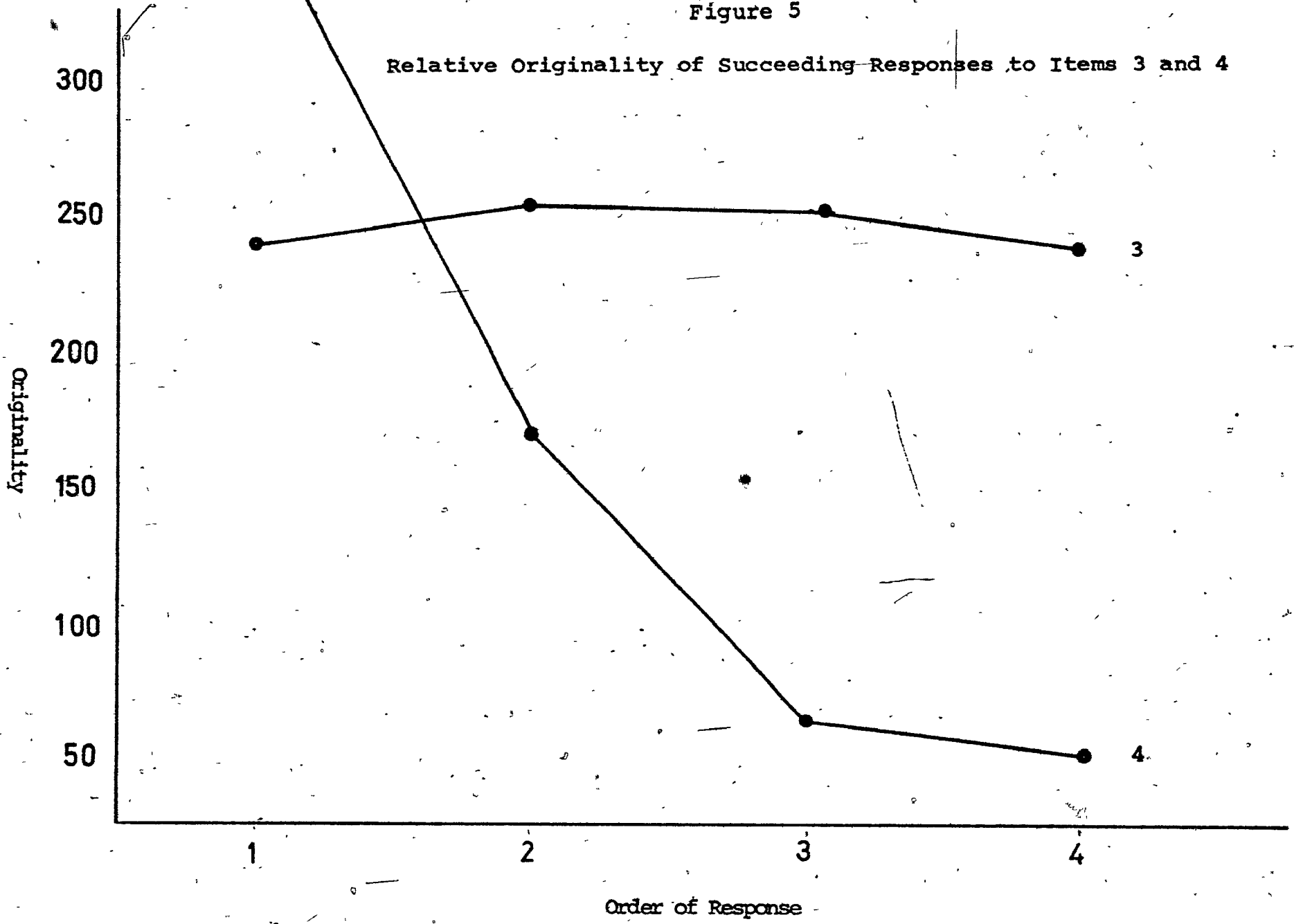


Figure 6

Relative Originality of Succeeding Responses to Items 5 and 6

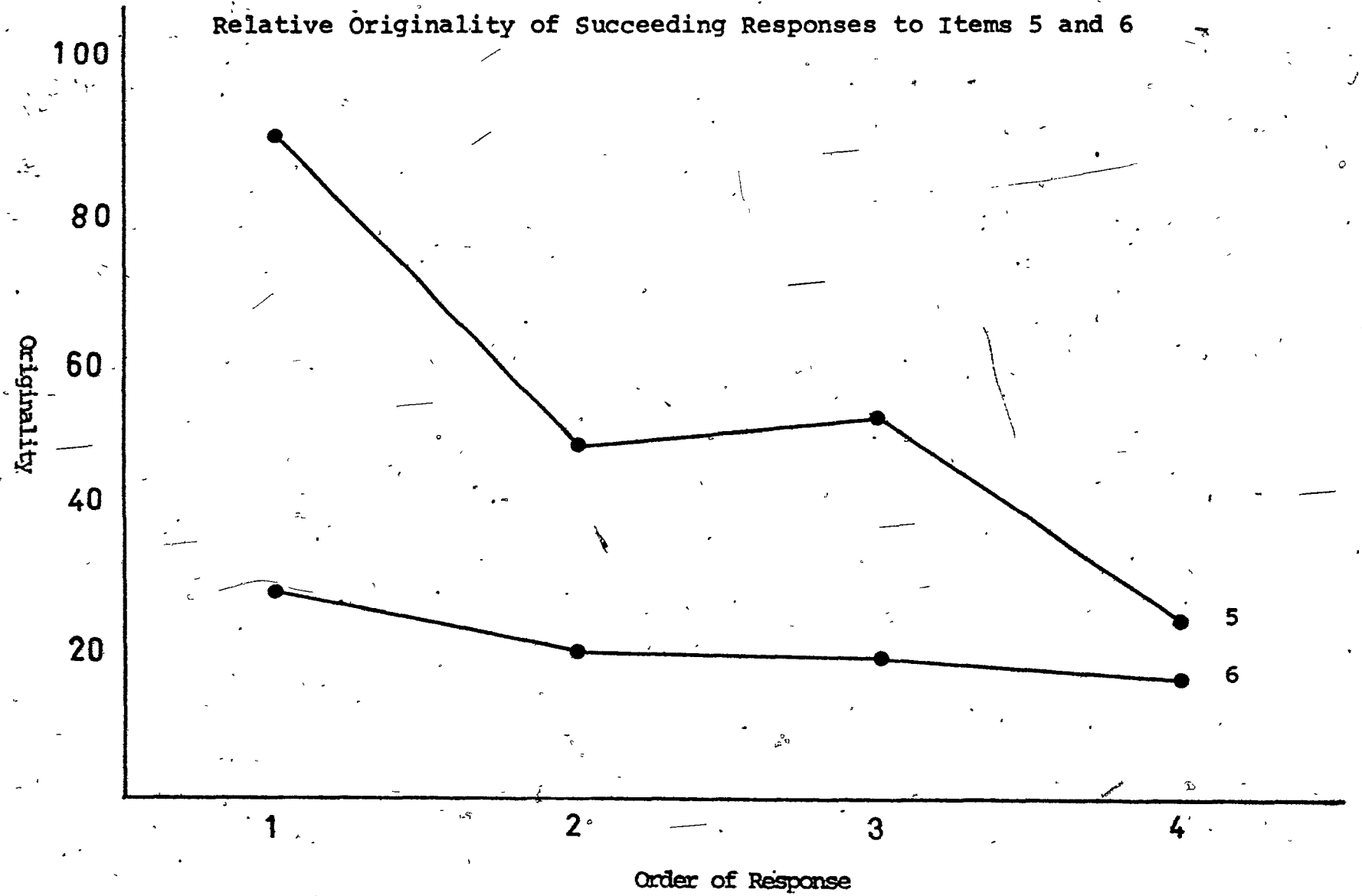
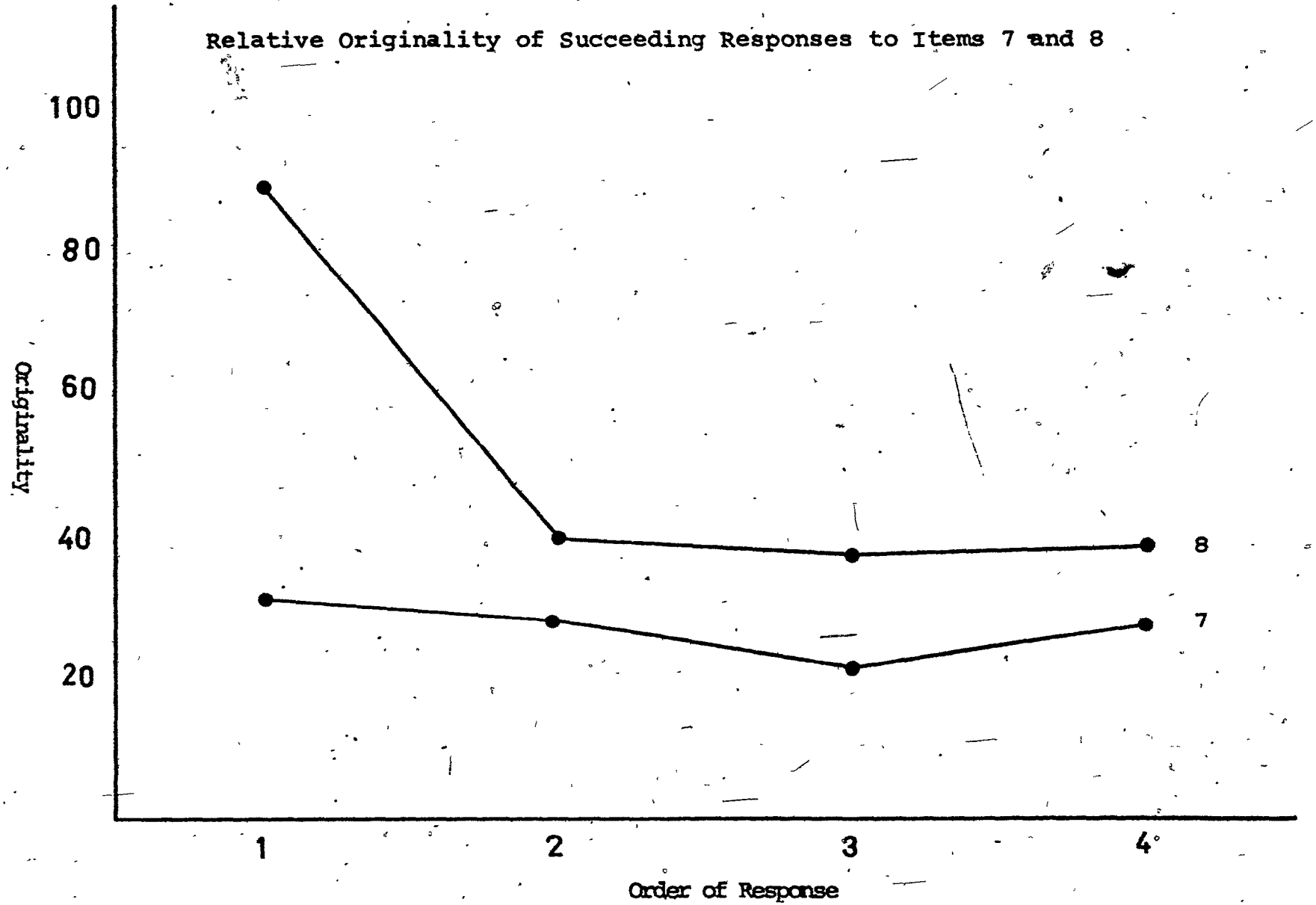


Figure 7

Relative Originality of Succeeding Responses to Items 7 and 8



criteria or level of satisfaction where they realise that the last response is the most original, thereby making further responses unnecessary. This does not mean that further responses are not possible. Evidence on the effects of testing conditions show that subjects can elicit more responses on demand although these are often highly stereotyped. In a way these results indicate that subjects evaluate their own originality, ceasing to respond when some undefined personal criterion has been reached.

c) Gradient-Interaction Hypothesis

The Mednick gradient-interaction hypothesis was tested by performing a two-way repeated-measures analysis of variance. The eight divergent originality scores for subjects who produced four or more responses to items served as the dependent variable. These scores were ranked and the sample was dichotomized into high-and low originality groups. In six of the eight groups there was a significant difference between the high and low groups but only one interaction was significant. This is presented in Figure 8 as an illustration of the Mednick Associative Theory.

INSERT TABLE 29 AND FIGURE 8 ABOUT HERE

Thus the Mednick proposal that the associative process gradient for high divergers is different from that of low divergers was not supported. Mednick's theory, however, does provide substantial evidence for the associative theory of divergent thinking which Wallach and Kogan used in the development of their divergent thinking tests.

TABLE 29

TWO WAY ANALYSIS OF VARIANCE OF THE ORIGINALITY RESPONSES OF HIGH AND LOW DIVERGENT GROUPS: TEST OF ASSOCIATIVE HYPOTHESIS

USES

1. Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	82347.58	1	82347.58	(5)	111.9**
(2) R	522144.63	3	17414.88	(3)	21.4**
(3) S (R)	500670.30	616	812.78		
(4) G x R	2851.56	3	950.52	(5)	1.29
(5) GS (R)	453065.30	616	735.50		

2. Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	22789.22	1	22789.22	(5)	534.06**
(2) R	65394.96	3	21798.32	(3)	327.99**
(3) S (R)	205550.70	264	778.60		
(4) G x R	3026.13	3	1008.71	(5)	51.51
(5) GS (R)	176662.10	264	669.17		

SIMILARITIES

3. Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	158290.30	1	158290.30	(5)	268.71**
(2) R	4535.95	3	1511.98	(3)	1.96
(3) S (R)	299716.60	388	772.47		
(4) G x R	20980.38	3	6993.46	(5)	11.87**
(5) GS (R)	288560.30	388	589.07		

where G = high or low divergent group
R = order of successive response
S = responses

TABLE (CONT'D)

4.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	32832.90	1	33832.90	(5)	66.82**
(2) R	133952.10	3	44650.72	(3)	68.27**
(3) S (R)	115106.60	176	654.02		
(4) G x R	1205.79	3	401.93	(5)	0.82
(5) GS (R)	86486.27	176	491.40		

5.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	8857.35	1	8857.35	(5)	13.11**
(2) R	4461.83	3	1487.28	(3)	1.90
(3) S (R)	90673.89	116	781.67		
(4) G x R	2364.48	3	788.16	(5)	1.17
(5) GS (R)	78363.14	116	675.54		

6.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	20041.74	1	20041.74	(5)	70.06**
(2) R	6369.65	3	2123.22	(3)	5.87**
(3) S (R)	59283.68	164	361.49		
(4) G x R	95.51	3	31.84	(5)	0.11
(5) GS (R)	46912.25	164	286.05		

LINE MEANINGS

7.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	23967.11	1	23967.11	(5)	54.84
(2) R	2513.31	3	837.77	(3)	1.66
(3) S (R)	60603.90	120	505.03		
(4) G x R	757.18	3	252.40	(5)	0.58
(5) GS (R)	52447.71	120	437.06		

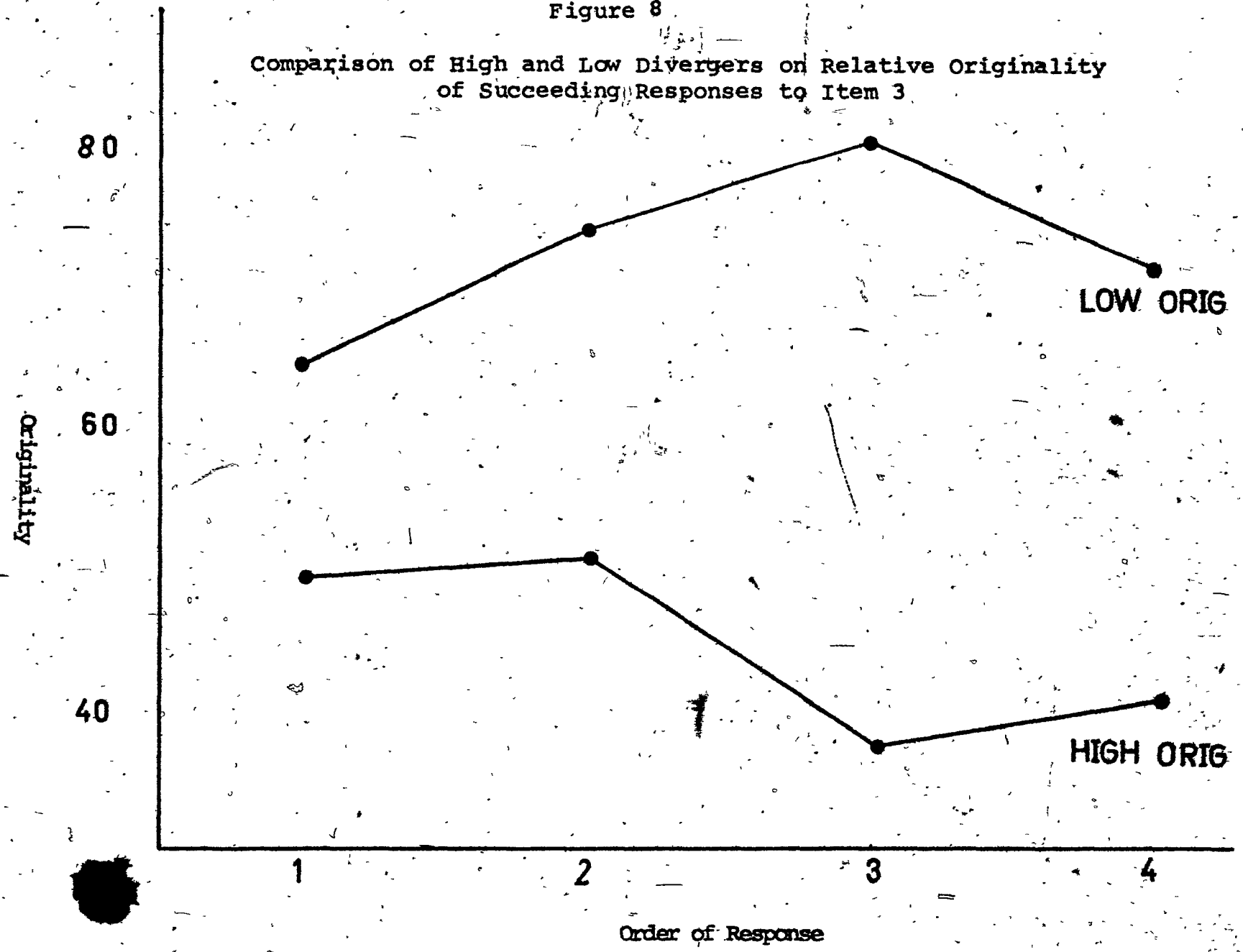
TABLE (CONT'D)

8.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Error Term	F
(1) G	1248.60	1	1248.60	(5)	3.51
(2) R	2165.38	3	721.79	(3)	1.74
(3) S (R)	33102.95	80	413.79		
(4) G x R	461.83	3	153.94	(5)	0.43
(5) GS (R)	28476.57	80	353.95		

Figure 8

Comparison of High and Low Divergers on Relative Originality of Succeeding Responses to Item 3



d) Summary

It was Mednick's theoretical considerations which provided Wallach and Kogan (1965) with the impetus to devise their divergent tests. As few studies have considered his initial proposition about the process of divergent production, an analysis of the originality data was undertaken. The results of these analyses are contradictory.

Divergent production is associative although the degree of associativeness appears to be contingent upon the item stimulus. In some cases originality increases at a higher rate yielding more original responses while at other times the originality slope is less steep.

An analysis of variance testing for linear trends yielded three linear combinations and three quadratic functions of originality. These linear results clearly demonstrate the associative process of divergent production while the quadratic findings indicate the possible leveling off of originality production.

The proposed interaction of the originality slope of high and low divergers was only evident in one of the eight cases and consequently this hypothesis was not confirmed.

5. PREDICTION OF STUDENT BEHAVIOUR

Hypotheses 7 and 8 After accounting for student and teacher (when applicable) convergent ability, divergence will increase the predictability of student behaviour as measured by the TRF (Hypothesis 7). However, the predictability of student behaviour will significantly increase when the teacher related cognitive variables interact with the same student variables (Hypothesis 8).

a) Introduction

Based on the considerations of Getzels and Thelen (1960) and Cronbach and Snow (1969) the the experimental findings of Anderson (1970) and Joyce and Hudson (1968), the final series of hypotheses were tested.

As explained earlier in the Review of the Literature, the classroom is an environment subject to many types of stimuli, some of which ultimately affect the classroom learning environment and student behaviour. To date, the published literature indicates that the cognitive abilities of teachers may interact with those of their students resulting in forms of behaviour unique to this interaction. The purpose of this section is to test the student-teacher hypotheses using two types of analysis. As outlined earlier, the first considers the value of each individual student's cognitive ability to predict classroom climate and student behaviour. As only individual student scores will be used, this type of approach is referred to as the "within class" analysis.

The second approach attempts to test the hypotheses in a different way. This time, the within class variance is controlled for by using the standardized class means of students' cognitive scores in addition to those of their teachers. Using the class as the basic unit of analysis yields a method that studies the sources of variance "between classes".

Stepwise multiple regression was the principle method of analysis used in this portion of the study and to aid in the interpretation of the results both the independent and dependent variables were

standardized, while for the within class analysis, the individual scores were standardized using the class means. Hays (1963) recommends this standardization procedure and Cronbach (1968) applied this mode of analysis on data similar to those used in this study.

To avoid the added possibility of deriving spurious significant results an a-priori ordering of the independent variables was once again necessary. The actual order of the variables for this study was based on the considerations of two researchers. As mentioned previously, Cronbach (1968) using an historical argument suggested that the better understood variable, convergent thinking, should be entered first in the regression equation and the "burden of proof" be left to the divergent variable to establish its usefulness to psychological and pedogological research. Maslany (1973) also encouraged using the convergent measure as the primary predictor. Quite simply, he argued convergent tests are easy to administer and far less time consuming to score than the divergent tests. The considerable time needed to use the divergent measures would only be warranted by demonstrating the efficiency of the divergent measure. For these reasons, the convergent measures were introduced first in both the within class and between class analyses and the two divergent scores for both teacher and student were entered into the regression equations immediately following the convergent scores. In the case of the between class comparisons both the student and teacher convergent measures were included before the divergent measures with the student convergent scores preceding those of the teacher. Thus the complete within class (1) and between class (2) regression equations without interaction terms appear as follows:

COMPLETE

(1) $Y = b_1X_1 + b_2X_2 + b_3X_3 + e$

(2) $Y = b_1X_1 + b_4X_4 + b_2X_2 + b_3X_3 + b_5X_5 + b_6X_6 + e$

where Y = the dependent variable

X_1 = student convergence

X_2 = student verbal divergence

X_3 = student figural divergence

X_4 = teacher convergence

X_5 = teacher verbal divergence

X_6 = teacher figural divergence

$b_1 \ldots b_6$ = beta coefficients

e = error

b) Within Class Analysis

Before presenting the within class results the reader is cautioned to be wary of the ease by which significance can be obtained with large sample sizes. While the majority of the following results are statistically significant the low simple and multiple correlations render many of the results meaningless from a practical point of view.

Although significance tests take sample size into account, the underlying assumption of inference tests is the larger the sample size the closer it approximates the population parameters and the

smaller the value needed to reject the null hypothesis. Any deviation from the null no matter how small, could always be significant depending upon the manipulation of the sample size.

All ten of the Teacher Ratings variables (TRF) were significantly predicted by students' convergent abilities with values varying from 0.08 for Discipline to 0.23 for Achievement. All of the variables

INSERT TABLE 30 ABOUT HERE

were significant at the 0.01 level except Praise Seeking where the large standard error kept the relationship at the 0.05 level of significance.

The addition of the two divergent fluency scores significantly increased the predictability of the regression equation in six of ten cases. These six (Achievement, Participation, Interest, Originality, Preference, and Attendance) were significantly better predicted by the addition of the verbal and figural fluency scores. In keeping with the generally low simple correlations, the largest change from simple to multiple correlation was a meagre 0.05 and this occurred with the psychologically least interesting variable, Attendance.

INSERT TABLE 31 AND 32 ABOUT HERE

By examining the simple correlations of both the verbal and figural divergent scores with the dependent variables, as well as the beta weights it was apparent that convergence was the more important variable. In fact, in each case the convergent-dependent variable correlations were larger than the multiple correlation between the two divergent scores and the TRF measures.

TABLE 30

WITHIN CLASS MULTIPLE CORRELATIONS OF THE PREDICTOR VARIABLES AND STUDENT BEHAVIOUR (TRF) 1/

	X_1			$X_1 + X_2 + X_3$			$X_1 \# X_2$
	r	df	F	R	df	F	R
Attention	.20	1,814	31.41**	.20	3,812	11.60**	.20 2/
Achievement	.23	1,786	45.77**	.26**	3,784	18.60**	.26
Seeks Praise	.10	1,816	8.96*	.12	3,814	3.66	.12
Discipline	.08	1,804	5.79**	.09	3,802	2.43	.11
Participation	.18	1,827	26.63**	.22**	3,825	14.58**	.22
Interest	.20	1,824	34.56**	.23**	3,822	15.22*	.23
Originality	.20	1,805	33.60**	.23**	3,803	15.36**	.23
Independence	.22	1,789	40.86**	.23	3,787	14.66**	.23
Preference	.16	1,803	20.77**	.19**	3,801	10.20**	.20
Attendance	.15	1,774	17.16**	.20**	3,772	10.70**	.20

*P < 0.05
**P < 0.01

where X_1 = Student convergence
X_2 = Student verbal divergence
X_3 = Student figural divergence

1/In this and the following tables the asterisks beside the F ratio indicate whether the regression equation is statistically significant. The asterisks beside the multiple correlations (R) indicate if the increase in R^2 is statistically significant.

2/None of these values significantly increased the multiple correlations. The same results were obtained for the $X_1 \times X_3$ interaction.

TABLE 31

WITHIN CLASS SIMPLE CORRELATIONS OF THE VERBAL AND FIGURAL DIVERGENT TEST SCORES WITH THE STUDENT BEHAVIOUR (TRF) VARIABLES

	VERBAL DIVERGENCE	FIGURAL DIVERGENCE	N
Attention	.10	.06	816
Achievement	.12	.10	788
Seeks Praise	.03	.05	818
Discipline	.05	.05	806
Participation	.15	.10	829
Interest	.13	.10	826
Originality	.12	.11	807
Independence	.08	.06	791
Preference	.11	.10	805
Attendance	.10	.13	776

TABLE 32

BETA COEFFICIENTS OF THE COMPLETE WITHIN CLASS MULTIPLE REGRESSION MODEL OF STUDENT BEHAVIOUR (TRF)

	CONVERGENT	DIVERGENT	
		FIGURAL	VERBAL
Attention	.18	.04	.04
Achievement	.23	.03	.09
Seeks Praise	.11	-.02	.05
Discipline	.08	.02	.03
Participation	.16	.11	.06
Interest	.19	.07	.07
Originality	.19	.06	.08
Independence	.22	.03	.04
Preference	.14	.06	.07
Attendance	.13	.05	.10

Since both interaction terms were not significant, they were deleted from subsequent analyses, and the more parsimonious regression model was used. This explains why the beta weights for the interaction terms for Table 31 were not included.

As expected the interaction between convergence and verbal divergence was not significant for any of the ten dependent variables. This indicates that the regression slopes for student behaviour on divergence can be regarded as homogeneous across different levels of convergence. That is, convergent and divergent abilities of individual students do not appear to interact in teachers' perception of their students' classroom behaviour.

High convergent students were rated higher on all of the TRF behaviours indicating that convergence was the more important variable of the two used in this within class analysis.

Divergent scores contributed in the prediction of the dependent variables in six of the ten cases when convergence was also related to them.

c) Between Class Analysis

Although the findings of the within class variations have limited usefulness due to their low values the between class comparisons of teacher ratings yielded clearer results.

The standardized class means of student and teacher convergent and divergent test scores for each of the forty-eight classes in this survey were used as the basic unit of analysis. Following the procedure outlined earlier in this section, the variables were entered into the

equation in the following order: student convergence (X_1); teacher convergence (X_4); student divergence (X_2 and X_3); and teacher divergence (X_5 and X_6). Each resultant F ratio was tested for significance and in those cases where the Fs were statistically significant, the increments in variance accounted for by each additional cognitive variable was tested using the equation described on page 37.

Of the ten TRF variables, five of them were significantly predicted by the cognitive variables. Three variables, Achievement,

INSERT TABLE 33 ABOUT HERE

which had the highest correlation with the predictor variable (0.51), followed by Interest (0.46), and then by Participation (0.38) were all significantly related to student convergence. Similar to the results from the prediction of academic achievement, teacher ratings of achievement provided further evidence of the importance of convergent thinking in school behaviour.

Classes which were high in convergence were also rated high in achievement and participation. This may seem contrary to common sense expectation, since divergent students are usually reported to participate more. However, the TRF form explicitly requested the teacher to rate the level of participation of each student and considering the earlier finding that convergers were higher achievers than the high divergers, it was not unlikely that teachers might have appeared to and solicited responses from the highly convergent students. This alone might have encouraged a greater participation on the part of the convergent classes.

TABLE 33

BETWEEN CLASS MULTIPLE CORRELATIONS OF THE PREDICTOR VARIABLES AND STUDENT BEHAVIOUR

	X_1		$X_1 + X_4$		$X_1+X_4+X_2+X_3$		$X_1+X_4+X_2+X_3+X_5+X_6$	
	r	F	R	F	R	F	R	F
Attention	.25	2.94	.27	1.74	.32	1.21	.38	1.13
Achievement	.51	15.9**	.52	8.31**	.59*	5.74**	.60	3.80**
Seeks Praise	.08	.33	.09	.91	.31	1.14	.32	0.77
Discipline	.02	.01	.14	.44	.17	.30	.47*	2.88*
Participation	.38	7.70**	.39	3.80*	.52**	3.80**	.59*	3.54**
Interest	.45	11.82**	.45	5.81**	.52*	3.82**	.58*	3.47**
Originality	.20	1.81	.22	1.17	.25	.70	.27	0.54
Independence	.10	.43	.12	.33	.14	.23	.27	0.55
Preference	.24	2.88	.28	1.94	.28	.93	.53*	2.57*
Attendance	.28	4.00	.31	2.42	.32	1.24	.45	1.71
df =		1,46		2,45		4,43		6,41

where X_1 = student convergence

X_2 = student verbal divergence

X_3 = student figural divergence

X_4 = teacher convergence

X_5 = teacher verbal divergence

X_6 = teacher figural divergence

In addition, one other factor might have also explained this result. Traditionally the classroom has been described as a convergent environment (Heist, 1968). The emphasis on correctness and the concentrated activities towards problem solving may be a "negative press" on the high divergers. In fact the classroom might be a hostile place for the diverger whose consequently low level of motivation may inhibit his participation. At a later date it would be useful to explore students' attitudes towards participating in classes of high and low divergent teachers.

The third convergent predicted variable, Interest, was a new finding which complemented the other two results. Students who achieved well and were active participants in class were most likely going to demonstrate a positive interest in class. The high intercorrelations between these variables supported this position.

Discipline was the fourth significantly predicted variable in the Teacher Rating Form group and in this case a slightly different method of interpretation was needed. The regression equation demonstrated that Discipline was predicted only when all four variables had been entered into the equation. Subsequently, a test of the variance increased by the addition of each new variable showed the singular importance of the teacher divergent scores (see also Table 33). A review of the simple product moment correlations between the predictor variables and the dependent variable as well as the beta weights indicated that a revised and

INSERT TABLES 34 AND 35 ABOUT HERE

"novelty" hypothesis should be tested. This time the teacher divergent variables were entered into the equation first.[1] Once again, the

[1] These results are not reported in tabular form.

TABLE 34

BETWEEN CLASS SIMPLE CORRELATIONS OF THE PREDICTOR VARIABLES AND STUDENT BEHAVIOUR

	CONVERGENCE		DIVERGENCE			
	STUDENT	TEACHER	STUDENT		TEACHER	
			VERBAL	FIGURAL	VERBAL	FIGURAL
Attention	.25	-.05	.06	.00	.00	.04
Achievement	.51	.00	.14	.06	-.11	-.16
Seeks Praise	-.08	.02	.14	.18	.06	.12
Discipline	.01	.14	-.07	-.03	.39	.32
Participation	.38	.12	.08	-.08	-.02	.09
Interest	.45	.08	.14	.06	-.04	.04
Originality	.20	-.06	.07	.02	-.06	-.02
Independence	.10	.09	.00	.05	-.02	.15
Preference	.24	.19	.12	.12	.09	.33
Attendance	.28	.19	.11	.10	.25	.11

TABLE 35

BETA COEFFICIENTS OF THE COMPLETE BETWEEN CLASS MULTIPLE REGRESSION MODEL OF STUDENT BEHAVIOUR[1]

	CONVERGENCE		DIVERGENCE			
	STUDENT	TEACHER	STUDENT		TEACHER	
			VERBAL	FIGURAL	VERBAL	FIGURAL
Attention	.52	-.19	-.08	-.17	.02	.22
Achievement	.82*	-.16	-.18	-.22*	.00	.11
Seeks Praise	-.30	.03	.18	.23	-.01	.08
Discipline	.27	-.04	-.07	-.09	.33*	.25
Participation	.76*	-.06	-.04	-.40*	-.04	.34*
Interest	.80*	-.13	-.14	-.21*	-.04	.33*
Originality	.37	-.15	-.06	-.10	-.03	.13
Independence	.23	.01	-.16	.09	-.15	.29
Preference	.47	.00	-.05	.01	-.09	.54*
Attendance	.46	.02	-.00	-.14	.27	.13

[1] Refers to the regression model on page 125.

*P < 0.05

resultant F ratio clearly demonstrated the remarkable finding that teacher perceived discipline problems are apparently a function of the teachers' own divergent ability. It seems plausible that this type of a result might be due to two effects. First and central to the thesis of this study, divergent teachers may set up learning environments which are seemingly disorganized although they rate their students as easy to discipline. Alternatively, as is so often the case, some other intervening variable such as class size might simultaneously correlate with both the variables under inspection and give the impression that the relationship is both causal and meaningful.

Like Discipline, the fifth variable, Preference, was also treated in the same manner and similar significant results were obtained. The evidence seems clear that divergent teachers tended to prefer to teach their students the next year regardless of the students' cognitive strength.

This result was surprising and not expected. In line with the results of both Heider (1958) and Feather (1971) it was expected that teachers would prefer to teach those students with consonant cognitive abilities. Instead, a general divergent effect was detected although it is too premature to state that divergence alone was the critical variable.

d) Between Class Interactions

Unlike the interaction study between "creativity" and "IQ" in the case of Wallach and Kogan (1965) and "achievement" and "fluency" in the reconsideration of the Wallach and Kogan data (Cronbach, 1968), the term interaction refers to the three interactions of consonant cognitive abilities between students and teachers. That is, the interactions between like cognitive variables were examined. Unfortunately, due to

the limited number of classes (48) with the reduction in the degrees of freedom, the six other more complex interactions were not tested.

To test interactions and maintain the strict objective of placing the burden of proof on the new variable, the interaction terms were placed into the regression equation after all of the simple variables (complete model) had been entered. The change in R^2 due to the additional interaction terms was then tested for significance. The three resulting regression equations are presented below.

$$Y = \text{complete model} + (X_1 - \bar{X}_1) \cdot (X_4 - \bar{X}_4)$$

$$Y = \text{complete model} + (X_2 - \bar{X}_2) \cdot (X_5 - \bar{X}_5)$$

$$Y = \text{complete model} + (X_3 - \bar{X}_3) \cdot (X_6 - \bar{X}_6)$$

where Y = dependent variable

X_1 = student convergence

X_2 = student verbal divergence

X_3 = student figural divergence

X_4 = teacher convergence

X_5 = teacher verbal divergence

X_6 = teacher figural divergence

complete = the complete regression model described on page 125.

Although twelve of the thirty possible consonant interaction terms were statistically significant, none of the student behaviour variables met the second criterion of adding a substantial enough amount of the variance to the predictability of the dependent variable. Similar to the within class analyses, the slope of the regression equation of student behaviour on student convergence or divergence was constant at

all levels of teachers' scores on the same measure.

INSERT TABLE 36 ABOUT HERE

e) Class Size as a Mediator Variable

The continuous interaction which takes place within the classroom is affected by many factors aside from the cognitive variables used in this study. Class size, for one, has been included for inspection because of the interesting effects, Walberg (1969) and Anderson and Walberg (1971) discovered using the LEI.

In an earlier study with physics classes, Walberg (1969) found a linear relationship between class size and four group characteristics. Two, Formality and Diversity were positively related and two, Cohesiveness and Difficulty, were negatively related. Curvilinear relationships between class size and Cohesiveness, Formality, Goal Direction, Disorganization and Diversity were also uncovered.

A replication of this study with a different sample of high school students yielded one significant negative linear relationship (Difficulty) and two curvilinear functions (Cohesiveness and Friction) (Anderson, 1971). While the results in part replicate the Walberg effort, Anderson adds a cautionary note that a third variable may have created a spurious correlation between group size and group characteristics. Variables such as an attractive teacher, the subject matter, and other pupil variables may have influenced the size of the correlation coefficient.

In this study, three significant linear relationships were noted from the Teacher Rating Form.

TABLE 36

BETWEEN CLASS MULTIPLE CORRELATIONS OF STUDENT-TEACHER PRODUCT TERMS AND STUDENT BEHAVIOUR

	COMPLETE MODEL		TEACHER-STUDENT PRODUCT					
			CONVERGENCE		DIVERGENCE (VERBAL)		DIVERGENCE (FIGURAL)	
	R	F	R	F	R	F	R	F
Attention	.38[1]	1.13	.44	1.39	.43	1.27	.38	0.96
Achievement	.60	3.80**	.61	3.31*	.60	3.20*	.60	3.25*
Seeks Praise	.32	0.77	.35	0.79	.39	1.01	.36	0.87
Discipline	.47	2.88	.49	1.80	.49	1.77	.47	1.65
Participation	.58	3.54**	.59	3.03*	.59	3.02*	.59	3.00*
Interest	.58	3.47**	.59	3.00*	.59	2.98	.58	2.90*
Originality	.27	0.55	.27	0.45	.30	0.58	.28	0.50
Independence	.27	0.55	.27	0.47	.35	0.80	.27	0.47
Preference	.53	2.57*	.56	2.60*	.55	2.42	.53	2.20
Attendance	.45	1.71	.50	1.94	.46	1.52	.46	1.55
df =		6,41		5,40		5,40		5,40

[1] The values in this column were derived from Table 32.

*P < 0.05

INSERT TABLE 37 AND FIGURE 9 ABOUT HERE

Discipline, Participation and Preference were all negatively related to the size of the class. A further analysis of possible curvilinear relationships yielded one significant result. This variable, Participation, had a final multiple correlation of 0.45 which was significantly larger than the correlation for the linear regression. No cubic equations were tested.

The results provided a number of interesting relationships which deserved to be further developed. Not surprisingly, Discipline was found to be negatively related to the size of the class. The larger the class, the more difficult it was to control individual students. This finding promises to confound many other results because teachers preoccupied with discipline and classroom control will undoubtedly have less time to devote to more "cognitive" classroom activities. Extending this argument further, the finding that preference for teaching the same student the following year was also negatively related to the class size, perhaps points out the difficulty involved with teaching larger classes and the importance of controlling for class size. Apparently, more time has to be spent disciplining students with less time for the kinds of activities which might improve student-teacher relationships. In fact, one might be led to the tentative conclusion that the role of teachers in large classes was to provide a custodial service.

The third statistically significant result rounds out this line of discussion. Once again, class size appeared to have a generally negative effect on classroom behaviour. This time, Participation and

TABLE 37

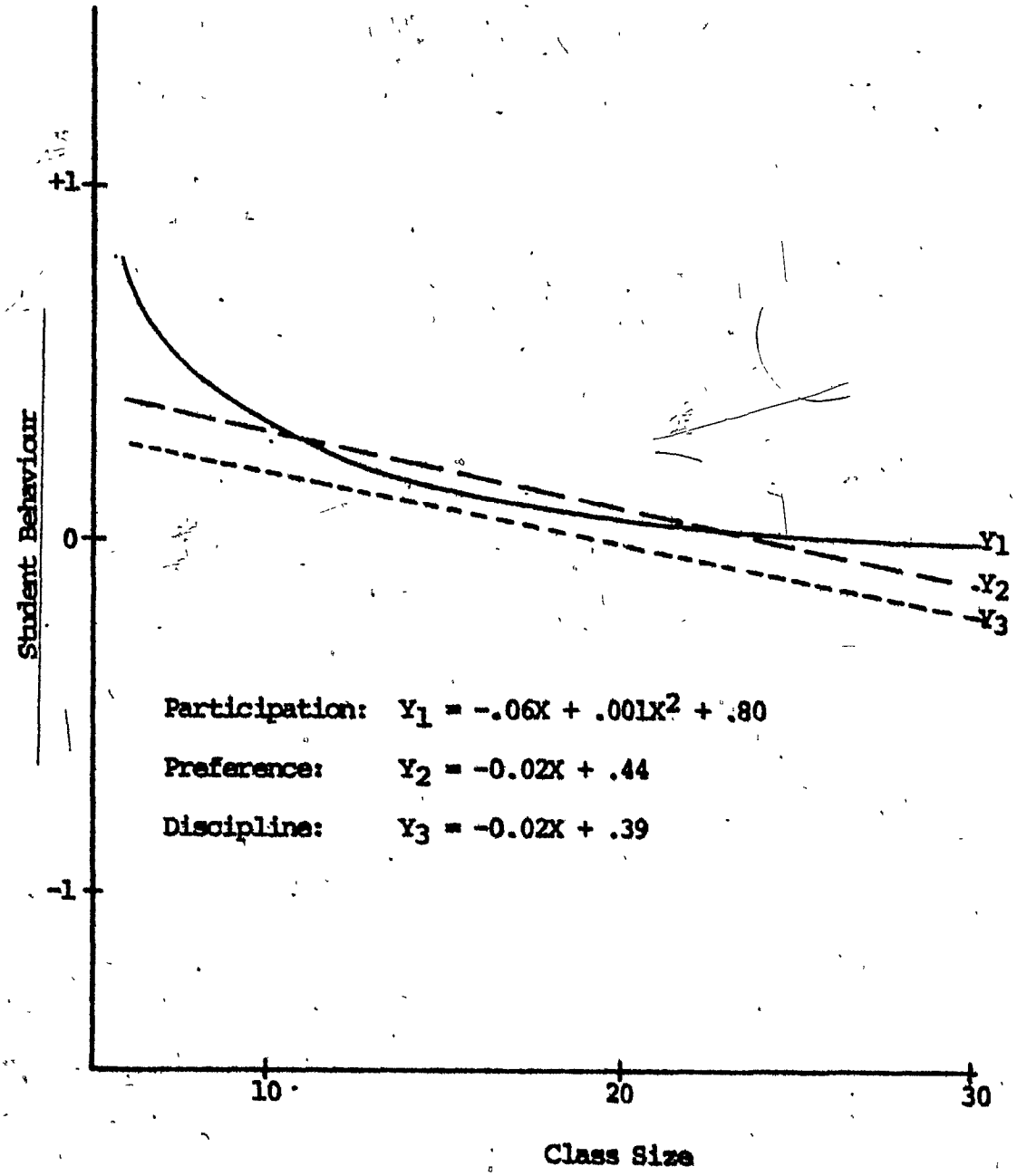
CLASS SIZE AS A LINEAR AND QUADRATIC PREDICTOR OF STUDENT BEHAVIOUR (TRF)

	LINEAR		QUADRATIC	
	r	F	R	F
Attention	.20	1.93	.25	1.49
Achievement	.12	0.70	.18	0.72
Praise Seeking	.23	2.65	.30	2.17
Discipline	-.34	6.06*	-.34	3.99
Participation	-.36	6.95*	-.45	5.81*
Interest	.16	1.14	.21	1.08
Originality	.08	0.27	.11	0.30
Independence	.06	0.16	.11	0.28
Preference	-.29	4.19*	-.29	2.05
Attendance	.19	1.68	.19	0.82
df =		1,46		2,45

*P < 0.05

FIGURE 9

The Relationship Between Student Behaviour and Class Size



Participation: $Y_1 = -.06X + .001X^2 + .80$

Preference: $Y_2 = -0.02X + .44$

Discipline: $Y_3 = -0.02X + .39$

class size had a U shaped relationship, such that participation in class decreased as class size grew until it reached a critical minimum value (saddle point) and then slowly levelled off for the remaining class sizes. The curve is plotted in Figure 9 to demonstrate the shape of the regression curve. Based on these results the most desirable class size in terms of participation of the students is the smallest possible, although certain anectotal data would suggest that these results should not be generalized.

Apparently, it has become common practice in many canadian schools to make up small remedial classes for those students who experience certain types of learning problems. While these students are not emotionally disturbed or slow learners, they certainly are not drawn from the same population of regular learners. For this reason the curvilinear curve of Participation probably described this characteristic of the high school program and consequently, a general conclusion should be viewed with suspicion.

f) Summary

With respect to the comparisons between classes, five of the dependent variables were significantly predicted by the predictor variables. In one case, student convergence and verbal and figural divergence combined to predict Achievement. This result was anticipated

INSERT TABLE 38 ABOUT HERE

as these two variables had jointly predicted nine of the sixteen dependent achievement variables in Section 3 of this chapter. As the dependent variables in the earlier instance had been actual achievement scores the finding provided a validity check of the attitudinal variable.

TABLE 38

SUMMARY TABLE OF THE SIGNIFICANT CORRELATION BETWEEN STUDENT BEHAVIOUR AND THE PREDICTOR VARIABLES

	BETWEEN CLASS					WITHIN CLASS		CLASS SIZE	
	X_1	X_4	$X_2 + X_3$	$X_5 + X_6$	INTER-ACTIONS	X_1	$X_2 + X_3$	LINEAR	QUADRATIC
Attention						**			
Achievement	X_1^{**}		X_2^{*}			**	X_2^{**}		
Seeks Praise						*			
Discipline				X_5^{*}		**		*	
Participation	X_1^{**}		X_2^{**}	X_6^{*}		**	X_3^{**}		*
Interest	X_1^{**}		X_2^{*}	X_6^{*}		**	X_2^{**}		
Originality						**	X_2^{**}		
Independence						**			
Preference				X_6^{*}		**	X_2^{**}	*	
Attendance						**	X_2^{**}		

Note: $^{*}P < 0.05$
$^{**}P < 0.01$

where X_1 = student convergence

X_2 = student verbal divergence

X_3 = student figural divergence

X_4 = teacher convergence

X_5 = teacher verbal divergence

X_6 = teacher figural divergence

Both ratings of Participation and Interest were predicted by student convergence, and teacher and student divergence. Although no interaction term was found to be significant it was apparent that the two student cognitive variables and teacher divergence were important predictors of at least these two types of student behaviour. Further importance of the teacher variable was demonstrated with a third type of between class result which showed the singular importance of teacher divergence as it predicted both ratings of Discipline and Preference. Both of these findings were unexpected as the ratings of Discipline and Preference were initially assumed to be primarily determined by student related variables (Getzels and Jackson, 1962). Instead the two teacher variables emerged as the primary predictors.

At the same time, ratings of Discipline and Preference were linearly predicted by classroom size, thus presenting some problems in interpretation. To determine the extent of the relationship between the dependent variables and the teacher divergent variable, a partial correlation was derived, partialling out the effect of classroom size. For both Discipline and Preference ratings the partial correlations were statistically significant yielding values of 0.39 and 0.29 respectively. From these results it seems that teacher divergent variables appear to affect student behaviour even after accounting for the possible influence of classroom size.

With regard to the within class analyses, the large number of observations yielded mostly significant results with very little of the variance accounted for by the regression equations. For the record, all ten student behaviours were significantly predicted by the student

convergent scores while the addition of the student divergent scores significantly increased the predictability of the dependent scores in six cases.

As a mediator variable class size was linearly correlated with two of the aforementioned dependent variables, Discipline and Preference, and quadratically related to Participation.

6- PREDICTION OF CLASSROOM CLIMATE

The following two hypotheses relate to the between class analysis. In addition, the results of the within class analysis are also presented.

> Hypotheses 9 and 10 After accounting for student and teacher (when applicable) convergent ability, high divergent teachers will conduct classes that conform to the traditional expectation of divergers; that is, the classes will be more diverse, more informal, less goal directed, more democratic, more disorganized and less competitive than those of low divergent teachers. In operational terms, teacher divergence will significantly predict classroom climate as measured by the LEI (Hypothesis 9). No hypotheses are stated about the remaining dependent variables which are included for speculative purposes. However, in spite of the importance of teacher divergence students will more positively perceive the classroom environment when taught by teachers of similar cognitive style (Hypothesis 10).

a) Within Class Analysis

In general, the multiple correlations of student divergence and convergence with classroom climate (LEI) were uniformly low and generally not statistically significant.

INSERT TABLES 39, 40 AND 41 ABOUT HERE

Only Formality, Friction and Democracy were significantly predicted by convergence and in two of these cases the beta weights were negative, signifying that students low in convergent ability characterized their classes as being dissident and more formal.

The addition of the divergent variables increased the predictability of the model although the multiple correlations were still low. This time, Favouritism, Cliqueness and Satisfaction were predicted by the full model (without the interaction term) while only Friction of the original three convergent predicted variables continued to be significantly predicted.

Judging from the simple correlations of the divergent scores with the dependent variables and the beta weights of the regression equations, it was quite clear that figural divergent scores were more important than verbal divergent scores for these four significant regression equations. In three of these cases, Friction, Favouritism and Cliqueness, high divergent scores predicted the dependent variables while in the other case, Satisfaction, the relationship was negative; that is, high divergers tended to be dissatisfied with their class.

Interactions were also tested and none of the interaction terms significantly increased the multiple correlation.[1]

In summary, the full predictive model predicted student perception of the socio-emotional climate of the class fairly well but the low multiple correlation values left this series of results with a very

[1] This Table is not presented as it does not pertain to the hypotheses.

TABLE 39

WITHIN CLASS MULTIPLE CORRELATIONS OF THE PREDICTOR VARIABLES AND CLASSROOM CLIMATE

	CONVERGENCE			DIVERGENCE (VERBAL AND FIGURAL)			INTERACTION (CONVERGENCE AND VERBAL)
	r	df	F	R	df	F	R
Cohesiveness	.02	1,802	0.57	.05	3,800	0.76	.06
Diversity	.05	1,786	1.61	.07	3,784	1.21	.08
Formality	.10	1,802	8.66**	.12	3,800	3.87*	.13
Speed	.04	1,789	1.06	.08	3,787	1.58	.09
Friction	.08	1,799	4.73*	.13**	3,797	4.70**	.14
Goal Direction	.08	1,802	0.66	.08	3,800	1.51	.09
Favouritism	.06	1,776	3.02	.14**	3,774	4.93**	.14
Difficulty	.02	1,799	0.48	.06	3,797	0.90	.07
Apathy	.00	1,808	0.02	.02	3,806	0.13	.04
Democratic	.08	1,804	4.95*	.11	3,802	3.06*	.11
Cliqueness	.02	1,798	1.24	.11**	3,796	3.37*	.11
Satisfaction	.04	1,797	1.28	.11**	3,795	3.31*	.12
Disorganization	.03	1,779	0.55	.03	3,777	0.32	.04
Competitiveness	.04	1,792	1.04	.08	3,790	1.52	.08

Note: **P < 0.01
*P < 0.05

TABLE 40

BETA COEFFICIENTS OF THE COMPLETE WITHIN CLASS REGRESSION MODEL OF CLASSROOM CLIMATE ON CONVERGENCE AND DIVERGENCE

	CONVERGENCE	DIVERGENCE	
		VERBAL	FIGURAL
Cohesiveness	.02	.03	.05
Diversity	-.05	.05	.02
Formality	-.10	-.07	.03
Speed	-.03	-.06	.06
Friction	-.09	.05	.08
Goal Direction	-.02	-.07	-.01
Favouritism	-.05	-.06	.13
Difficulty	-.02	-.05	.05
Apathy	.00	.01	.02
Democratic	.08	-.01	-.07
Cliqueness	-.04	.04	.09
Satisfaction	-.04	.02	-.11
Disorganization	.03	-.01	-.02
Competitiveness	-.04	.00	.07

TABLE 41

WITHIN CLASS SIMPLE CORRELATIONS OF THE DIVERGENT PREDICTOR VARIABLES AND CLASSROOM CLIMATE[1]

	VERBAL DIVERGENCE	FIGURAL DIVERGENCE	N
Cohesiveness	.01	-.04	804
Diversity	.06	.05	788
Formality	-.03	.01	804
Speed	-.02	.05	791
Friction	.07	.11	801
Goal Direction	-.04	-.03	804
Favouritism	-.03	.09	778
Difficulty	-.02	.05	791
Apathy	.02	.03	810
Democratic	-.03	-.08	806
Cliqueness	.06	.10	800
Satisfaction	-.01	-.09	798
Disorganization	-.02	-.03	781
Competitiveness	.01	.05	794

Note: [1] The convergent dependent variable correlations are not included since they are presented in the previous table.

restricted use. Even the best predicted dependent variable only accounted for five percent ($.23^2$) of the variance, an amount too small to have any real educational relevance.

b) Between Class Analysis

Five of the fourteen LEI variables were significantly predicted by the student and teacher cognitive variables. One of the variables was predicted by student convergent measures alone, two by teacher convergence, one by student and teacher convergence and the last by teacher divergent scores.

INSERT TABLE 42 ABOUT HERE

Keeping in mind that the predictor scores in this analysis were actually mean scores for each class, it was interesting to note that Difficulty and Competitiveness were best predicted by student convergent scores. Based on the students' own perceptions, classes with the highest mean values for student convergers tended to be difficult and competitive.

The positive simple correlation between student convergence and the dependent variable indicated that the linear relationship was positive; that is, classes of high convergent students were rated more difficult than those classes of low convergers. This finding was particularily interesting as the principal determinant of the dependent variable was not related to differences among teachers but rather a student oriented variable. In this instance, this might indicate that student perceptions of their classroom climate were related to their own cognitive abilities rather than the expected product of teacher effects.

TABLE 42

BETWEEN CLASS MULTIPLE CORRELATIONS OF THE PREDICTOR VARIABLES AND CLASSROOM CLIMATE[1/]

	X_1		X_1+X_4		$X_1+X_4+X_2+X_3$		$X_1+X_4+X_2+X_3+X_5+X_6$	
	r	F	R	F	R	F	R	F
Cohesiveness	.08	.31	.43	.33	.30	1.02	.33	.86
Diversity	.09	.39	.11	.26	.25	.68	.44	1.60
Formality	.13	.85	.29	2.02	.42	2.30	.65**	4.87**
Speed	.16	1.17	.24	1.35	.31	1.14	.36	1.00
Friction	.19	1.71	.26	1.62	.30	1.08	.37	1.11
Goal Direction	.01	.00	.17	.67	.21	.46	.21	.29
Favouritism	.04	.06	.29	2.00	.40	2.03	.49	2.21
Difficulty	.34	6.07*	.37	3.66*	.39	1.95	.42	1.45
Apathy	.07	.21	.31	2.39	.32	1.21	.36	1.00
Democratic	.16	1.28	.26	1.58	.32	1.21	.43	1.58
Cliqueness	.02	.01	.30	2.29	.31	1.13	.43	1.53
Satisfaction	.23	2.62	.46**	5.95**	.50	3.51*	.50	2.29
Disorganization	.07	.22	.37**	3.62*	.39	1.89	.40	1.32
Competitiveness	.33*	5.47*	.43**	4.98*	.46	2.76*	.48	2.05
df =		1,46		2,45		4,43		6,41

Note: *P < 0.05
**P < 0.01

[1/] See Table 33 for an explanation of variables X_1 to X_6.

In addition to student convergence, the predictability of Competitiveness was increased by the addition of the teacher convergence variable indicating the complexity of Competitiveness in the classroom. Classes taught by high convergent teachers were more competitive than those taught by low convergers but this was particularily noted when the classes were composed of highly convergent students. Here was a situation where the classroom climate was determined by two different and relatively independent sources of influence. It remains to be seen whether the relationship was optimal in terms of student achievement.

The negative beta weights (-0.20 and -0.43) and negative zero-order correlations (-0.32 and -0.52) for teacher verbal divergence and figural divergence respectively indicated that Formality in the classroom was negatively related to teacher divergent scores. As a result, high divergers set up less formal classes while low divergent teachers were liable to instruct their students in a formal,

INSERT TABLES 43 AND 44 ABOUT HERE

ritualized manner. This finding was most unexpected and lends substantial support to the potential importance of divergent thinking as a major predictor of classroom climate.

One other finding from the Learning Environment Inventory (LEI) showed that teacher convergence best predicted students' general Satisfaction with the class. Considering the general interest of educators in attending to the individual needs of students it was indeed interesting to note that Satisfaction was related to high teacher convergent ability and not to a student related variable.

TABLE 43

BETA COEFFICIENTS OF THE COMPLETE BETWEEN CLASS REGRESSION MODEL OF CLASSROOM CLIMATE ON CONVERGENCE AND DIVERGENCE[1]

	CONVERGENCE		DIVERGENCE			
	STUDENT	TEACHER	STUDENT		TEACHER	
			VERBAL	FIGURAL	VERBAL	FIGURAL
Cohesiveness	-.05	.09	.38	-.12	-.07	-.20
Diversity	.08	.06	.02	-.23	-.37	-.36
Formality	-.14	-.06	.05	-.31	-.43	-.20
Speed	.21	-.13	.15	-.24	-.21	-.08
Friction	-.05	-.15	-.07	-.12	-.26	-.12
Goal Direction	.01	.18	.05	-.15	.01	.02
Favouritism	.15	-.21	-.36	.01	-.27	-.10
Difficulty	.19	.23	.17	-.11	-.06	-.12
Apathy	-.09	-.28	.15	-.09	-.16	-.18
Democratic	-.23	.12	-.08	.19	-.34	-.12
Cliqueness	-.03	.22	.09	-.04	.29	.06
Satisfaction	.04	.40	.29	-.08	.02	.07
Disorganization	.11	-.41	-.13	.01	-.13	-.04
Competitiveness	.28	.30	.16	.26	.18	.15

[1]Refers to the regression model on page 125.

TABLE 44

BETWEEN CLASS SIMPLE CORRELATIONS OF THE PREDICTOR VARIABLES AND CLASSROOM CLIMATE

	CONVERGENCE		DIVERGENCE			
	STUDENT	TEACHER	STUDENT		TEACHER	
			VERBAL	FIGURAL	VERBAL	FIGURAL
Cohesiveness	.08	.11	.24	.10	-.01	.13
Diversity	-.09	.03	-.11	-.22	-.20	.20
Formality	-.13	-.28	-.14	-.13	-.52	-.32
Speed	.16	-.14	.13	-.05	-.27	-.12
Friction	-.19	-.21	-.18	-.24	-.22	.02
Goal Direction	-.01	.16	-.05	-.09	.05	.07
Favouritism	-.04	-.28	-.21	-.18	-.33	-.25
Difficulty	.34	.23	.26	.17	-.12	-.19
Apathy	-.07	-.31	.03	-.05	.00	-.15
Democratic	-.16	.15	-.11	.05	.37	.15
Cliqueness	-.01	.29	.00	-.04	.36	.24
Satisfaction	.23	.44	.25	.19	.10	.10
Disorganization	-.07	-.37	-.09	-.07	.01	-.08
Competitiveness	.32	.34	.17	.08	.10	-.10

This result, if reliable, cast some doubt on the research of those who have advocated that less structured classes would increase student satisfaction. Assuming that this finding was causal to the extent that teacher cognitive ability influenced a particular classroom climate, then it seems possible that Satisfaction was in part a function of the teachers' convergent ability. Keeping in mind that this relationship was positive, it was the high convergers, those teachers who were the good abstract problem solvers whose classes were best appreciated. While there is some possibility that a third unaccounted for variable may have simultaneously explained the variance, this finding may be a subtle indication that students really did prefer classes that are well structured and orderly. In fact, some of the anecdotal data presented below bears this supposition out.

Linked with the previous finding that low formality was a divergently produced outcome, it appeared that overall Satisfaction with the learning environment had little to do with the mode of presentation.

Many of the comments received from the students in this study indicated a desire for a more structured learning environment. As the anecdotal data below illustrate, students appear to recognize the continued importance of order, the need for well structured classes and teachers who were well prepared to finish the course requirements.

> "This is one of the few classes in our school in which a certain amount of work is done. I am satisfied with this class and the teacher. This class is quite efficient" (405-01-01)

> "We get our work done but it is very dull" (161-01-01)

> "...The class is very well organized and for the first time in two years, I walk out of class satisfied with my knowledge" (439-07-15)

> "Most people in this class strongly enjoy their work. Even though it is competitive, better students help the others" (254-12-34)

Disorganization, like Satisfaction, was also significantly predicted by teacher convergence, although in this instance the beta coefficients were negative, indicating a negative relationship. Thus, teachers who scored poorly on the convergent measure taught classes which were characterized as disorganized. Once again, this finding seemed to indicate that divergence did not operate in its expected role. Judging from the literature with its constant reference to divergers' artistic and unconforming behaviour, it was expected that high divergers would set up learning environments which were highly disorganized. Instead, the opposite effect appeared. If anything, this finding demonstrated once again the importance of the convergent measure.

As a final note, the correlations between convergence and the LEI variables were substantially different from those reported by Anderson.[1] These differences are undoubtably due to a number of factors, not the least of which is the liberalization of secondary schools.

In summary, of the five significant simple predictions, four of them involved either student or teacher convergent thinking. The one lone detractor, Formality, was significantly predicted by teacher figural divergence.

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[1] Personal communication.

c) Between Class Interactions

Two significant interactions were discovered using the LEI scales as the dependent variable. Both Democracy and Favouritism were noted to be significantly predicted by the interaction of student and teacher verbal divergence yielding overall F ratios of 5.33 and 25.14 respectively.

INSERT TABLE 45 ABOUT HERE

To better understand the relationship between the two significant teacher student variables, the teachers' divergent scores were divided into two groups. Those above the mean divergent verbal scores were called high divergers and those below the mean were labelled low divergers. It should be kept in mind that this division represented only relative values.

The two following graphs showed the linear relationships between student verbal divergence and the dependent variables with teacher divergence held constant.

INSERT FIGURES 10 AND 11

Although both the interactions were significant, they were of two different types. The intersection of the high and low divergent teacher regression lines for "Democratic" was -0.436, a value well within the range of the independent variable (student verbal divergence). According to Cronbach and Snow's (1969) definition of disordinal, this was a disordinal interaction since the regression lines intersected at a reasonable value of verbal divergence.

TABLE 45

BETWEEN CLASS MULTIPLE CORRELATIONS OF STUDENT-TEACHER INTERACTION TERMS AND CLASSROOM CLIMATE

			INTERACTIONS					
			CONVERGENT		DIVERGENCE (VERBAL)		DIVERGENCE (FIGURAL)	
	COMPLETE MODEL R	F	TEACHER R	STUDENT F	TEACHER R	STUDENT F	TEACHER R	STUDENT F
Cohesiveness	.33	0.86	.39	1.04	.34	0.73	.49	1.82
Diversity	.44	1.60	.46	1.53	.48	1.68	.44	1.35
Formality	.65	4.87	.66	4.34	.65	4.08	.65	4.76*
Speed	.36	0.99	.36	0.87	.37	0.88	.36	0.85
Friction	.37	1.11	.39	1.02	.39	1.03	.40	1.11
Goal Direction	.20	0.30	.26	0.40	.20	0.25	.21	0.26
Favouritism	.49	2.21	.50	1.87	.55	2.44*	.50	1.95
Difficulty	.41	1.41	.43	1.28	.42	1.19	.43	1.29
Apathy	.36	1.01	.39	1.03	.36	0.86	.43	1.33
Democratic	.43	1.58	.44	1.35	.65	4.23**	.44	1.37
Cliqueness	.43	1.53	.49	1.82	.47	1.61	.43	1.30
Satisfaction	.50	2.29	.51	1.98	.51	2.03	.51	2.00
Disorganization	.40	1.32	.41	1.14	.40	1.11	.40	1.11
Competitiveness	.48	2.05	.48	1.74	.49	1.77	.51	1.97
df =		6.41		7.40		7.40		7.40

FIGURE 10

The Interaction of Student and Teacher Verbal Divergence in the Prediction of Democracy

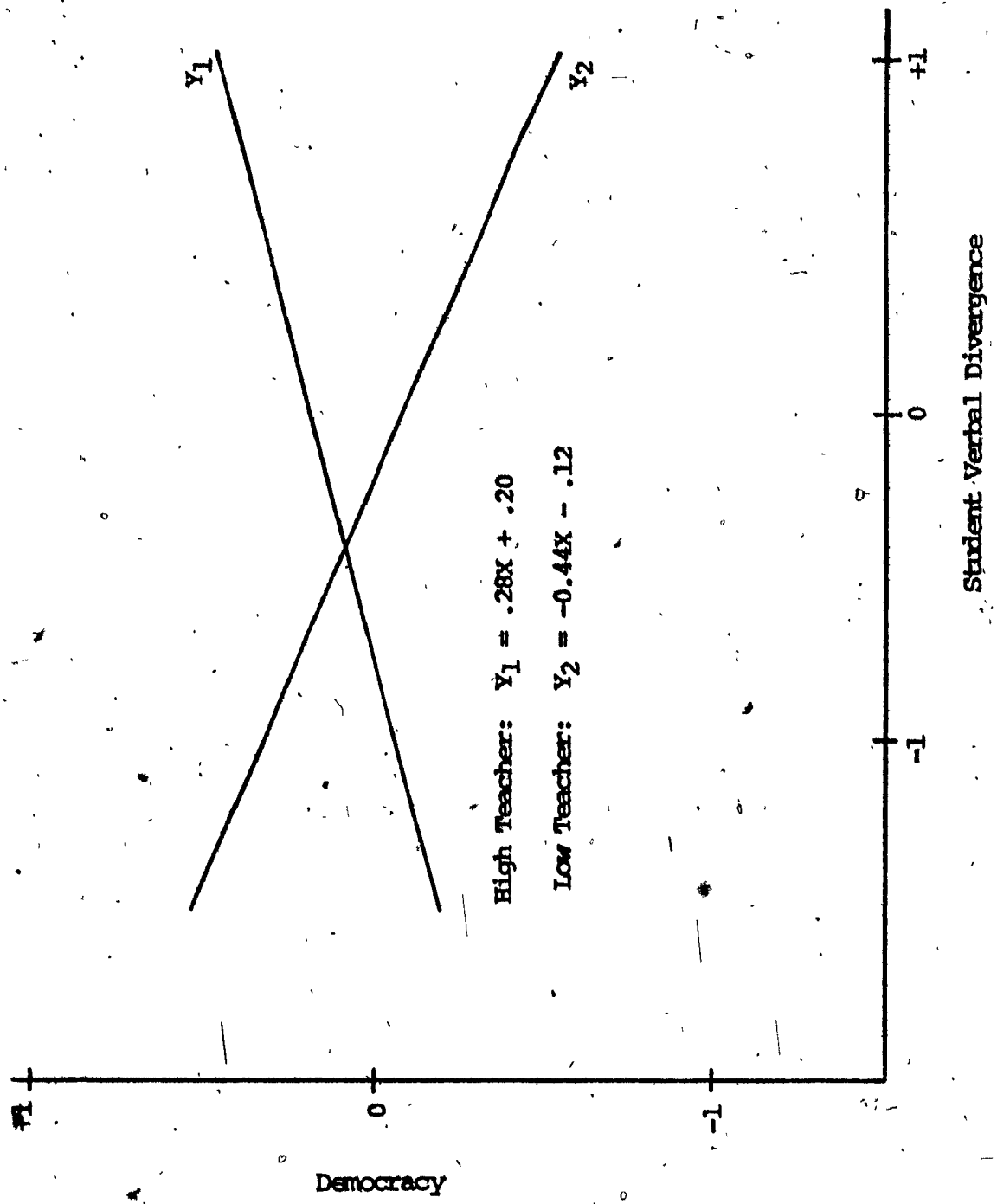
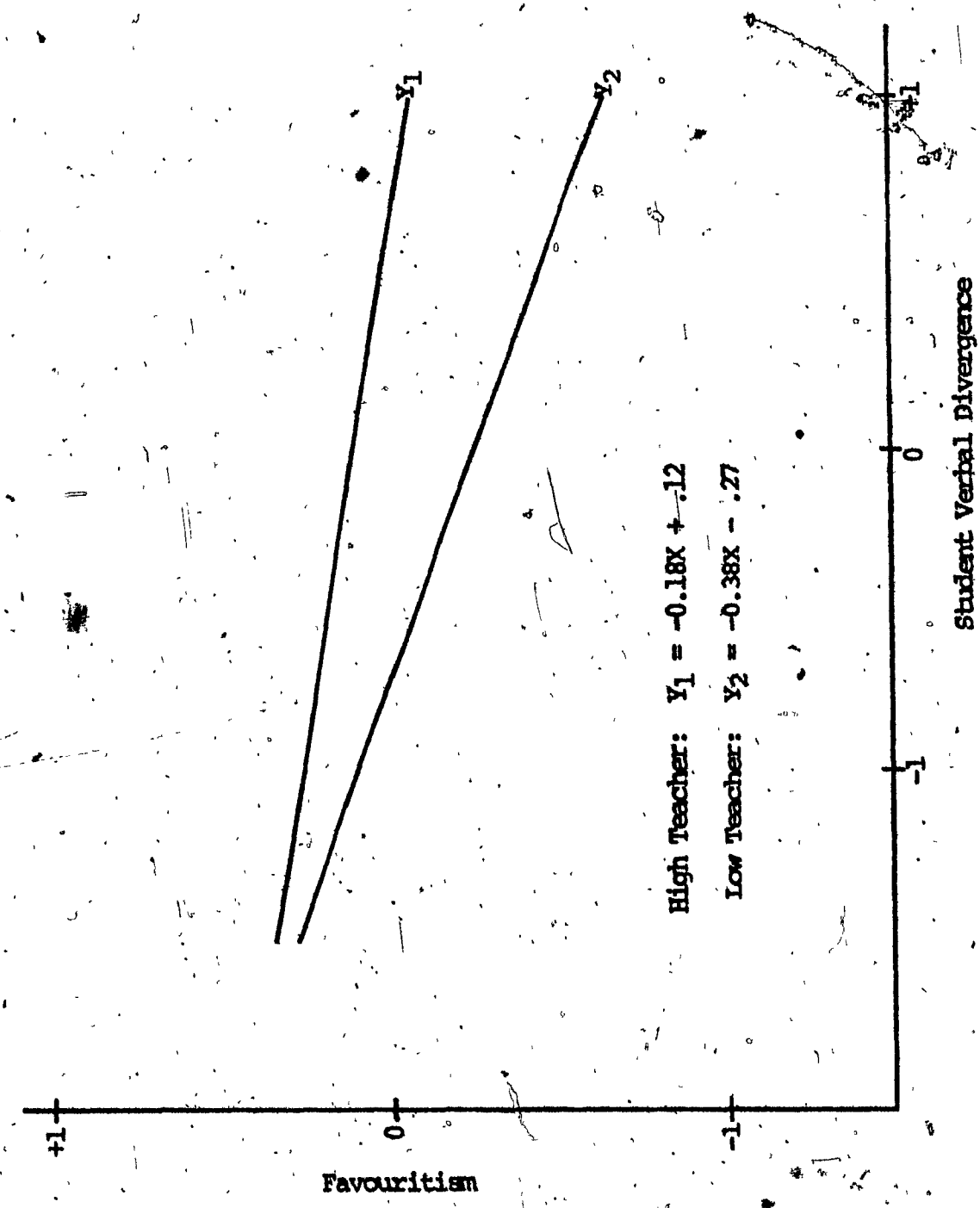


FIGURE 11

The Interaction of Student and Teacher Verbal Divergence in the Prediction of Favouritism



Favouritism was also significant but the intercept was -2.0, an extreme score which represented two standard deviations from the mean and a value far down the possible range of student divergent scores. This "ordinal" interaction although significant, was not interpreted since the point of interaction was almost outside the range of verbal divergent scores.

Returning once again to the first significant interaction, this case was the only example that student perceptions of classroom climate were an interactive function of student and teacher divergence. In only one other similar case, Competitiveness, did the predictors (convergent verbal ability) act together but, in that case the variables were additive. With Democracy, it was not the concomitant high or low values of the predictor variables which produced the significant relationship. Instead, the finding indicated that classes below the intersection perceived themselves as being democratic when taught by teachers who had similar low cognitive divergent strengths. On the other side of the intersection, the relatively high divergent classes perceived themselves as democratic when taught by high divergent teachers. As with the low divergers, these classes rated themselves as a function of similar cognitive abilities.

d) Class Size as a Mediator Variable

Only one of the fourteen Learning Environment Inventory scales was related to class size. In fact, Cohesiveness was both linearly and curvilinearly associated with size of class. What made this finding so important was the consistency of this result with previous studies. Both Walberg (1969a) and Anderson and Walberg (1971) observed the same

relationship with completely different groups of students of similar ages. As in the other two studies, classes tended to become less cohesive the larger they became. That is, students tended to be less aware of their fellow students, the larger the class size. Intuitively obvious, the persistent curvilinear nature of this variable added an interesting detail to the study of classroom size and behaviour.

In light of the between-class student behaviour data, one interpretation of these results might indicate that large classes do not allow students to get to know each other well. This might

INSERT TABLE 46 AND FIGURE 12 ABOUT HERE

subsequently encourage discipline problems thereby hampering teachers from encouraging student participation. Overall, the persistent need for teachers to discipline their students might lead them to prefer students from smaller classes which was a finding reported in an earlier section of this study.

e) Summary

As hypothesized, the between class variance was explained by an interaction term in two instances (Favouritism and Democracy). In

INSERT TABLE 47 ABOUT HERE

both of these cases the interaction was the product of teacher and student verbal divergent ability. In addition to the interaction terms, three dependent variables (Formality, Difficulty and Satisfaction) were predicted by teacher cognitive variables, one dependent variable (Difficulty) was predicted by a student variable and one other dependent variable (Competitiveness) was significantly predicted by a linear and additive combination of student and teacher convergent ability.

TABLE 46

CLASS SIZE AS A LINEAR AND QUADRATIC PREDICTOR OF CLASSROOM CLIMATE (LEI)

	LINEAR		QUADRATIC	
	r	F	R	F
Cohesiveness	.35	6.22*	.40	4.31*
Diversity	.07	0.25	.07	0.12
Formality	.10	0.45	.15	0.52
Speed	.12	0.63	.15	0.52
Friction	.16	1.23	.16	0.60
Goal Direction	.20	1.90	.22	1.15
Favouritism	.07	0.21	.24	1.38
Difficulty	.03	0.04	.05	0.05
Apathy	.09	0.38	.11	0.30
Democratic	.09	0.37	.13	0.40
Cliqueness	.04	0.06	.18	0.72
Satisfaction	.14	0.91	.14	0.46
Disorganization	.01	0.00	.03	0.02
Competitiveness	.00	0.00	.07	0.10
df =		1,46		2,45

FIGURE 12

The Relationship Between Cohesiveness and Class Size

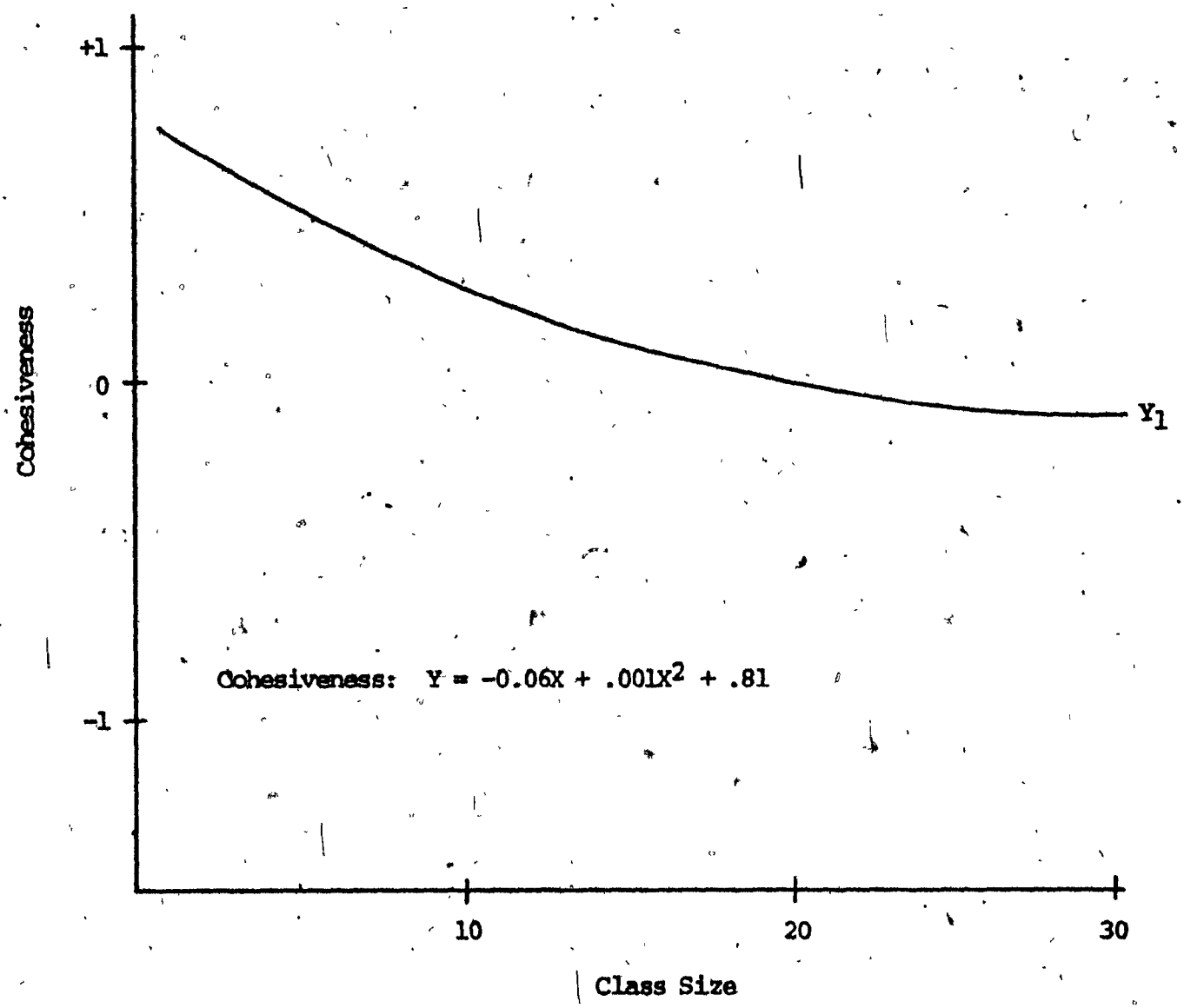


TABLE 47

SUMMARY TABLE OF THE SIGNIFICANT CORRELATIONS BETWEEN CLASSROOM CLIMATE AND THE PREDICTOR VARIABLES

	BETWEEN CLASS					WITHIN CLASS		CLASS SIZE	
	X_1	X_4	$X_2 + X_3$	$X_5 + X_6$	INTER-ACTIONS	X_1	$X_2 + X_3$	LINEAR	QUADRATIC
Cohesiveness									*
Diversity									
Formality				X_6^*		**	X_2^*		
Speed									
Friction						*	X_3^{**}		
Goal Direction									
Favouritism					*		X_3^{**}		
Difficulty	*								
Apathy									
Democratic					**	*	X_3^*		
Cliqueness							X_3^*		
Satisfaction		*					X_3^*		
Disorganization		*							
Competitiveness	*	*							

Note: *P < 0.05
**P < 0.01

where X_1 = student convergence

X_2 = student verbal divergence

X_3 = student figural divergence

X_4 = teacher convergence

X_5 = teacher verbal divergence

X_6 = teacher figural divergence

In contrast to the between class analyses, two of the within class scores were predicted by student convergence and divergence while four other dependent variables were predicted by student divergence alone. These results are not generalizeable to the between class situation although divergence may in fact be a critical variable in the within class situation.

Of these three dependent variables, the predictability of two of them (Participation and Interest) was significantly increased with the inclusion of student divergence and teacher divergence. In fact an inspection of the beta coefficients of these regression analyses yielded some interesting results (See Table 43). In both of these cases, student convergence was the predominantly important predictor while student figural divergence and teacher verbal divergence seemed to play equal but opposite roles. Apparently students participated more and showed greater interest in those classes of high verbal divergent teachers when their own figural divergent ability was not particularily high. At the same time, the addition of figural divergent ability significantly increased the prediction of student achievement.

This series of negative findings for the divergent variable presented a problem which will be dealt with in a later chapter.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

1- Summary

The major purpose of this study was to investigate the relationship of convergence and divergence and the effectiveness of these two variables in the prediction of academic achievement, student behaviour and classroom climate. In particular, the study focussed on the possible interactions between student and teacher related variables in the prediction of the dependent variables.

While there already exists a number of studies in these areas, findings have frequently been rendered suspect by inappropriate instruments, poorly controlled testing conditions, or inadequate research methodology. Unfortunately even this study will not permit definitive conclusions. What makes this task so difficult is the generally low correlation of some of the significant findings and the sometimes better prediction of the rival variables. Despite these limitations, the study provides a number of instructive and potentially useful findings.

There were five groups of hypotheses tested in this study. Convergent and divergent thinking abilities were tested for sex and grade differences as well as the relationship between the two variables. Subsequently, hypotheses were stated about the theory of divergent production and the relative importance of the two cognitive variables in the prediction of academic achievement, student behaviour, and classroom climate.

No sex differences were noted for both grade levels although the scores of divergent production and convergence were significantly higher for the grade 11 students. The lack of sex differences was important as many researchers have assumed that these differences exist and conduct their analyses with this supposition.

The relationship between convergence and divergence was not as simple as hypothesized. Three factors were derived from a principle component analysis of each grade level. Two divergent (verbal and figural) and one convergent factor emerged from the analysis, suggesting that divergence was not a unitary factor. The results of the initial principle component analysis indicated that two divergent scores be used in testing the subsequent analyses in this study. Consequently, a re-analysis of the original Wallach and Kogan data was undertaken, resulting in four factors which incidentally did not match those obtained in this study.

Mednick's Associative hypothesis was investigated by testing the mean originality of four successive responses and then examining the predicted slopes of originality productivity between high and low divergers. The results of both these analyses were different from those hypothesized although there was enough evidence to support the associative hypothesis. Of the eight divergent items used in this study, the change in originality of six of them was significant although the expected linear relationship was only found in three cases. A curvilinear relationship was found with the remaining three items, perhaps signifying a levelling-off effect of productivity.

The interaction between the scores of high and low divergers was tested and only one of the items interacted (item 3), indicating that the gradient interaction hypothesis was not supported.

All of the sixteen achievement scores were significantly predicted by the convergent measures although the correlations varied considerably. The addition of the two divergent scores significantly increased the predictability of the achievement score in seven cases, six with the grade 11 scores and once with the grade 10 score. Once again the increments varied and no definite pattern emerged to describe the type of subject matter which might be increased by divergence.

An analysis of convergence-divergence (verbal and figural) interactions produced only one significant interaction, Biology, and there was some evidence to suggest that these results were not reliable.

The considerations of Getzels & Thelen (1960) and Siegel & Siegel (1967) demonstrated that the classroom was a complex environment partially determined by students' and teachers' characteristics. Convergent and divergent scores of teachers and students were used in the prediction of student behaviour, within and in between classes, with the burden of proof placed on the newer cognitive variable (divergence).

In the within class analysis, the convergence scores significantly predicted all the classroom behaviours while in six instances divergence significantly added to the predictability of the dependent variables (Achievement, Participation, Interest, Originality, Preference, Attention). In spite of these statistically significant findings, the generally low correlations mean that the results have little practical value.

However, the between class analysis yielded more substantial correlations. Once again, Achievement, Participation, and Originality were predicted by student divergence and convergence while teacher

divergence predicted discipline problems (Discipline) and a preference for teaching a student a second time (Preference). Teacher divergence also increased the predictability of Participation and Interest.

Noting the importance of other intervening variables, an analysis was done using class size as a predictor; as might be expected, class size predicted Discipline and Preference in a linear manner and Participation was best predicted as a quadratic function of classroom size. As both convergence and class size predicted the same aspects of student behaviour, classroom size was partialed out of the convergent-student behaviour correlations yielding a new series of significant results.

Similar to the rationale used in establishing the analysis for student behaviour, the classroom climate variables derived from a series of studies by Anderson and Walberg were subjected to an identical series of analyses.

The divergent variables fared somewhat better in the within class analysis than with student behaviour as three classroom climate variables were predicted by divergence alone (Favouritism, Speed and Satisfaction) and three others (Formality, Friction and Democracy) benefited from the addition of the divergence scores to the convergence scores. With the between class analysis, divergence played a lesser role as only Formality was predicted by the teacher divergence scores. In the four other significant cases, student divergence predicted one variable (Difficulty), teacher convergence predicted two dependent variables (Satisfaction and Disorganization) and Competition was predicted by a linear addition of teacher and student convergence.

Two significant student-teacher interactions were noted, where in both cases, the optimum conditions were determined by the congruent interaction of student and teacher verbal divergence. High divergent students rated teachers also high on divergence as more democratic and demonstrating more favouritism while low divergers rated low divergent teachers high on the same dependent variables.

With regard to classroom size, only cohesiveness was significantly predicted by quadratic function of classroom size.

2- Discussion and Conclusions

The simple independence of convergence and divergence so often reported in other studies appears to be somewhat questionable. When testing conditions are similar, the cognitive variables do not separate as distinctly as Wallach and Kogan (1965) claimed. Using a principal component analysis of the convergent and fluency and mean original divergent test scores, it is apparent that convergence is independent of two divergent subtests, subsequently labelled verbal and figural. Curiously, they did not divide along a verbal/non-verbal factorial structure as Vernon (1973) had hypothesized although his projection may prove correct when a verbal convergent test is included in the test battery.

This finding was totally unexpected but ultimately a most useful one when it was discovered that figural divergence played such an important role in predicting both student behaviour and classroom climate. The use of two divergent measures may also have aided the study by accounting for a larger proportion of the variance than a

total score. This type of procedure possibly led to a higher number of significant results than would normally have been expected. While it has generally been accepted that divergence and convergence are complementary abilities it remains to be seen whether figural divergence will act independently of verbal divergence.

The issue however is more complicated since independence means that the two variables have nothing in common. To some extent, the interpretation of these results depends on one's orientation. Convergence and divergence are not the only two cognitive abilities which could have been chosen as predictors. Their inclusion was determined by previous research which has indicated their independence and the knowledge that the variables had, in the past, been good delimiters of certain types of behaviour.

With regard to the associative-productivity hypotheses, the results demonstrated a generalized gradient curve similar to Mednick's, although the interaction predicted by the Mednick model appeared only once and then only when the main effect was not significant. Since the stimulus items were not semantically neutral the results may have been confounded. As yet, no study has investigated the content-specificity of divergent test items and until this is examined, the actual effect of item ordering and stimulus meaning will continue to be a source of uncontrolled variance. Though interactions were not as prominent as predicted, one is left with the impression that original responses are rarely among the first elicited. Generally, the most original response is the last of a series of more and more original responses.

The respondent, using some sort of subjective evaluation system, apparently ceases to respond when some unspecified level of originality

has been reached. Perhaps, by encouraging him to respond more often and at the same time changing his self-evaluation system, the subject can be lead to produce even more original responses.

Whether increased creativity would be the final outcome of this exercise is a much more complicated issue. Originality, the statistical infrequency of a given response, is a far easier concept to understand and quantify than creativity. Realistically, creativity must meet this originality criterion and additionally others which are culturally based and time specific, thus making it more difficult to define and measure.

Though Wallach and Kogan (1965) may have misnamed their tests as "creativity measures" they were quite right in insisting that the tests should be administered without a time limit. To produce the most original responses respondents should be given sufficient time in which to reach their "own" level of originality. Tests which use timed conditions may cut off the most potentially original responses, thereby seriously threatening the validity and usefulness of the tests.

In agreement with most previous work, this study found that divergent and convergent abilities are often good predictors of classroom achievement. As Cicerelli (1965) previously demonstrated, the results generally imply additivity and linearity instead of interactions. While the results tend to contradict those of Maslany (1973) who found divergence to have limited usefulness for prediction, it should be kept in mind that his study was longitudinal, thereby introducing a myriad of intervening variables. However, both these studies support the present findings that convergence is the more important factor, with divergence playing a secondary and at times unimportant role.

Nevertheless, the rival predictors, past performance and teacher predictions, were in each case a better predictor of student achievement than the cognitive variables. While Cronbach (1970) has previously reported that teacher predictions were poor predictors of standardized tests, the teachers in this study were able to estimate student achievement relatively well. The difference in these two findings can possibly be attributed to the type of outcome variables used. In the Cronbach study, the dependent variable was less school specific and, therefore, less contingent upon teacher intervention. Accordingly, the difference between the Cronbach findings and those reported in this study may in part be explained by teacher expectations. Evidence for this contention is provided by the high correlation between teacher predictions and verbal French speaking skills which were scored by the same teachers who predicted the scores. All the other dependent variables yielded lower correlations and were measured by objectively scored written exams.

The potentially most interesting aspect of the study, that of predicting student behaviour and classroom climate, yielded a variety of results which ultimately make interpretation difficult. Clearly, it was demonstrated that using individuals as the basic unit of analysis leaves such a substantial amount of the variance unexplained that results, even those that are statistically significant, are meaningless from a practical point of view. Quite simply, it appears that an individual's performance is too complex to be explained fully by a small number of simple cognitive tasks. In spite of the low rate of return in terms of significant and potentially applicable findings this line of exploration promises to continue.

Fortunately the unit of analysis most likely to be manipulated in the real life situation is the same one which yielded the highest multiple correlations. The between class results were provocative and potentially useful. One such example was the student behaviour finding where teacher cognitive ability explained a significant part of the variance attributed to students' participation in class. This finding is important as it points to the relative importance of the teacher in student behaviour. If results such as these can be replicated, the perception of teachers primarily as disseminators of knowledge may be less defensible. The evidence is quite clear that teachers may have another and potentially more direct influence on students although the causality of the relationship has yet to be determined.

The few number of hypothesized significant interactions represent an interpretative dilemma. Since the 0.05 level of significance was used as the standard for rejecting the null hypothesis, the results may mean that possibly some of the interaction hypotheses would have been rejected by chance alone. Thus two interactions do not represent a significant departure from chance.

Alternatively, it could be argued that since both the classroom climate (LEI) and the student behaviour (TRF) measures are independent of each other, the two significant interactions would legitimately explain the appropriate behaviour. Unfortunately, such an argument only applies when the dependent variables have been tested in a number of situations under different conditions. As this was not the case in this study, one must be cautious of the significant findings, particularily those involving large samples and correlational analysis.

As a result, it must be concluded that the important hypotheses involving the interaction of consonant teacher and student cognitive abilities have not been demonstrated.

This is indeed unfortunate as it seemed plausible that the findings of Feather (1972) and Majasan (1972) could have been extended to include cognitive skills instead of values and attitudes. In a sense, an attempt was made to redefine Heider's (1958) and later Newcomb's (1961) theory of interpersonal attraction where they demonstrated that persons with similar orientations (attitudes) are attracted to each other. In the case of this study, Newcomb's theory would have predicted that as teachers began to interact with their students and thus gain information about them, the bonds of attraction making up the effect of the structure would form more strongly between those who held similar attitudes towards objects of common relevance. In this study, cognitive variables were substituted for attitudes in an effort to explain the interaction between teachers and students. Unfortunately, this way, teachers of similar cognitive strengths were predicted to conduct more positively rated classes by those students of like cognitive ability. The results do not seem to support the contention and it must be assumed that the cognitive abilities do not function in a way similar to attitudes or values.

Although the two cognitive variables were statistically independent, the results do not indicate that they have separate and equal importance. In each of the major analyses performed in this study, the convergent variable was easily the more important, although, at times, divergence was the more powerful predictor (Formality). Cronbach's warning, when he reexamined the original Wallach and Kogan data that, "My final impression is that the F (Divergent) variable has disappointingly limited psychological significance", has an ominous ring. (Cronbach, 1968).

Divergence is an interesting variable although it seems to have little to do with creativity or success in so-called creative activities (Maslany, 1973; Kogan and Pankove, 1974). Its strength lies in its independence from convergence and hence its ability to account for more of the predictor variance. Conceptually, therefore, it is somewhat of a failure, although in practical terms, it is at times quite useful.

Perhaps the best way of explaining divergence and convergence is that they are two cognitive abilities, requiring different response modes, one of which more accurately predicts student activities than the other. While it is seems most appropriate to expect great things from divergence, its tentative relationship with achievement, classroom climate and student behaviour makes it a most difficult variable to understand.

3- Recommendations for Further Research

Any study of this scope needs to be replicated in order to test the reliability and the generalizability of its results. This is expecially important when no comparable findings are available.

Should further studies of this type be carried out two procedural changes might be made. As the results of this study suggest the importance of item ordering for divergent tests, the divergent test items should be randomized to eliminate the ordering effect. Also, due to scheduling problems, a verbal type of convergent measure was not included as part of the testing program. As divergent items are both verbal and non-verbal (figural) it would be wise to include a verbal

convergent measure to complement the non-verbal Raven Progressive Matrices. The Remote Associates Test (RAT), which was once proposed to be a measure of creativity, might be suitable as it is entirely verbal and loads heavily on convergent factors (Mednick, 1962).

From a analytical point of view, further analyses of the type carried out in this study might be applied using cognitive bias instead of the actual cognitive abilities as the predictor variables. As Hudson (1966) has noted, the relative cognitive strength of students, measured by the difference between the standardized convergent and total divergent scores, is a good predictor of academic specialization at the secondary level. Perhaps the bias of student and teacher might also serve as useful predictors of the dependent variables.

The residuals, particularly those of the between class regressions, might also be studied. A cursory inspection of the residuals was carried out yielding no apparent consistent deviation of those classes which were more than one standard deviation from the mean values. However, a more systematic approach is warranted along the lines suggested by Daniel and Wood (1971).

Finally, the total data base could be subjected to a path analysis as outlined by Duncan (1966). Without exploring the theoretical or analytical considerations in too much detail the data in this study conveniently lends itself to path analysis.

Although the path coefficients turn out to be standardized partial regression coefficients obtained in an ordinary regression analysis, there is an important difference between the two approaches.

In regression analysis, a dependent variable is regressed on all the independent variables in a single analysis. In path analysis, more than one regression may by called for. At each stage in the analysis, a variable taken to be dependent is regressed on the variable upon which it is assumed to depend. This process is continued until all of the paths have been considered.

One possible causal model might be set up so that academic achievement is regressed on student behaviour, classroom climate, and teacher and student cognitive abilities. In order to calculate the

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INSERT FIGURE 13 ABOUT HERE

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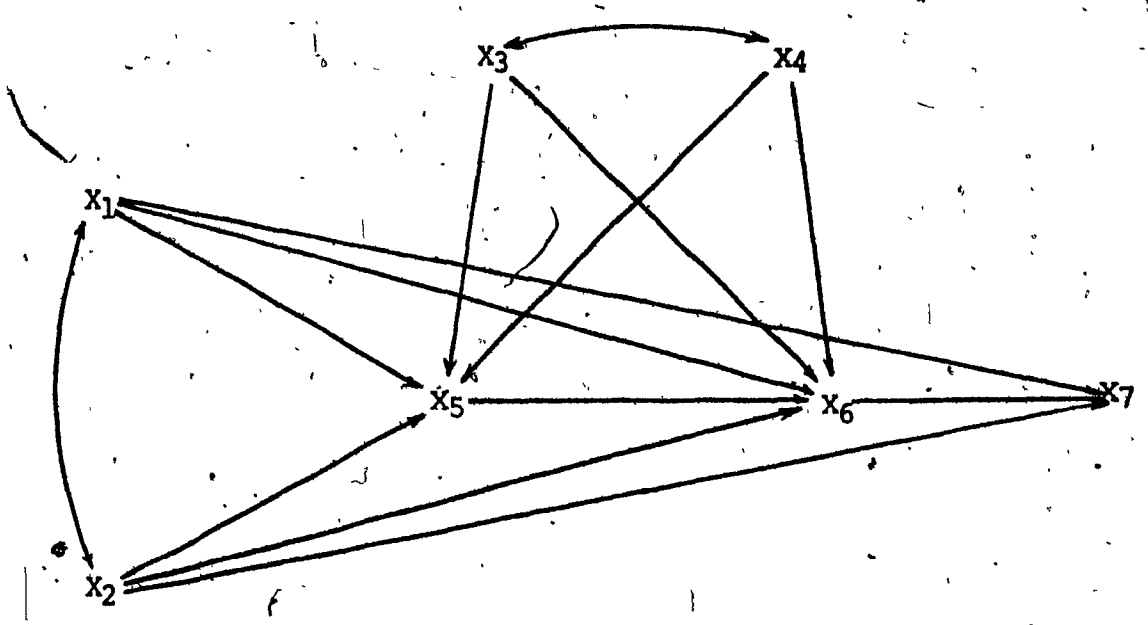
path coefficients for the causal model depicted below, three regression analyses are necessary.

FIGURE 13

Causal Model of Student Achievement



where X_1 = student convergence

X_2 = student divergence

X_3 = teacher convergence

X_4 = teacher divergence

X_5 = student behaviour (TRF)

X_6 = classroom climate (LEI)

X_7 = student achievement

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APPENDIX A

NAME _____ TEACHER _____ SUBJECT_____ BLOCK____

OPEN-ENDED QUESTIONS

There are no right answers to these questions, except that answers that seem totally inappropriate will not be counted. However, a tremendous number of responses are possible. You are asked to write as many responses as you can. I am interested in both the quality and quantity of responses, so if you are in doubt about a particular response, by all means put it down.

There are no limits on this section. Work on these items until you have exhausted your ability to give relevant responses. Come back to it later if you like. If you run out of space on the page, use the back.

A-2

SECTION I: USES OF OBJECTS

Write down all the uses you can think of for a:

*A. Newspaper.

B. Knife.

*C. Brick.

D. Barrel.

E. Paper Clip.

F. Tin Can.

SECTION II: SIMILARITIES

Write down all the ways you can think of in which the following pairs of objects are similar to each other.

A. Potato and Carrot.

*B. Cat and Mouse.

C. Train and Tractor.

D. Milk and Meat.

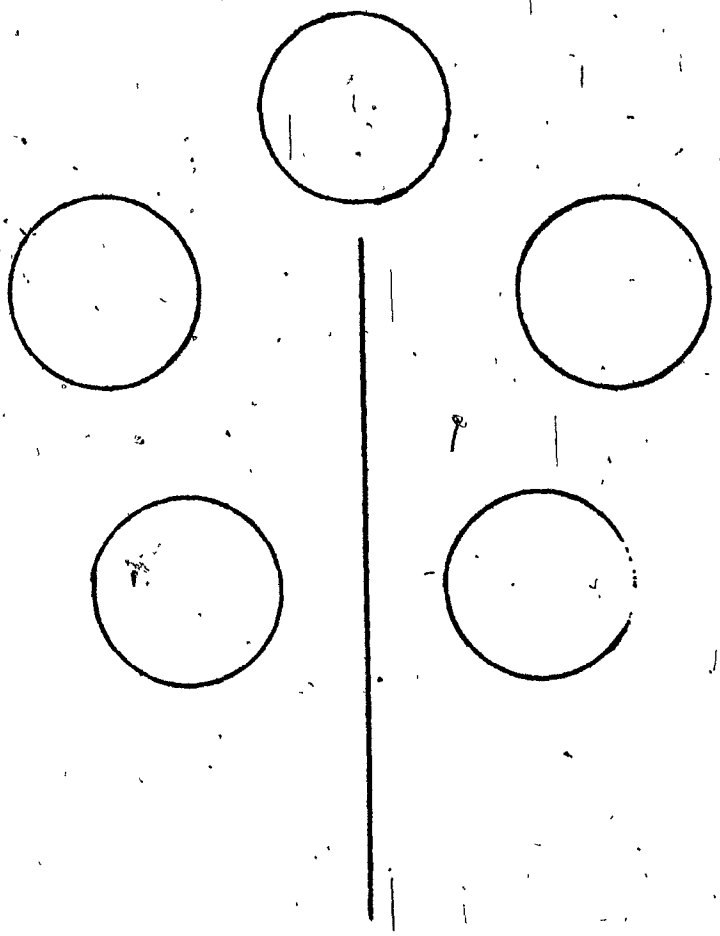
*E. Grocery Store and Restaurant.

F. Violin and Piano.

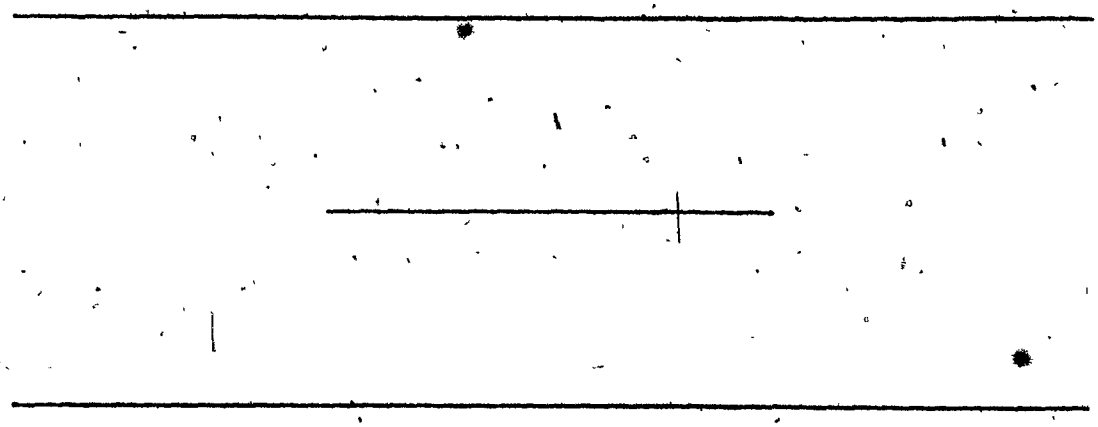
SECTION III: PATTERN MEANINGS

Given a particular pattern, list all the possible things that it could be. There are eight such drawings. For example, pattern "A" below could be a bursting bomb, arrows heading toward a target, and an eskimo with a parka hood.

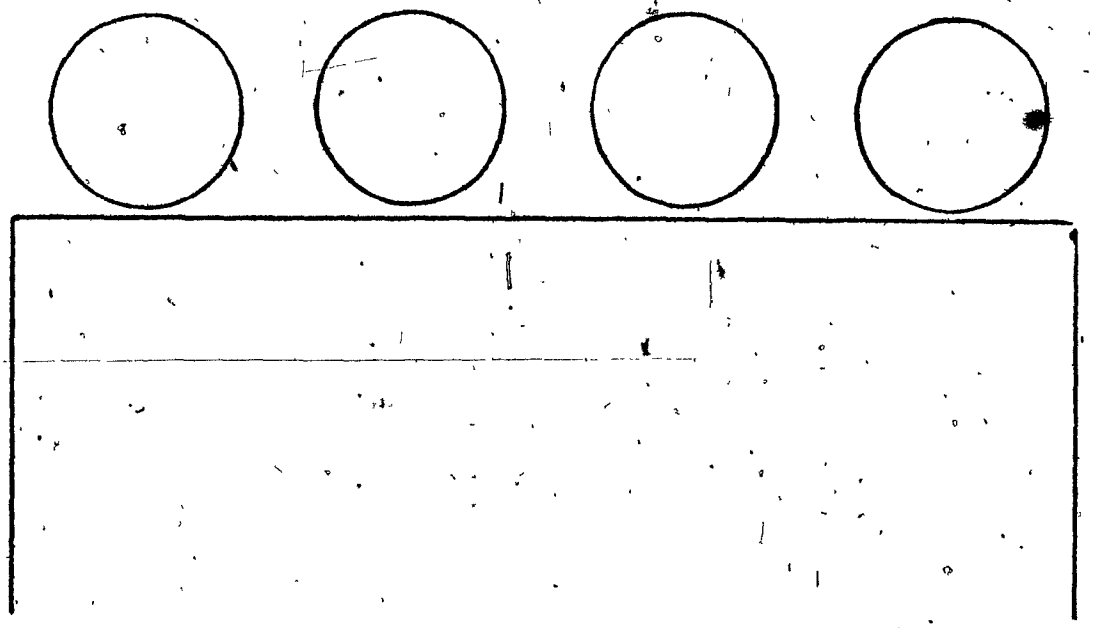
A.—This pattern could be:



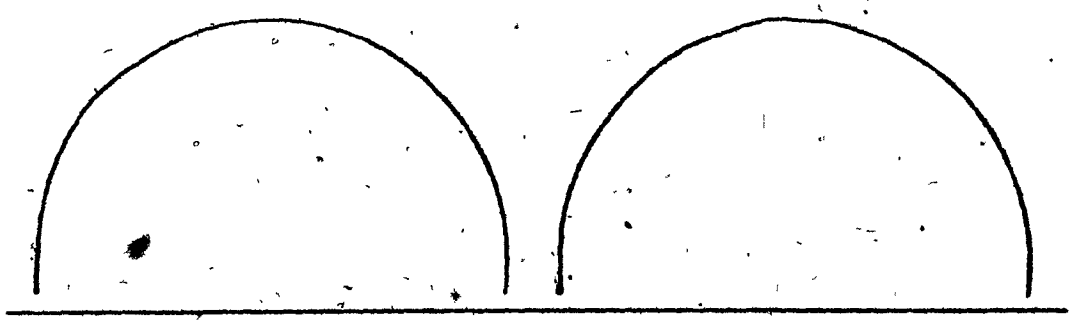
B. This pattern could be:



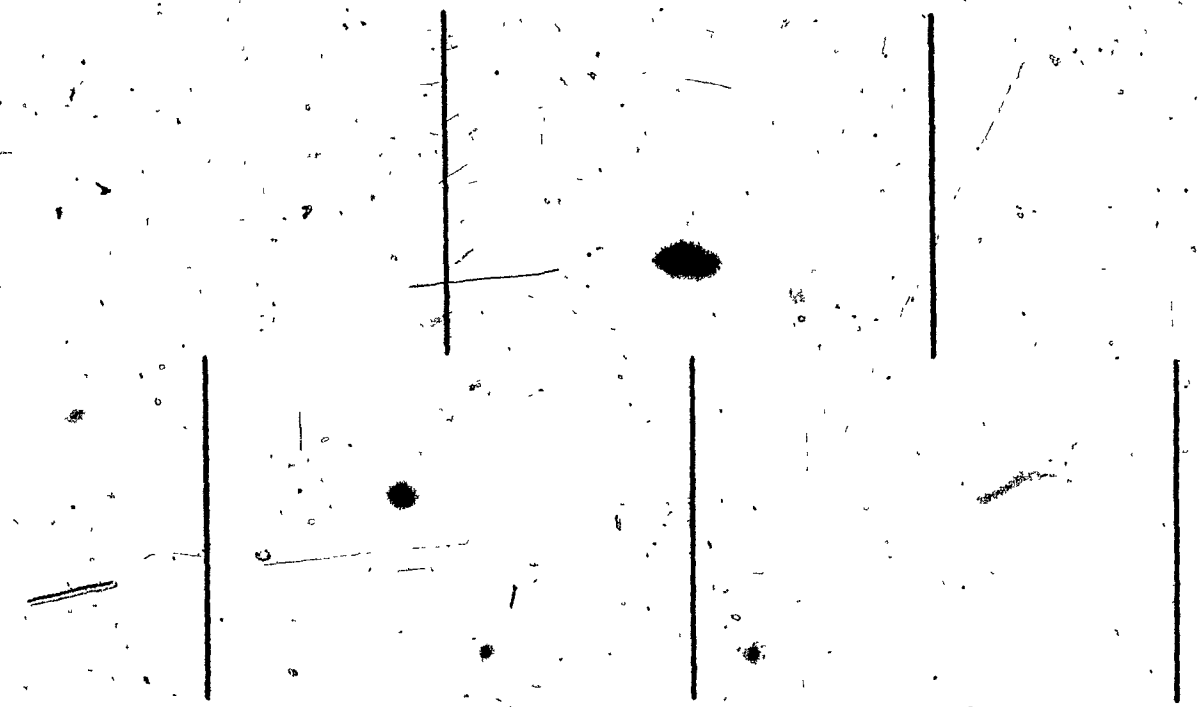
*C. This pattern could be:



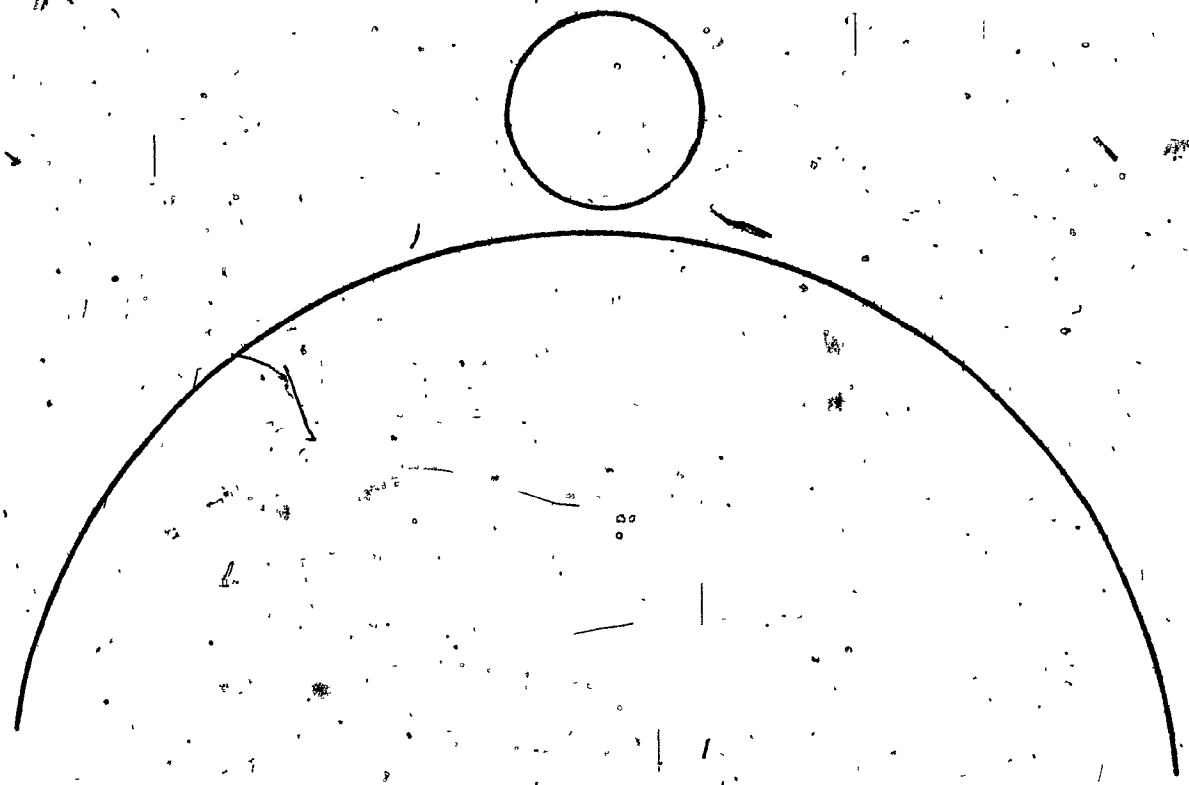
D. This pattern could be:



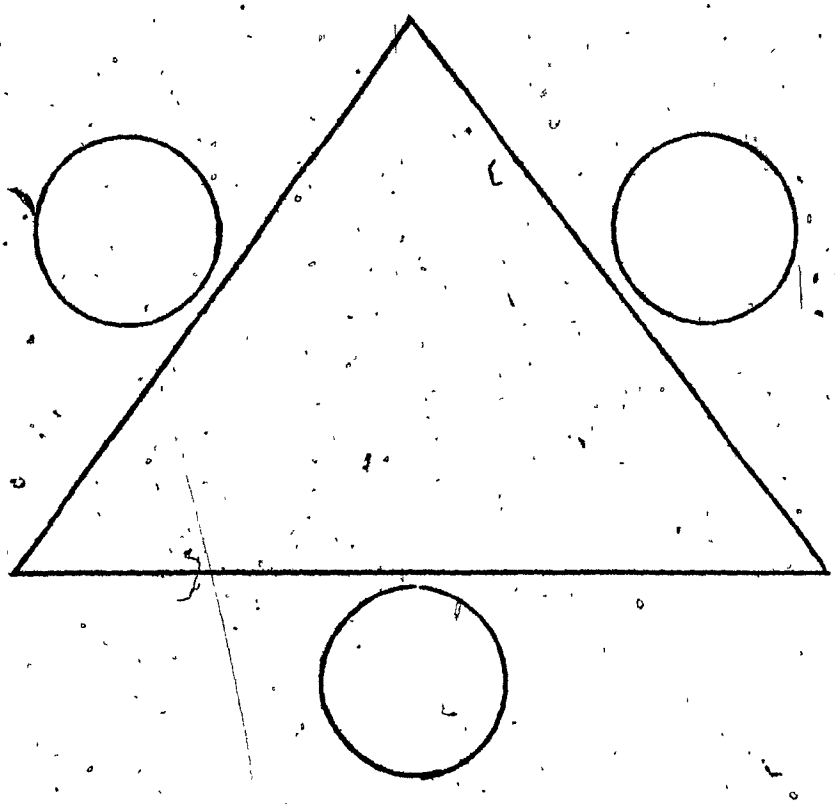
*E. This pattern could be:



F. This pattern could be:



G. This pattern could be:

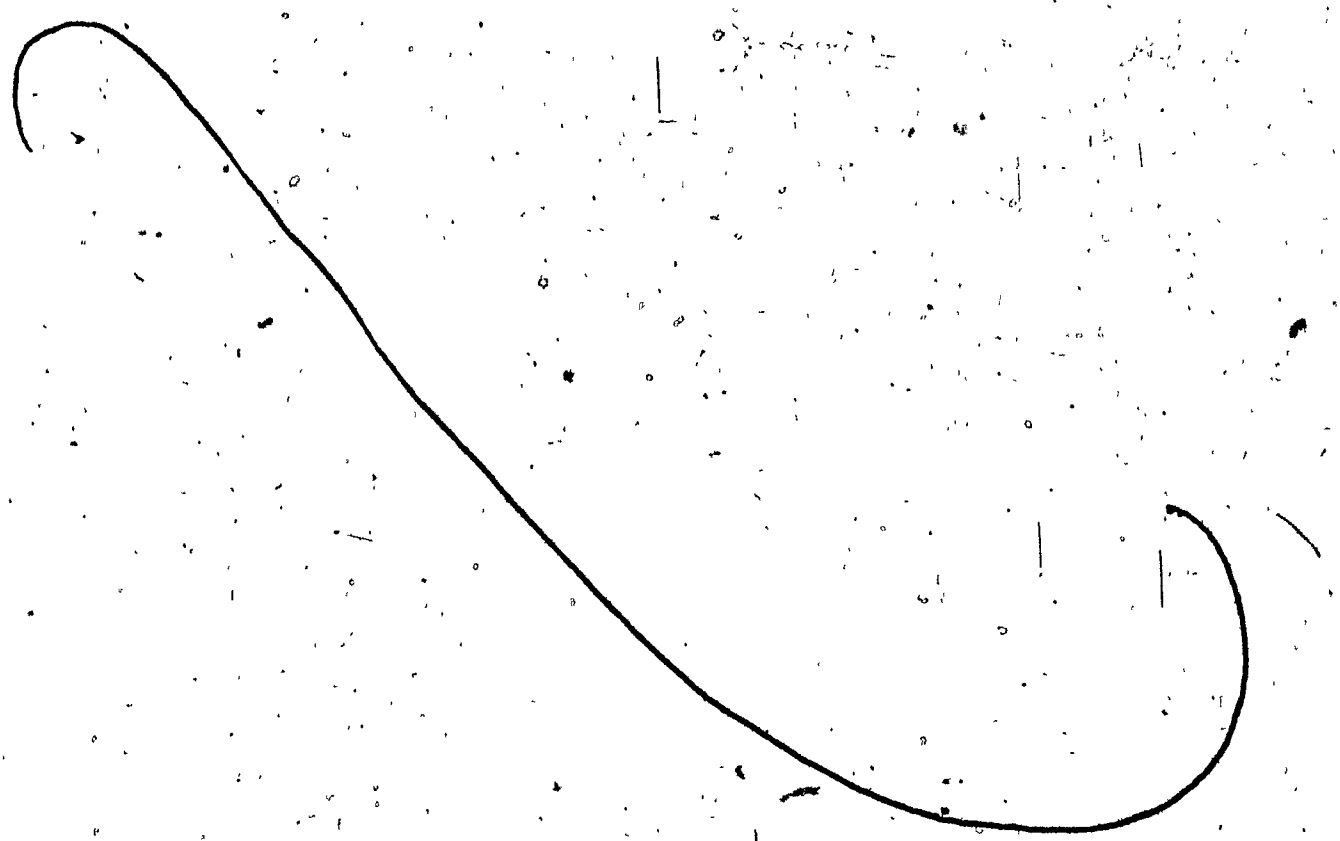


H. This pattern could be:

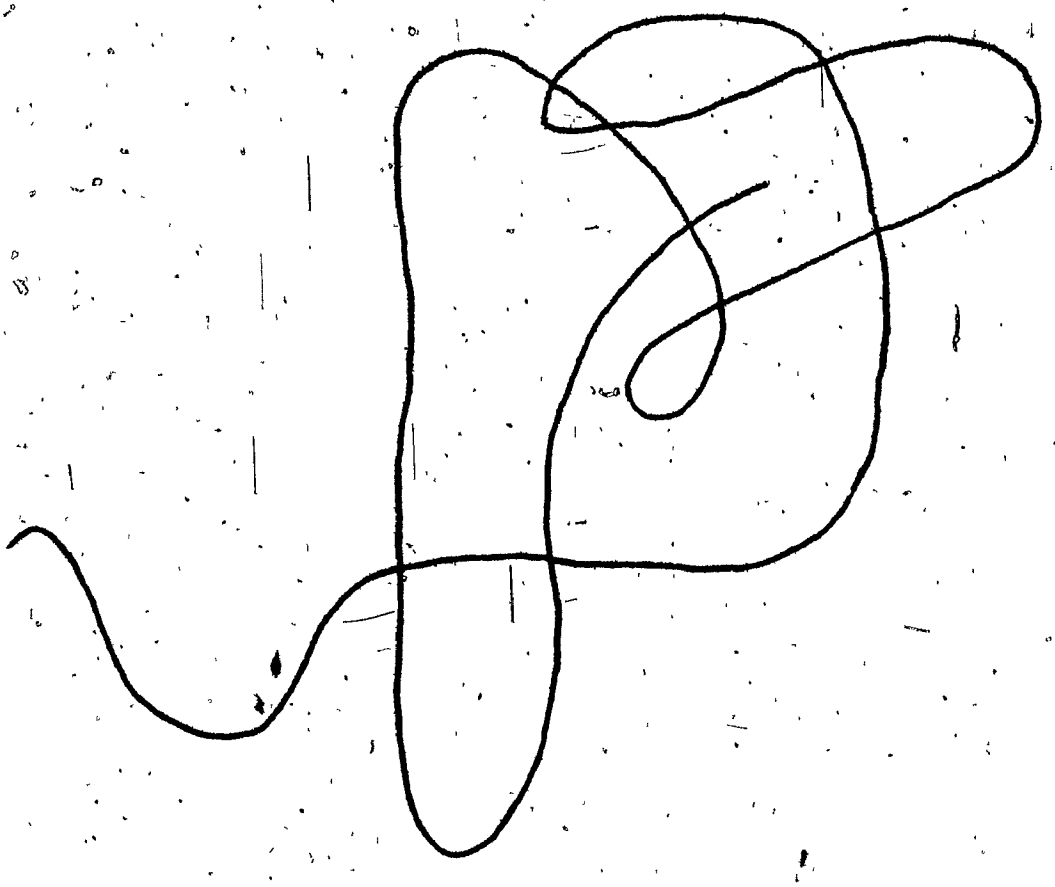
SECTION IV: LINE MEANINGS

This section is similar to the previous one, except that in this case you are dealing with lines rather than patterns. Again, list all the things that the line might be. For example, the first one "A" could be the profile of a man with a long nose facing up.

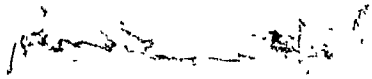
A. This line could be:

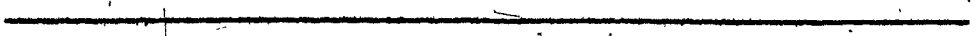


*B. This line could be:



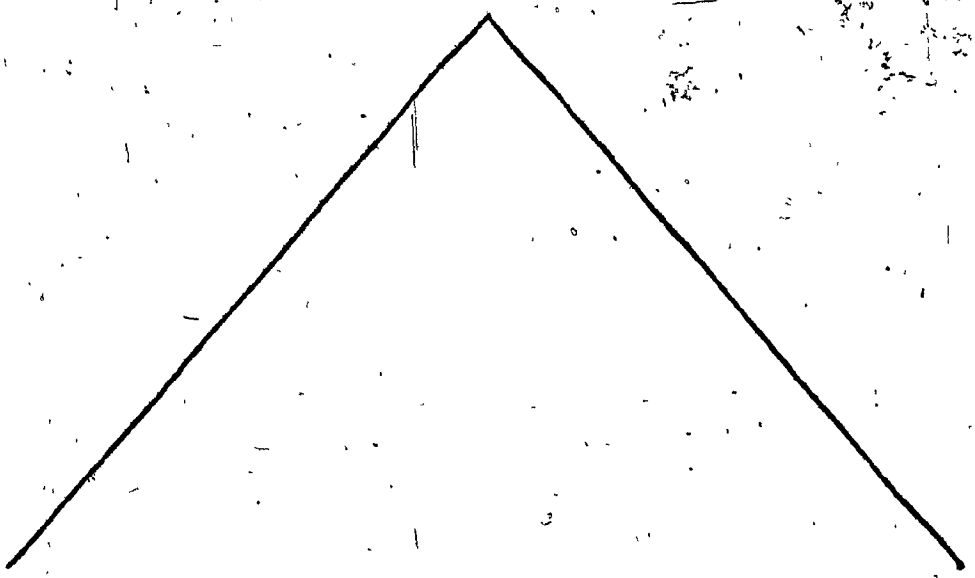
C. This line could be:



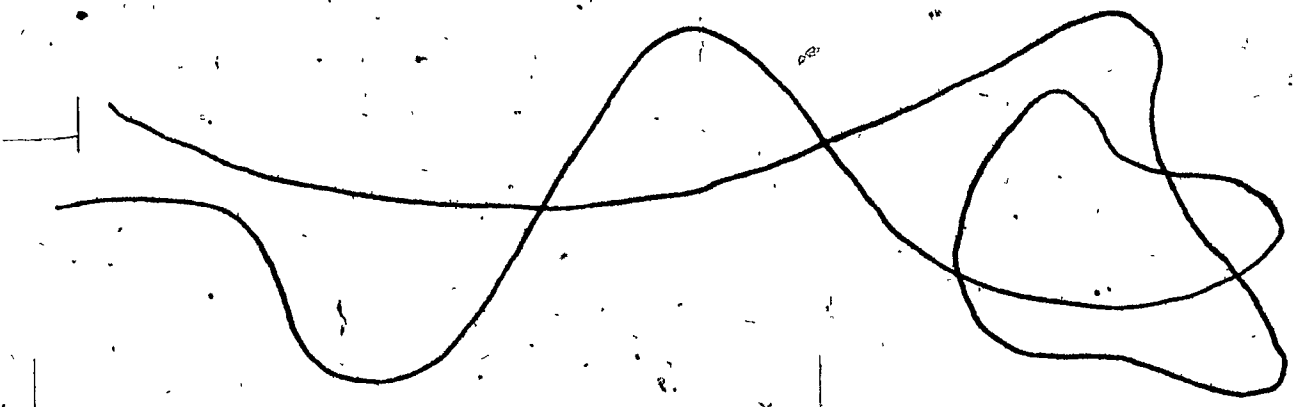


D. This line could be:

*E. This line could be:



F. This line could be:



G. This line could be:

APPENDIX B

Student Evaluation Form

Name of Student _____ Date _____

Course _____ Block _____ Teacher _____

1. Attention

1	2	3	4	5	6	7
very easily distracted			pays attention most of the time			gets absorbed in lesson/task

2. Achievement

1	2	3	4	5	6	7
A low achiever			an average achiever			always a high achiever

3. Praise

1	2	3	4	5	6	7
very often seeks praise or encouragement			seeks some praise or encouragement			self-assured - seeks minimum encouragement

4. Discipline

1	2	3	4	5	6	7
is very difficult to control			causes problems only occasionally			always does what he is told

5. Participation in Class

1	2	3	4	5	6	7
does not generally volunteer answers to questions						frequently volunteers

6. Interest in Learning

1	2	3	4	5	6	7
very little enthusiasm						usually very high enthusiasm about learning

7. Originality

1	2	3	4	5	6	7
completely unoriginal						outstandingly original

8. Independence

1	2	3	4	5	6	7
requires constant supervision						works best by himself

9. If given a choice, I would

1	2	3	4	5	6	7
prefer not to have this student in my class			indifferent			enjoy having this student in my class very much

10. Attendance

1	2	3	4	5	6	7
rarely in class						always in class

11. Are you aware of this student's standardized test scores?

Yes _____ No _____

Comments:

APPENDIX C

LEARNING ENVIRONMENT INVENTORY

DIRECTIONS

The purpose of the questions in this booklet is to find out what your class is like. This is not a "test". You are asked to give your honest, frank opinions about the class which you are now attending.

Record your answer to each of the questions on the answer sheet provided. Please make no mards on the booklet itself. Answer every question.

In answering each question go through the following steps:

1. Read the statement carefully.
2. Think about how well the statement describes your class (the one you are now in).
3. Find the number on the answer sheet that corresponds to the statement you are considering.
4. Write a number on the answer sheet according to the following instructions:

   If you strongly disagree with the statement, write a 1.
   If you disagree with the statement, write a 2.
   If you agree with the statement, write a 3.
   If you strongly agree with the statement, write a 4.

5. You will have approximately 40 minutes to complete the 42 questions in the booklet. Be sure the number on the answer sheet corresponds to the number of the statement being answered in the booklet.

		Strongly disagree	Disagree	Agree	Strongly agree
1.	There are long periods during which the class does nothing.	1	2	3	4
2.	The class has students with many different interests.	1	2	3	4
3.	The students enjoy their class work.	1	2	3	4
4.	Interests vary greatly within the group.	1	2	3	4
5.	The work of the class is difficult.	1	2	3	4
6.	A student has the chance to get to know all other students in the class.	1	2	3	4
7.	Students cooperate equally with all class members.	1	2	3	4
8.	The better students are granted special privileges.	1	2	3	4
9.	Only the good students are given special projects.	1	2	3	4
10.	Certain students have no respect for other students.	1	2	3	4
11.	Some students are interested in completely different things than other students.	1	2	3	4
12.	Certain students have more influence on the class than others.	1	2	3	4
13.	The class is disorganized.	1	2	3	4
14.	Students compete to see who can do the best work.	1	2	3	4
15.	The class is well-organized and efficient.	1	2	3	4

	Strongly disagree	Disagree	Agree	Strongly agree
16. Students are asked to follow strict rules.	1	2	3	4
17. Students don't care about the future of the class as a group.	1	2	3	4
18. Each member of the class has as much influence as any other member.	1	2	3	4
19. All students know each other very well.	1	2	3	4
20. The class is rather informal and few rules are imposed.	1	2	3	4
21. After the class, the students have a sense of satisfaction.	1	2	3	4
22. Each student knows the goals of the course.	1	2	3	4
23. Certain students in the class are responsible for petty quarrels.	1	2	3	4
24. The class is made up of individuals who do not know each other well.	1	2	3	4
25. The class has plenty of time to cover the prescribed amount of work.	1	2	3	4
26. Students do not have to hurry to finish their work.	1	2	3	4
27. Certain groups of friends tend to sit together.	1	2	3	4
28. There is much competition in the class.	1	2	3	4
29. The subject presentation is too elementary for many students.	1	2	3	4

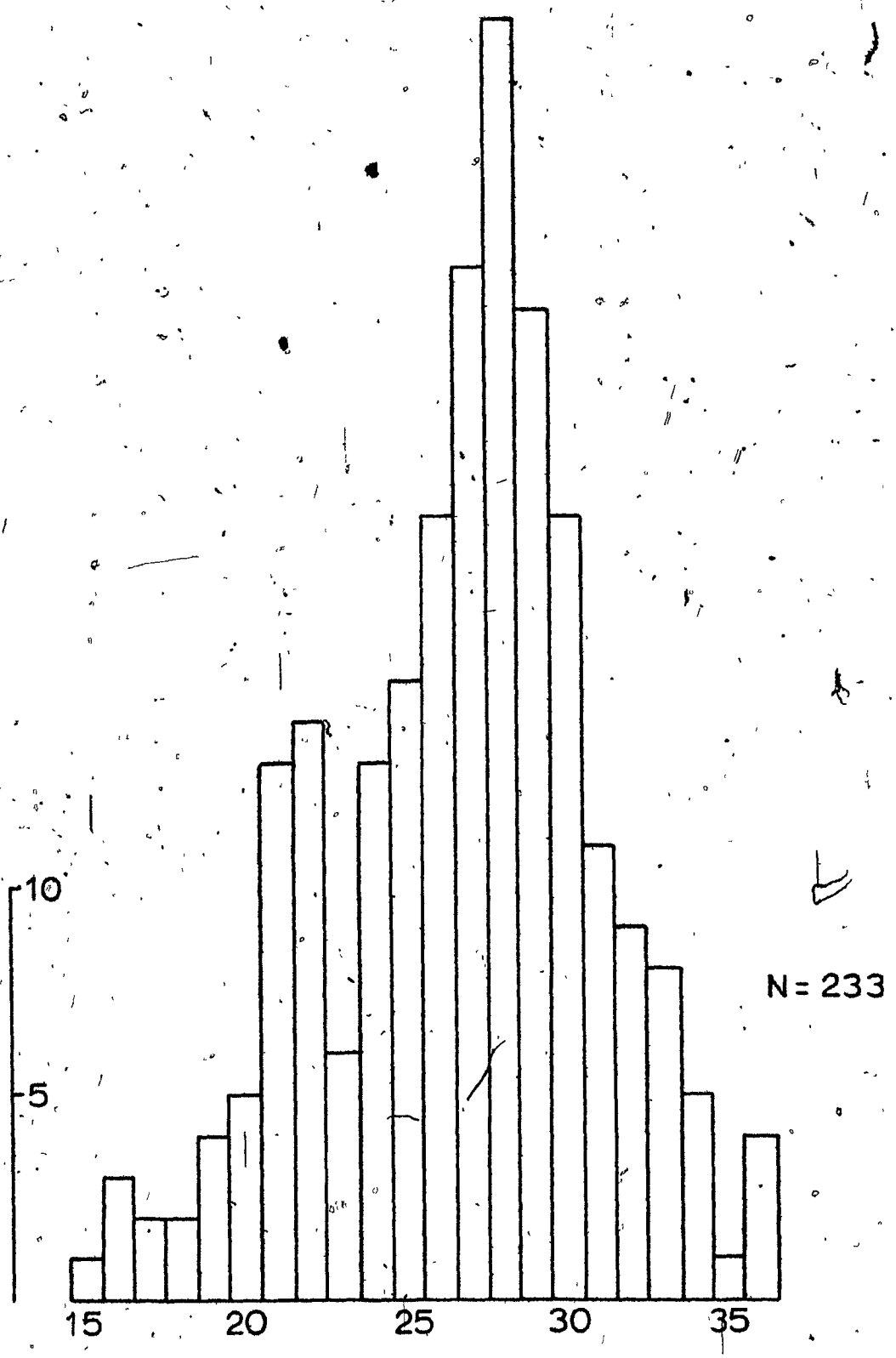
		Strongly disagree	Disagree	Agree	Strongly agree
30.	Students are well-satisfied with the work of the class.	1	2	3	4
31.	A few members of the class have much greater influence than other members.	1	2	3	4
32.	There is a set of rules for the students to follow.	1	2	3	4
33.	The class realizes exactly how much work it has to do.	1	2	3	4
34.	Students share a common concern for the success of the class.	1	2	3	4
35.	The class members feel rushed to finish their work.	1	2	3	4
36.	Certain students are considered uncooperative.	1	2	3	4
37.	Failure of the class would mean nothing to most members.	1	2	3	4
38.	Certain students are favoured more than the rest.	1	2	3	4
39.	Each student in the class has a clear idea of the class goals.	1	2	3	4
40.	Certain students stick together in small groups.	1	2	3	4
41.	Most students consider the subject-matter easy.	1	2	3	4
42.	Students seldom compete with one another.	1	2	3	4

Scales of the LEI and Corresponding Items

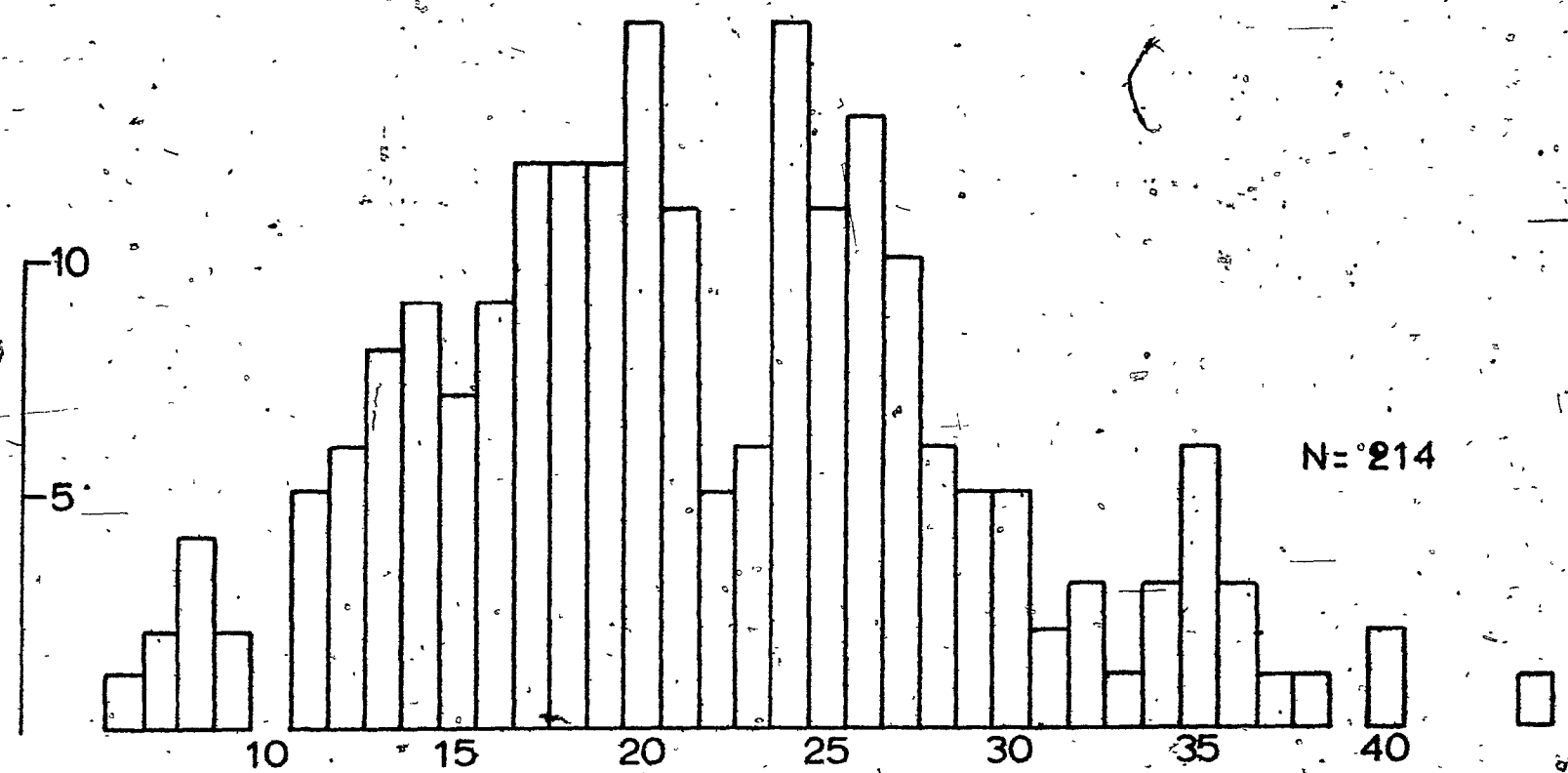
Cohesiveness	6	19	24R
Diversity	2	4	11
Formality	16	20R	32
Speed	25R	26R	35
Friction	10	23	36
Goal Direction	22	33	39
Favouritism	8	9	38
Difficulty	5	29R	41R
Apathy	17	34R	37
Democracy	12R	18	31R
Cliqueness	7R	27	40
Satisfaction	3	21	30
Disorganization	1	13	15R
Competitiveness	14	28	42R

APPENDIX D

Frequency Distribution of Convergent Test Scores for the Grade 10 Sample.

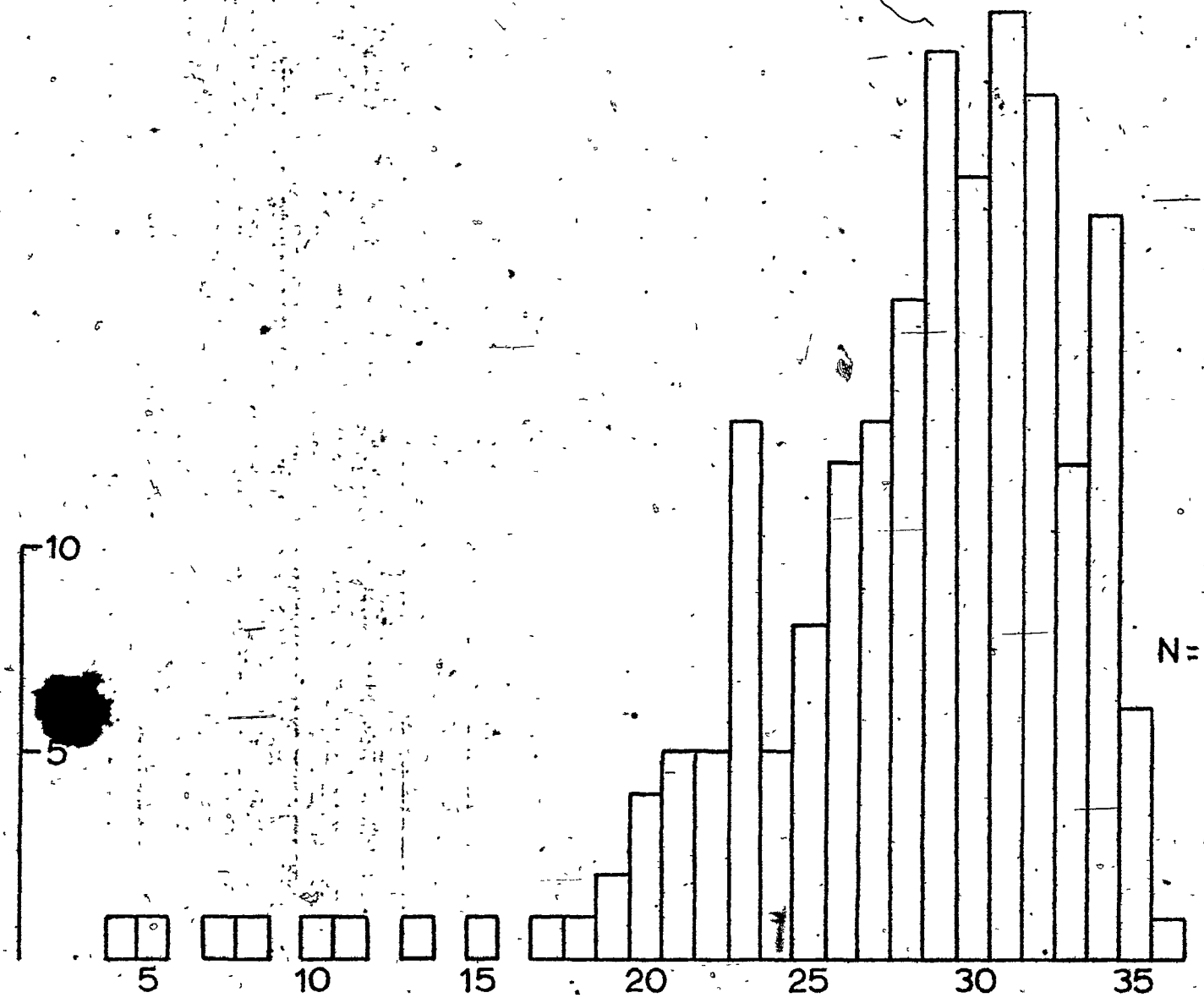


Frequency Distribution of Divergent Fluency Test Scores for the Grade 10 Sample

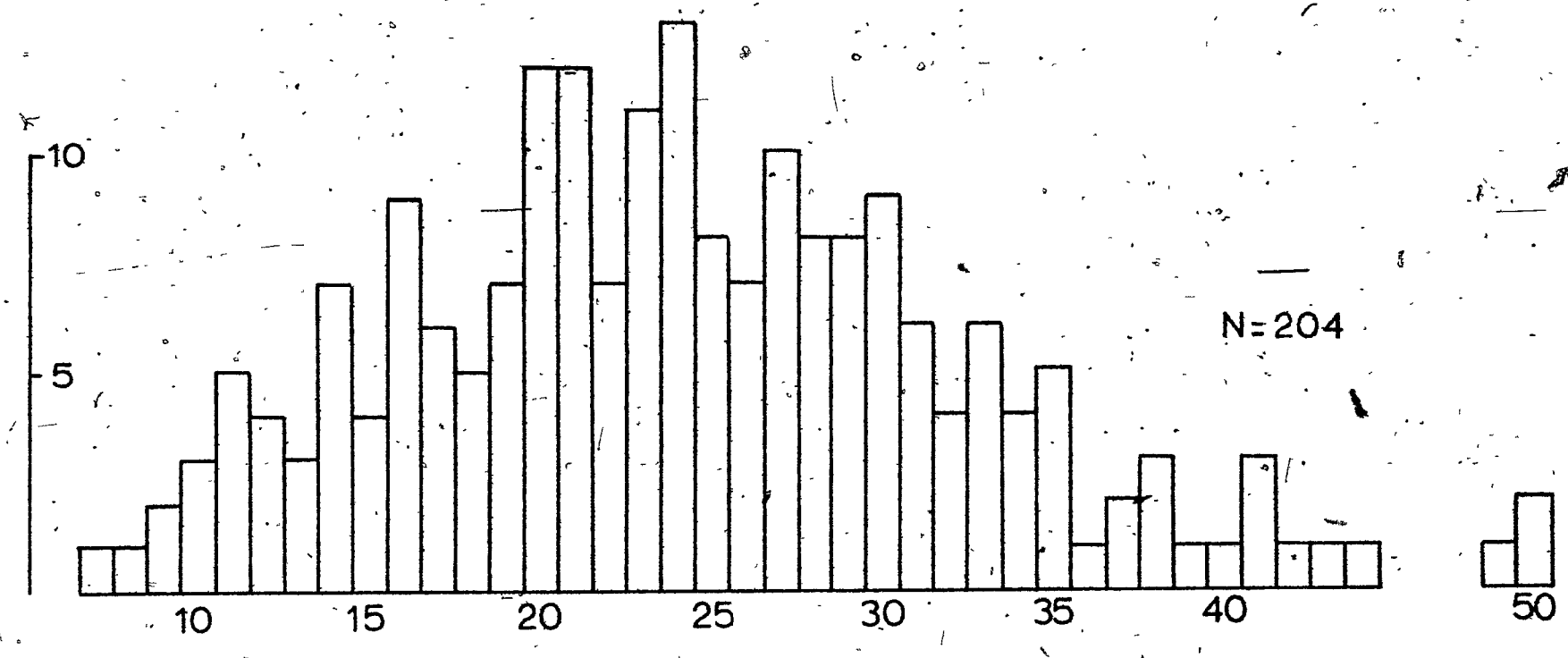


Frequency Distribution of Convergent Test Scores

for the Grade 11 Sample



Frequency Distribution of Divergent Fluency Test Scores for the Grade 11 Sample



APPENDIX E

Frequency Distribution of Convergent and Divergent Fluency Scores for the Grade 10 Sample

DIVERGENT FLUENCY SCORES	15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
43-45					1			
40-42					1	1		
37-39					1	1		
34-36			1		5	4	1	1
31-33				1	1	2	1	1
28-30				4	4	7		1
25-27			1	5	13	9	4	1
22-24		1	3	2	3	8	6	3
19-21		1	2	5	9	11	9	1
16-18		2	4	3	6	13	3	1
13-15	1			5	5	11	1	1
10-12		2	2	2	5			
7-9			3	3		1	1	
up to 6			1					

CONVERGENT SCORES

Frequency Distirbution of Convergent and Divergent Fluency Scores for the Grade 11 Sample

DIVERGENT FLUENCY SCORES

	15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
46-48					1		1	1
43-45						1		
40-42					2	2	2	
37-39						3	3	
34-36	1					2	5	2
31-33				1	3	4	5	3
28-30				3	3	6	11	1
25-27	1		2	4	4	3	10	1
22-24	1	1		5	6	8	4	6
19-21	1		3	1	4	10	6	6
16-18			1	3	6	3	4	2
13-15	3		1	2	1	7		1
10-12	1		3	1	1	4		1
7-9	2		1			1		
6								

CONVERGENT SCORES