6698

NATIONAL LIBRARY
OTTAWA

CANADA

BIBLIOTHÈQUE NATIONALE
OTTAWA

NAME OF AUTHOR.....B. R. D'Aoust.....

TITLE OF THESIS.....Teaching for originality

.....

.....

UNIVERSITY.....of Alberta.....

DEGREE FOR WHICH THESIS WAS PRESENTED.....Ph. D.....

YEAR THIS DEGREE GRANTED.....1970.....

Permission is hereby granted to THE NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

(Signed).....B. R. D'Aoust.....

PERMANENT ADDRESS:

.....130 W 12th.....

.....N. Vancouver, B.C.

.....

DATED.....Sept. 18.....1970

NL-91 (10-68)

THE UNIVFRSITY OF ALBERTA

TEACHING FOR ORIGINALITY

by

© BERNARD RENE D'AOUST

A TFESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIFS

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBFRTA

FALL 1970

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Teaching for Originality" submitted by Bernard Rene D'Aoust in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

Charles C. Anderson
Supervisor

External Examiner

Date: September 18th, 1970

ABSTRACT

The primary purpose of the present study was to examine the effects of three teaching techniques used in four 38 minute periods on the development of originality. One, labelled "practice", provided practise with problems which required more than one answer. A second, labelled "extraction", called for the subjects to provide and critically examine the criteria for what constituted a better than ordinary answer. The third technique, labelled "teaching" was rather pedagogic and consisted of the subjects being told how they might come up with answers which were more unusual than normal.

Consideration was also given to the relationship of three theoretically-relevant personality variables to this development. These variables were I.Q., both verbal and non-verbal, pretreatment ideational fluency and originality.

A total of 359 grade eight pupils from 12 Alberta classrooms were involved. The measures of originality used were Consequences and Seeing Problems. Half of each was scored as a pre-test measure of ideational fluency and originality, and the other halves, given 72 hours after the treatments, were scored as the post-test measures.

An unexpected result was the different kinds of originality as reflected by performance on the two measuring instruments. Consequences seems to be a measure of originality in problem solving whereas Seeing Problems seems to measure originality in problem finding. Although the scoring for originality with both instruments consisted of assigning marks only for numerically uncommon but appropriate answers, the outcome of the experiment differed with

each instrument.

Ideational fluency and I.Q. were found to be important covariants of gains in originality as measured by Consequences but not as measured by Seeing Problems.

The experimental treatments did increase originality scores significantly when Seeing Problems was the measuring instrument used but not when Consequences was. The most effective treatment was "practice". There was no relationship between treatment used and initial level of originality considered as high, average, or low. The greatest gains made with both measuring instruments were by the groups initially low in originality.

ACKNOWLEDGMENTS

I was supported financially during my residency by a University of Alberta Intersession bursary and by the W. J. Gage Research Fellowship.

Special thanks are due to those grade eight pupils at Hillcrest in Edmonton, Stony Plain, Spruce Grove, Winterburn, Griesbach and Namaio who participated in the study, and to the many adults whose cooperation made it possible. These would include Mr. Evoy, Mr. Fitzpatrick, Mr. J. Flaherty, Mr. Flanagan, Mr. Karpiak, Mr. Klufas, Mr. B. McNeill, Mr. Ulmer and Mr. Wiznura. Miss M. McFarlane, who typed the manuscript, is both thanked and appreciated.

I am especially and sincerely grateful to Dr. C.C. Anderson and to Dr. S. Hunka for having helped me on many levels to complete my Doctorate. Dr. G. Lefrancois deserves special thanks for having taken the time to remind me of myself.

Finally, an inadequate, but sincere, thank you goes to Kathy for sharing and relieving the stresses and pressures experienced during the main effort in producing this document and for her unwavering faith in me during that period of time.

I would like to dedicate this thesis to my mother, Mrs. G. Moisan, who not only contributed time, energy and love toward its completion, but who, in addition, thinks that it is important.

TABLE OF CONTENTS

CHAPTER PAGE

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

CHAPTER I

INTRODUCTION TO THE PROBLEM

There is a relatively recent trend to regard "creativity" as an important goal of education. However, as Getzels (1964) has observed, the educational and psychological approach in this area seems "based more on exhortation and testimonial than on empirical demonstrations that this curriculum and this teaching method does indeed make this difference". This study attempts to meet the criticism in part by experimentally investigating the effects of various broad categories of classroom experiences on adolescent originality, a selected aspect of "creativity" (e.g. Arasteh, 1968).

That a need for studies of this type exists is supported by one of the major authorities in this area. In his review of Ray's The Experimental Psychology of Original Thinking (1967), P.R. Christensen (1968) concludes by suggesting three important directions for books departing from where Ray's stops. Especially pertinent to this thesis are the first, which calls for"an increase in the number and meaningfulness of experiments on a topic (presumably original thinking)we know very little about", and the third, which calls for "answers to teacher's questions as to how they can train original thinkers". He goes on to say that "it is clear that few answers to the teachers' questions on training can presently be found from the experimental literature".

The need for this type of study is particularly acute amongst adolescents (Arasteh, 1968). While a considerable body of research is

accumulating on such teaching for children (e.g. Crutchfield, 1965; Feldhusen, Freffinger and Bahlke, 1970; Kogan and Morgan, 1969; Rouse, 1965; Suchman, 1961; and Torrance, 1963) and adults (e.g. Edwards, 1967; Gordon, 1963; Karlins and Schroder, 1967; Osborne, 1953; Parnes and Harding, 1962; and Ridley and Birney, 1970) very little has yet been done with adolescents.

Because of the connotational and denotational complexities attached to the concept of "creativity", its uses in the present study will be restricted to associating it with the work of authors who have elected to employ the term in their work. No attempt is made to report their multitudinous definitions of the term (for one attempt, cf. Mackler and Shantz, 1965). Instead, it is assumed that creative thinking involves the complementary aspects of original thinking and logical reasoning with the first aspect generating novel ideas and the second systematically evaluating them (Pitt, 1965).

The present study is concerned with originality defined as the ability to produce appropriate but statistically uncommon responses to a given population (Maltzman, 1960). Such a definition has the advantage of lending itself to replicable study, as well as to increased reliability and validity of measurement. Rather than relying on subjective evaluation of cleverness or remoteness, scoring becomes a function mainly of recording and tallying answers. Providing that similar samples are tested using the same instruments, the statistical definition of originality has been found to lead to replicable and

reliable results (Mackler, 1962; Maltzman et al., 1960). Similarly, the definition is explicit enough to permit anyone examining the record of answers produced to agree that one answer is more, less, or as uncommon as any other. Thus, the validity of scoring for originality seems attainable.

The main purpose of the present study is to see whether originality thus measured can be increased by the use of three different treatment procedures.

Without denying the important contribution which a personological approach (Dallas and Gaier, 1970) could make to a study of this topic, personality and motivational traits are not included. Instead, a cognitive orientation is adopted (Guilford, 1967) within which the dimensions of ideational fluency and intelligence are examined.

Selecting treatments and individual differences for study appears to require the resolution of at least four key problems. The first of these concerns the strengthening or encouraging of a divergent thinking tendency. The second involves the determination of what experimental manipulations might succeed in achieving the divergent tendency. The third requires the selection for study of those individual differences which seem most likely to be related to the growth of originality. The fourth problem is to design an experiment to investigate the interaction between the selected solutions of the first three problems.

Divergent thinking tendency

If the widespread use in our schools of multiple-choice examinations may be taken as evidence, it would appear that a set to think convergently is now primarily fostered. Without attempting to belittle the importance and the need for such a thinking set, it would appear that a major aim of any experimentation designed to increase originality should be aimed at strengthening the tendency or propensity to think divergently. If this strengthening occurred, this now more potent tendency would then presumably become more likely to be available whether the need for it arose or not.

Bruner (1967) has suggested two ways of doing this. The first, which involves specific directions such as "be original", is regarded as too transient for inclusion in this study. The second is more Tolmanian (1948) in that it requires the tendency to be derived from various conditions existing in the general situation. It is this latter approach which is used in each of the three experimental treatments employed in this study.

Theories and treatments

If it is assumed that the development of originality follows the same psychological principles that account for the development of other intellectual processes (cf. Pribram, 1964), the specifications of how nurturance proceeds can be fruitfully discussed in terms of reinforcement, cognitive structure, and a combination of these. Experimental treatments

based on these specific processes can then be formulated.

Reinforcement, considered as any stimulus which increases the probability of a specific response (Skinner, 1953), is assumed by Maltzman (1958, 1960) to be an important determiner of originality. In his studies, he found that making different responses to the same stimuli led to increased originality in each of a series of experiments. Interestingly, the transfer effects seemed to be nonspecific in that the gains were greater when training involved non-test stimuli rather than the test-stimuli themselves. The results were interpreted as indicating that the development of performance follows the principles of operant conditioning. Thus, behavior which is emitted in practise will continue to be emitted with selected reinforcement. Although initially it seemed important to Maltzman to provide extrinsic reinforcement, the later studies revealed that reinforcement intrinsic to the task was equally effective. He interpreted this tentatively in terms of differential reinforcement, first, because the occurrence of a response is self-reinforcing, and second, because the occurrence of an original response is more reinforcing than that of a common response. He suggested that the amount of reinforcement is inversely related to the initial probability of a verbal stimulus evoking a verbal response (Maltzman, 1960; Berlyne, 1960, 1965).

Experimental validation was provided by Ridley and Birney (1967) in a study involving Amherst freshmen which found that work-association training as used by Maltzman led to significant gains in both ideational

fluency and originality.

The importance of cognitive structure to learning, while not new in psychology (e.g. Tolman, 1923), is a topic which has received a great deal of its recent impetus from Bruner (e.g. 1957, 1962, Bruner et al., 1956). Aspects of his work which are most relevant to the present study of thinking involve the development of what he calls generic coding systems, defined as a set of contingently related, non-specific categories. These in turn are used in decision-making and as such involve strategies which refer to a pattern of decisions in the acquisition, retention and utilization of information. The primary aim of these coding systems should be to permit their user to go beyond the information available in a stimulus situation. If, as he later argues, both the goal and the process of education are the same--disciplined understanding--it would follow that one way of teaching for originality would be to attempt to engender generic coding systems within pupils. However, his suggestions for attempting this are so varied as to require more than one method to test them.

While admitting that we do not know how coding systems are learned, he later comments on teaching them. He describes two modes of teaching and hypothesizes that one is better than the other for developing discovery. The first, which he labels the "expository" way, involves control by the teacher of the mode, pace and style of exposition. The second way, which he labels "hypothetical", involves a great deal of interaction between the student and the teacher. It is this second mode which Bruner

feels is most conducive to discovery because it "helps the child to learn the varieties of problem-solving, of transforming information for better use, (and) helps him to learn how to go about the very task of learning" (1962, p. 82). By placing more onus for learning on the pupil, it, like a practice treatment, would make reward more intrinsic. He further hypothesizes that the working heuristics of discovery are learned only through the exercise of problem-solving and the effort of discovery. The more exercise that occurs, the more the generalization to other tasks. Yet, he recognizes the need for learned knowledge, and here, where the problem is not storage but retrieval, the key is described as organization or coding systems.

An obvious contrast to any treatment derived from Bruner's ideas about discovery learning would be one which emphasized an expository and external presentation of rules for thinking.

Individual differences and originality

The contrived experiences provided by the experimental treatments should work differently only in part because of the differences between them. The same treatment should also have different effects on various subjects because of the differences between individuals.

One such trait which is studied is the individual's level of originality at the beginning of the experiment. It has been found that experimental manipulation designed to increase such factors or creativity

as the need for novelty (Houston and Mednick, 1963) and the ability to recombine associations (Mednick and Mednick, 1964) had the greatest effect on those initially high as opposed to low on creativity measures.

Since the treatments used are intended to help the pupils in our samples to learn to become more original, factors related to the capacity to learn would also seem to be important. The best of these, other than past learning performance, is intelligence (Bloom, 1964) which is commonly represented by I.Q. measures.

Yamamoto (1964, 1965) and Cropley (1965) found positive relationships between levels of I.Q. and creativity in heterogeneous samples. However, the relationship seems far from clear or simple (Dallas and Gaier, 1970). Guilford and Hoepfner (1966) found no relationship at the ninth grade level. Wallach and Kogan (1965) found that varying testing conditions led to a marginal relationship. This finding has been confirmed wholly (Boersma and O'Bryan, 1968), and in part (Cropley, 1968; Fee, 1968; Kogan and Morgan, 1969). Torrance (1967) reported that of 178 correlation coefficients between intelligence and creativity scores contained in the literature at that time, the median was r= .20. Dacey and Ripple (1969), in a study with 8th grade subjects found a non-significant correlation coefficient of .19. Perhaps a major problem in this general area is Yamamoto's (1966) finding that scores with common semantic labels did not represent the same thing in each test.

Another area of individual differences which seems related to originality is semantic fluency (Mednick, 1962). Mednick's thesis is

that creativity (the word is used by Mednick who defines it very much like our definition of originality--cf. Guilford, 1967) is in large part a function of recombining associations in a useful and unusual manner. He hypothesizes that the number of associations available for use will therefore be related to creativity.

The theoretical importance of studying the effect of ideational fluency on originality scores has just recently been noted. Clark and Mirels (1970) studied the relationship between creativity scores derived from Torrance's tests both amongst themselves and with I.Q. scores. While they found that creativity scores uncorrected for ideational fluency had a mean correlation of .45 with themselves and .09 with I.Q., when corrected by statistically controlling the effect of ideational fluency on the creativity scores, these corrected scores had a mean correlation of .08 with themselves and .13 with I.Q. They suggested that ideational fluency may be a factor which, while previously regarded as largely concurrent with creativity, is in fact pervasive in it. If this were so, it might explain the many findings (cf. Dallas and Gaier, 1970; Jacobson, Elenweski, Karlin, 1967; Lordahl and Liroff, 1968) concerning Mednick's Remote Associations Test which challenge its validity as a measure of creativity.

CHAPTER II

EXPERIMENTAL MODEL

The purpose of this study is to investigate the effects of three experimental treatments on originality and the relationship between originality and certain individual differences.

Treatments

On the basis of Maltzman's interpretation, one experimental technique used consists of practice with open-ended questions. This practice treatment (P) resembles Maltzman's general training model in (a) calling for many responses to the same stimulus, (b) thereby providing for operant conditioning to occur, and, (c) encouraging the training effects to transfer to similar but different situations. The (P) treatment differs basically from Maltzman's in using a variety of training conditions whereas he only used a list of words. (For details of (P), cf. Appendix A).

If Bruner was right about the hypothetical mode being most conducive to discovery, and, if discovery involving going beyond the information available is related to originality, then one method of teaching needed to test his idea would likely resemble our second technique which is labelled "extraction" (F). This method involves a lot of group discussion about ideas and thinking with most of the information about these being extracted from the pupils by questions from the teacher. Answer to these are first recorded briefly by the individual pupils, and then these are discussed overtly within the group. Since the onus for respond-

ing is on the pupil, intrinsic reinforcement is assumed operative. A variety of problems, their solutions, and the intellectual operations producing these solutions are discussed, providing for Bruner's varieties of problem-solving and information transforming. Unlike the (P) treatment, (F) provides for the overt exercise of problem-solving and the effort of discovery. The discussion is guided by external questions and standards, and focus is on cognitive products and processes. Where it differs from Bruner's favored mode is in its relative lack of imposed organization, this being left largely to each individual pupil. (For details of (F), cf. Appendix B).

The third experimental condition, which does emphasize organization, resembles Bruner's expository mode in being very much teacher controlled and involving a great deal of passive listening from pupils. Nevertheless, on the basis of Hunt's contention (1961) that during the period of formal operations, both information and skill can best be acquired by verbal communication and exercise, and Bruner's emphasis on the importance of organized knowledge for creativity (1963), an expository teaching mode, called teaching (T), was deemed useful in the present study. As well as serving as contrast for the other two experimental conditions, (T) can also serve to test the effect of externally received rules for thinking (cf. Berlyne, 1965, p. 172). Involved in the procedure is a description of blocks to divergent thinking, general procedures for attempting to solve problems, and a method of generating ideas based on arithmetical operations familiar to the pupils. These operations were adding, sub-

tracting, multiplying, dividing, magnifying, minification, re-grouping, and substituting (Torrance, 1962). Practice was only provided to illustrate how the problem-solving and idea generating techniques worked. (For details of (T), cf. Appendix C).

There appears to be several advantages in using the three experimental treatments. First, they provide the opportunity to compare both some techniques and some theories concerning how to augment originality. This should help to answer a problem considered of major importance (eg. Hunt, 1961, Torrance, 1962, Taylor, 1964), concerning how originality develops as a function of conditions external to the learner. Furthermore, the treatments used bear close enough resemblance to common teaching techniques to permit easy transference of any positive results from this study to the classroom. Finally, the use of three treatments permits the study of interactions between individual differences, or internal conditions, and the various treatments or external conditions, which lead to originality.

Increased originality

A high originality score in a post-treatment in contrast to a pre-treatment situation is taken as evidence that a tendency to think divergently has been strengthened, and that such increases must be attributable to the treatment that has occurred.

Individual Differences

If the level of originality attained is in fact a function of both heredity and environment (cf. Helson, 1964), one assumption which appears

tenable is that the pre-treatment level of originality of our subjects provides some indication of how nature and nurture have interacted in the past to produce that level of originality. If the total experimental population is divided into high originals (HO), average originals (AO) and low originals (LO) according to their initial originality scores, and if the assumption of past interaction leading to learning to be original is valid, it should happen that, as a result of the treatments but disregarding the kind, the HO will gain more than the AO who will gain more than the LO.

It is thus hypothesized that a good predictor of how learning will occur differentially in the present is what learning has occurred in the past (cf. Bloom, 1964).

If I.Q. is considered as an indication of potential for learning, Yamamoto's (1964, 1965) and Cropley's (1965) findings of a positive relationship between levels of I.Q. and creativity in heterogeneous samples suggest some interesting hypotheses. The one which will be investigated is that the correlations found between originality scores before and after treatment are in part a function of the exercised potential for thinking. While recognizing the superiority of a longitudinal study of this hypothesis, an attempt to test it will be made by predicting that the effectiveness of the experimental treatments will be partly related to I.Q. Specifically, it is expected that, given individuals at the same initial level of originality, those with the higher I.Q.'s will show more gain in originality.

Mednick's (1962) suggestion concerning the relationship between creativity and the number of associations available for use will be tested in this study by hypothesizing a relationship first between initial originality and ideational fluency and second, between initial, pre-treatment ideational fluency and growth of originality. Specifically, we are predicting that the more ideational fluency a person possesses (a) the more originality he will have initially, and (b) the more he will gain as a result of experimental manipulation.

Interaction between treatments and individual differences

The investigation of the interaction occurring between treatments and pre-treatment level of originality will initially ignore both ideational fluency and intelligence scores. For present purposes, consideration of these last two factors will first be limited for both to the question of whether or not they are related to the experimental development of originality, and to the added question of whether or not they are related to originality. Subsequently, the effects of both on the development of originality will be tested.

However, certain hypotheses regarding interaction arise when levels of originality and kinds of treatment are considered. Assuming that the highly original person is more like a creative person than the less highly original person, the knowledge available concerning creative persons provides clues regarding the likely outcome of these interactions. The traits which creative persons have been found to possess and which seem relevant include being more autonomous, self-sufficient, independent

in judgment, and more resourceful and adventurous than others (Taylor, 1964). Since the experimental methods clearly differ in the degree that guidance and structure is provided, certain interactions between them and initial originality should follow (cf. Fig. I). We would expect the HO to improve equally well under all three conditions. The AO should find more difficulty than the HO with (F) and (P) treatments because of the lack of structure inherent in these methods and the AOs expected lower autonomy, self-sufficiency, and resourcefulness. However, they should gain more than the LOs under the three conditions and nearly as much as the HOs under the structured (T) treatment. The LOs, who presumably are much lower than the HOs and somewhat lower than the AOs on autonomy, self-sufficiency, independence, resourcefulness and adventuresomeness, should gain the least relative to both level and treatments from the (P) and (F) treatments and, relative to treatment, the most from the well-structured (T) treatment.

Measurement considerations

As defined (cf. p. 2), it is assumed that originality can be expressed on a single continuum of very low to very high scores upon which can be found every individual in the sample. With other things such as speed of writing assumed equal and under time restrictions, the more uncommon responses produced on a measure of divergent thinking the fewer are the common responses. This then raises the possibility of a ceiling effect due to the time limitation. Such an effect would in turn restrict the amount of measurable gain possible for highly original subjects.

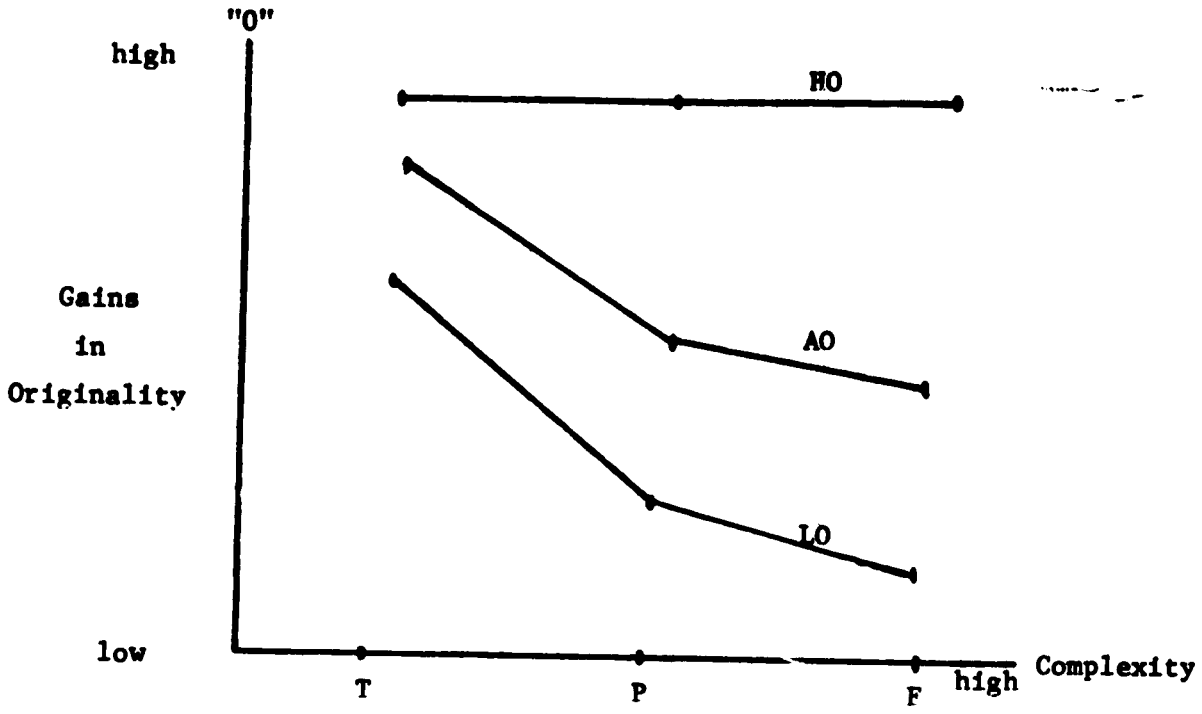


Fig. 1 Some expected gains resulting from treatment complexity, considered as absence of guidance, and initial level of originality, considered as high (HO), average (AO), and low (LO).

Two considerations appear to militate against such a possibility. The measures of originality used were designed for use with subjects ranging in education from grades 8 to 16 (French et al., 1963). It seems unlikely that our young grade 8 subjects would be able to produce as many responses as older subjects. Although this in itself would not prevent the ceiling effect from occurring, since a subject could be as original as was possible for him under the time limit, when combined with the instructions given to the subject, it at least seems to lessen the chance of a ceiling effect occurring. The instructions give no clue that uncommonness of responding is being measured. It therefore seems improbable that any subject would automatically begin and continue giving appropriate and highly uncommon responses throughout the testing. Hence, we will assume in making our predictions that no ceiling effect will be operative.

Indirect evidence, which seems to support this position comes from at least three sources. The first would be from all of the various studies of originality, none of which have yet noted a ceiling effect. A second would be the study done by Guilford and Hoepfner (1966). It dealt with a sample of grade nine students and included the use of the sames tests as the present study. The evidence is necessarily indirect because, while they do not mention finding a ceiling effect, neither do they mention not finding one since, perhaps, that was not a part of their study. The third source (Dacey and Ripple, 1969) is similar to the second in that the grade level (the eighth) is comparable to that

of our sample and no search for, or mention of, a ceiling effect occurred. It differs in having used Torrance's tests of creativity.

CHAPTFR III

HYPOTHESES

The first hypothesis is concerned with the feasibility of increasing performance on measures of originality through a practice treatment (P) which is assumed to involve intrinsic operant conditioning, an extraction treatment (E) which is assumed to involve cognitive re-structuring as a result of guided overt effort, and a teaching treatment (T) which involves an expository mode of presenting techniques for increasing both the quantity and quality of performance.

H_1 Ss who receive one of the training treatments will perform significantly better on post-treatment measures of originality than Ss not receiving such a treatment.

The second hypothesis deals with the function of initial individual differences on post-treatment originality scores of such variables as verbal and non-verbal I.Q., and pre-treatment ideational fluency and originality.

H_2 Performance on post-treatment measures of originality is a significant function of verbal and non-verbal I.Q., and of pre-treatment ideational fluency and originality.

The third hypothesis re-evaluates the first two hypotheses by attempting to determine whether the training treatments succeed differentially when these samples are controlled directly according to their pre-treatment levels of originality (high, average, low), and the effects of verbal and non-verbal I.Q.s, and pre-treatment ideational fluency are controlled statistically.

H_3 Increases in originality will be an interactive function of initial level of originality and training treatments.

CHAPTER IV

EXPERIMENTAL DESIGN

I. SAMPLE

A total of 359 grade eight pupils from 12 classrooms in the Edmonton, Alberta area were involved. In an attempt to guarantee an heterogeneous sample, four groups were selected from an Edmonton middle class district, 4 from a rural school district and 4 from Department of National Defence Schools. Table I contains comparative data on the groups by sex, treatment, and location.

The city sample consisted of 4 of the 8 grade eight classes from one school. The rural sample consisted of all grade eight pupils in 3 different schools. The Armed Service sample consisted of all grade eight pupils from 1 school, and a control group from a second school.

II. THE TESTS

The instruments selected were used to measure originality, ideational fluency, and verbal and non-verbal I.Q. during the month of May 1965.

Measures of Originality

These were selected from a test kit designed to measure various cognitive factors (French et al., 1963). The basis for selecting them was their high loading of .61 and .60 on a factor labelled divergent thinking in a study of talented behaviour involving grade seven pupils (McGuire et al., 1960).

TABLE I

COMPOSITION OF SAMPLES BY SEX, LOCATION AND TREATMENT

Treatment	Armed Services			City			Rural			Total		
	Boys	Girls	Totals	B	G	T	B	G	T	B	G	T
T_{1}*	14	17	31	17	13	30	15	16	31	46	46	92
T_{2}*	20	14	34	16	16	32	9	18	27	45	48	93
T_{3}*	16	16	32	17	15	32	16	13	29	49	44	93
T_{4}*	9	12	21	16	13	29	16	15	31	41	40	81

* T_1 is practice treatment

T_2 is extraction treatment

T_3 is teaching treatment

T_4 is non-treatment or control

Test	Description
Consequences	Designed to measure originality, it calls for the listing of the results of the occurrence of certain hypothetical situations.
Seeing Problems	Involves recognizing problems that might arise in connection with various common objects. Designed to measure sensitivity to problems, it is scored herein for originality.

These tests were used as measures of originality, the dependent or criterion variable in the study. The first half of each was used as the pre-treatment measures, and the second half for the post-treatment measures. Since "Consequences" as a whole involves 10 hypothetical situations, splitting it involved presenting 5 situations in each testing session. "Seeing Problems" includes 12 objects in all, the first 6 of which were used in the pre-test, and the last 6 in the post-test.

Measures of Ideational Fluency

The measures of originality were also scored for ideational fluency. According to Mednick (1962), the more ideas aroused by a stimulus situation, the greater the probability of achieving a creative response, with creativity being defined in terms of recombining associative elements (called originally herein) either to meet specified requirements or in some useful way. He supports his notion by quoting evidence of correlations of .38 ($p < .01$) and .44 ($p < .01$) between scores attained by subjects on his Remote Association Test of creativity and quantity of acceptable answers in other tests. (Mednick, 1962).

As well as testing the predicted interrelationship between ideational fluency and acquisition of originality (cf. Chapter I) it was decided to attempt to replicate Mednick's findings in what seemed a more reasonable, albeit untested, manner. Whereas he compared the inter-test relationship of fluency and creativity, this study compares the intra-test relationship. This should permit meaningful comment on the relationship between the two factors.

The Tests of Non-Verbal and Verbal Intelligence

The Lorge-Thorndike tests of Verbal and Non-Verbal Intelligence, level 4, Form A were administered to all 12 groups. Some justification for using a non-verbal measure of intelligence is provided by Cropley's (1965) finding that performance I.Q. correlates with Seeing Problems (.30) and Consequences (.35) about as well as does verbal I.Q. (.36 and .35 respectively). Furthermore, in view of Yamamoto's (1964, 1965) findings concerning relationships between high verbal I.Q./high originality, average I.Q./average originality, and low I.Q./low originality, curiosity concerning the possible existence of similar relationships between non-verbal I.Q. and originality made the choice of a non-verbal test seem interesting.

III. PROCEDURE

Test Administration

Each of the 12 groups was tested separately. Testing for pre-treatment originality was conducted by three trained testers, including the author (cf. Appendix D). One tested the 4 city groups, another the 4 Armed Service

groups, and the author tested the rural groups. (The post-testing was all done by the author). The order of testing for originality in all cases was Consequences followed by Seeing Problems. The performance I.Q. test was administered by school counselors in the Armed Service and City Schools, and by the author in the rural schools. The I.Q. measures were obtained according to published directions. In the case of the measures of originality and ideational fluency, the following procedure was used.

Scoring for Originality and Ideational Fluency

The scoring for divergent thinking is at once complicated and subject to criticism (Vernon, 1964; Torrance, 1962; and Mackler, 1962). This seems primarily due to the possibility of subjective elements out-weighing objective standards. The solution attempted in this study was to restrict the author's marking to less than 1/3 of the total marking load, assigning the marking to several markers who each marked the same number and kind of questions from pre- to post-treatment testing session, keeping the designation of group-to-treatment secret, and using an operational definition of originality as described below. The aim of using such a scoring procedure was primarily to reduce experimental bias while increasing scoring reliability and validity.

That such caution is necessary seems clear from recent investigations. Dewing (1970) studied the test-retest reliability of some selected tests of creative thinking by Torrance in a sample of seventh grade West Australian children after a 6 week incerval. Pertinent to the present study are

her findings of mean reliability coefficients of .515 for verbal fluency, with a range of .236 to .728, and of .390 for originality, with a range of .057 to .665. Dacey and Ripple (1969), using a similar test, a grade 8 sample, and a 5 month interval, report low test-retest correlations but fail to specify them. They attribute the low correlations to the general tendency of a great deal of fluctuation in the characteristics of adolescents at this age level as compared to other groups. Clapson (1970), in a five year test-retest reliability study of Consequences with 113 pupils who aged approximately from 12 to 17 during the interval, reports a reliability coefficient of .51. As these studies indicate, the problem of reliability in this area and at this age level is still troublesome.

In order to overcome the problem of between-marker reliability, the procedure followed was to have all of any single question marked by the same person. With answers judged appropriate being recorded as they occurred, intra-marker reliability was also expected to be high. Pre-post-test reliability was safeguarded as much as possible by following an identical procedure using the same markers on the same number and type of questions for the post-test scoring.

By using a statistical operational definition of originality (Maltzman, 1960), it seemed that both the validity (Vernon, 1964) and reliability (Mackler, 1962) of scoring for originality could be increased. This seems to result from the reliability depending largely on reading and counting, and the validity being a function of the definition used. As used here, originality is at once a function of an answer being appropriate and also uncommon

in a statistical sense. Scoring then became a matter of determining whether or not an answer was appropriate in the first instance. Appropriate answers were then recorded and counted. After all protocols had been so treated, weights were assigned to the recorded answers. The protocols were then re-read and, where applicable, weights were assigned to the uncommon and acceptable answers.

Scores for ideational fluency are relatively easy to assign. A mark is given for each appropriate answer given to a question with the sole proviso being that it must be an idea not previously expressed by the subject. According to the procedure followed in scoring for originality, ideational fluency scores were determined during the first reading of the protocols.

Weighting of answers in previous studies has ranged from giving marks only to unique answers (Maltzman et al., 1960) to the giving of marks according to the degree of originality found (Torrance, 1962). Torrance assigned weights of 0 to responses occurring 16% or oftener, and weights of 1 to 4 for responses occurring on 15-7% and less than 1% respectively. The Maltzman approach was rejected herein since it seems reasonable to assume in accord with Torrance that there are degrees of originality inherent in an array of responses. However, the weighting system used by Torrance was also rejected. To this author, the Torrance system seemed to include too much which was not very original. In the present study, it would have meant giving a mark for originality to a response occuring 54 times in only 359 protocols. Therefore, it was

arbitrarily decided to adopt a weighting system which resembled a reconciliation of the positions of Torrance and Maltzman.

In order then to recognize both high originality and degree of originality, weights were assigned on the following basis to responses occurring on the protocols at the rates of:

5% or less, 1 point,
4% or less, 2 points,
3% or less, 3 points,
2% or less, 4 points,
1% or less, 5 points.

General Procedure

Tests were administered to all twelve groups before treatment began. Before this testing was done and on the sole basis of knowing which groups were available in each of the three locations, one randomly chosen group from each location was assigned to each of four experimental conditions. These conditions may conveniently be labelled as practice, extraction, teaching and non-treatment. The last named condition served as the control for the three experimental treatments under study. Before describing the experimental treatments, an outline of the general procedure common to each follows.

The time allotted to each treatment was 152 minutes. This was divided into four 38 minute periods which occurred at the rate of one per day from Tuesday to Friday in the same week. For the three locations, the treatments

were administered by the author during the same half day.[1] The Armed Services groups were seen in the morning, and the other two in the afternoon. The post-treatment testing occurred during the teaching half day on the Monday following the Friday on which the treatments were terminated. Hence about 72 hours elapsed between the end of treatment and the post-test of originality.

The decision to present a part of each treatment on successive days was taken to simulate normal school procedure where subject content is usually presented under spaced rather than massed time conditions. Similarly, the decision to test three days after completing the treatments was determined by two considerations.

According to Berlyne (1965, pp. 325-6), at least one day must be allowed between treatment and post-testing if the conclusions one draws are to be related to learning rather than the production of temporary sets. This seems to have been the basis for one of Maltzman's experiments (Maltzman et al., 1960, Experiment #5) in which he allowed 24 hours to elapse before testing to see whether the training had resulted in learning as reflected by "some degree of permanence". Allowing three days to elapse in the present study thus permitted the question of whether or not learning had occurred to be answered. Conversely, the time interval permits

---

1. Although the author's involvement in presenting all treatments may raise suspicions of experimental bias and thus confounding of results, it seemed to the author that, on the basis of his prediction that each treatment would be effective but that this effectiveness would vary according to the present potential of each pupil in the sample, such suspicion could be faced. Thus, for the author consciously to favour one treatment over another seemed tantamount to invalidating two of his hypothesis at the outset at quite a considerable cost in terms of time and effort.

us to say whether or not the experimental treatments selected for study were effective.

In brief, the experimental design involves the following variables:

1. Dependent variable - measured post-test verbal originality

2. Independent variables
   - non-verbal intelligence
   - verbal intelligence
   - pre-treatment originality
   - ideational fluency
   - experimental treatments

3. Confounding variables
   - time intervals between lessons, and between lessons and post-treatment testing during which subjects were "uncontrolled".
   - the untreated control groups who had less experience with the experimenter than the experimental group.
   - a possible halo effect due to experimental groups receiving unusual treatment in school and then being re-tested by the experimenter.
   - possibility of increased measured originality in all groups in post-testing due to effectiveness of treatments in eliminating some of the tendency to give common responses amongst the experimental group protocols.
   - a marker variable due to diminishing interest as the marking progresses. The markers gave of their time freely because they thought the work sounded interesting. Without monetary reward, however, they soon began to find their duties tedious.

Experimental Treatments

One group from each location received the treatment labelled practice (P).

The main determinant in selecting exercises was to maintain interest by providing a variety of relatively unusual open-ended questions for the group

to work on individually. Nevertheless, it was felt to be of importance to focus some attention on the habit of overlooking the obvious. To point this out, a right-answer problem using geometric figures or designs was used in each of the first three sessions. Also, to give the students receiving the treatment some idea of the purpose of the exercises, they were asked to select and indicate what they considered their best, or most interesting answer to various problems. (For details of exercises used, see Appendix A). All questions were presented verbally by the author. The sessions consisted primarily of individual effort on the part of the pupils.

Another group from each location received the extraction (E) treatment. The major aim of this procedure was to have each group examine ideas and intellectual operations by first individually considering a problem, and then comparing individual solutions, with those of the group. While attempts were made to have the groups extract standards and rules which might be used to evaluate ideas and produce them, the difficulty of doing this in the treatment time allotted was recognized. Therefore, the immediate aim of the treatment was restricted to having the "groups" discuss certain aspects of thinking and thoughts in the hope that greater implicit understanding would result of the criteria which exist for governing thinking. (See Appendix B for details of exercises used). An attempt was made by the experimenter to conduct the sessions, after the initiating problem had been set, in a non-directive manner. Activity was centered in the group, and the experimenter refrained from stating the main point of each exercise.

The third treatment consisted primarily of teacher-presented information concerning blocks to thinking, and guides to effective thinking of an imaginative kind. The latter portion of the third session and the whole of the fourth consisted of the participating groups attempting to apply certain operations put forward by the author as positive, generalizable mental processes leading to divergent thinking. The operations "taught" were borrowed from Torrance (1962) and were called: magnification, minimizing, adding, subtracting, multiplying, dividing, substituting and regrouping. (For details, see Appendix C). The role of the experimenter in this condition was very directive, and the pupils were, relative to the other treatments, passive and docile.

Statistical Analyses

The increase in performance on measures of originality was initially tested by the calculation for each treatment group of means and standard deviations. A comparison of means by analysis of variance followed.

To determine whether differences between pre- and post-treatment test performances were a function of certain individual differences, a stepwise regression analysis and an analysis of variance was conducted for each test group.

A treatment (4) by starting level of originality (3) analysis of covariance was done to determine whether the treatments had a differential effect on subjects according to their initial level of originality. Approximately the top quarter and the bottom quarter, according to pre-treatment measures of originality, were selected as the high and low group respect-

ively. The remainder was used as the average group. The covariates used were verbal and non-verbal I.Q. scores, and pre-treatment ideational fluency scores.

Two sets of analyses were performed for each hypothesis. This was done since there were two sets of tests used (Consequences and Seeing Problems) in pre-testing and post-testing. Although it was assumed that much of what they measured would be common to each, differences of unknown magnitude could also be expected. Until these were determined, it seemed prudent not to assume additivity for the purpose of the present study.

CHAPTER V

RESULTS

HYPOTHESIS I

The first hypothesis was that performance on measures of originality could be increased by various training treatments labelled Practice (P), Extraction (E), and Teaching (T) compared to a control (C) group.

Table II shows the results on the pre-treatment and post-treatment measures of originality for each of Consequences and Seeing Problems. The post-treatment originality scores are clearly higher for all groups on each measuring instrument. However, the increase in scores by the control group on Consequences is of the same order as that by the other experimental groups. This suggests either that a test-retest treatment was as effective as the more elaborate treatments, or that the results using Consequences were not significant. The latter explanation seems to be the case. On Seeing Problems, the treatment groups obviously improved much more than the control groups.[1] A discussion of the differences on the two measuring instruments is postponed until the next chapter.

It seems that originality as defined in this study and as measured by using instruments such as were used can be increased. What is surprising

---

1. It should be noted that whereas the S.D. of the control group varied slightly on the two instruments, those of the treatment groups increased in 5 of 6 cases, the only exception being (P) on Consequences.

TABLE II

MEANS AND STANDARD DEVIATIONS FOR VERBAL I.Q. (VIQ), NON-VERBAL I.Q. (NVIQ), PRE-TREATMENT IDEATIONAL FLUENCY (IdF1) AND ORIGINALITY (Pre O), AND POST-TREATMENT ORIGINALITY (POST-O) BY TREATMENT (P,F,T AND C), A COMBINATION OF THE TOTAL SAMPLE (ToSa), FOR CONSEQUENCES (Consq) AND SEEING PROBLEMS (SePro).

		P		F		T		C		ToSa	
Test	Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Consqu.	VIQ	113.10	11.07	112.13	12.28	111.08	11.85	110.74	13.41	111.79	12.20
	NVIQ	109.12	15.07	112.92	11.87	111.54	12.14	110.84	13.16	111.12	13.31
	IdF1	11.54	4.95	11.20	4.45	10.96	4.05	10.67	4.19	11.11	4.45
	PreO	12.58	10.03	12.23	8.47	10.53	7.86	10.60	8.43	11.51	8.79
	Post O	17.01	10.24	16.52	10.67	15.05	11.15	14.70	8.44	15.85	10.26
	Post-pre O	4.43	10.55	4.29	9.93	4.53	10.64	4.10	10.34	4.34	10.38
Se Pro	IdF1	14.05	4.68	13.04	5.00	14.47	5.14	15.07	5.23	14.13	5.06
	Pre O	11.95	8.45	10.26	7.78	11.59	7.98	12.51	8.80	11.55	8.28
	Post O	21.09	11.05	18.60	9.78	17.77	10.45	16.16	9.96	18.47	10.48
	Post-Pre O	9.14	11.01	8.34	10.73	6.18	11.75	3.65	10.51	6.92	11.23
	N	92		93		93		81		359	

	Consequences				Seeing Problems			
	MS	df	F	P	MS	df	F	P
Total	107.79	358			126.21	358		
Groups	3.04	3	0.028	0.9932	523.96	3	4.26	0.006
Error	108.66	355			122.86	355		

is that even repeated testing after a period of time seems to result in some improvement. Whatever type of originality is being measured by Seeing Problems, compared to the control group, it is improved much more by the experimental treatments used in this study.

The first hypothesis thus seems unconfirmed when Consequences is the measuring instrument used, and confirmed when Seeing Problems is used.

HYPOTHESIS II

The second hypothesis was that increased performance on measures of originality would be a function of individual differences such as pre-treatment originality and ideational fluency, and of verbal and non-verbal intelligence.

Table III summarizes the amount of variance accounted for by each variable in a regression analysis. In general, pre-treatment ideational fluency and originality seem to account for most of the variance in the post-treatment scores on both Consequences and Seeing Problems. The only exception to this is on Consequences with the (C) group.

Table IV shows the results of the analysis of variance for each measuring instrument used after the stepwise multiple regression analysis. In all cases, a significant amount of variance can be accounted for by the use of the specified factors. Before examining the differing and group-specific contributions of each variable, it should be noted that these variables generally all contribute to the specifications of variance when performance is measured with Consequences (i.e. 6 or 7 variables) but that fewer contribute with those scores derived from Seeing Problems. It

TABLE III

PERCENT OF VARIANCE ACCOUNTED FOR BY VARIABLES
IN STEPWISE REGRESSION ANALYSIS

Test Group	N	Sex	DND	City	VIO	Non VIO	IdF1	Pre O	RSO*	P
Consequences										
Practice	92	0.5	4.2	0.4	0.8		27.8	1.4	35.1	.000001
Extraction	93	2.3	0.5	0.4	3.4	0.4	0.9	22.8	30.7	.00004
Teaching	93	0.5	1.3	3.4	5.9	0.6		17.3	29.0	.00004
Control	81	1.6	3.0	1.4	1.3	13.0	3.0		23.3	.002
Total	359									
Seeing Problems										
Practice	92			0.7	2.2		2.6	15.0	20.6	.0004
Extraction	93	0.8	2.3			1.7		7.2	12.0	.02
Teaching	93	0.7					9.8		10.5	.007
Control	81	0.8		1.9			17.1	4.1	23.9	.0003
Total	359									

*Squared multiple correlation produced by using all seven variables.

TABLE IV

ANALYSIS OF VARIANCE OF STEPWISE REGRESSION ANALYSIS FOR POST-TREATMENT ORIGINALITY SCORES

Test	Group	df	F	Prob	RSQ
Consequences	P	6,85	7.99	.000001	.351
	F	7,85	5.39	.000039	.307
	T	6,86	5.85	.000038	.290
	C	6,75	3.79	.0024	.233
Seeing Problems	P	4,87	5.65	.00044	.206
	F	4,88	3.009	.022	.120
	T	2,90	5.271	.0068	.105
	C	4,77	6.037	.00028	.239

appears that, in this experiment, despite the similar method of measuring originality with the two instruments, performance on each is dependent in different ways on different factors.

Although experimental curiosity was the only reason for including sex and 2 locations as variables in this analysis, it happens that in several cases, although accounting for only a bit more of the variance than more theoretically relevant variables, these variables account for more variance in post-originality scores than do the main variables of ideational fluency and originality. On scores from Consequences, sex is more important than pre-originality once, and pre-ideational fluency twice. Being in the City portion of the total sample is more important than pre-ideational fluency and pre-originality one time each. Being in the DND portion is more important than pre-originality twice, and pre-ideational fluency once. On scores from Seeing Problems, the importance of these three marker variables seems less but still noteworthy. Thus sex exceeds pre-ideational fluency once and pre-originality once. Inclusion in the DND portion exceeds pre-ideational fluency once.[1]

HYPOTHESIS III

This hypothesis states that an interaction between starting level of originality and treatment received would occur.

The results of the analyses of covariance contained in Table V indicate that this hypothesis was not confirmed. They indicate that, as seen earlier, the treatment effects were non-significant for Consequences but

---

1. These results could be due to the type of stepwise analysis used which progresses from the largest to the smallest correlation between the dependent and independent variables.

TABLE V

TWO-WAY ANALYSES OF COVARIANCE OF CONSEQUENCES AND SEEING PROBLEM SCORES (TREATMENTS X STARTING LEVEL OF ORIGINALITY) USING VERBAL AND NON-VERBAL I.Q., AND PRE-TREATMENT IDEATIONAL FLUENCY AS COVARIATES.

Consequences

Source	D.F.	M.S.	F.	Prob.	Decision
Treatment	3	64.30	0.76	0.52	n.s.
Levels	2	192.10	2.28	0.10	n.s.
Treatments x Levels	6	104.69	1.24	0.28	n.s.
Verbal I.Q.	1	378.45	4.49	0.03	sig.
Non-Verbal I.Q.	1	135.70	1.61	0.21	n.s.
Ideational Fluency	1	1141.60	13.54	0.0003	sig.
Error	344	34.31			

Seeing Problems

Treatment	3	369.76	3.81	0.01	sig.
Levels	2	431.70	4.45	0.01	sig.
Treatments x Levels	6	72.38	0.75	0.61	n.s.
Verbal I.Q.	1	64.18	0.66	0.42	n.s.
Non-Verbal I.Q.	1	16.06	0.17	0.68	n.s.
Ideational Fluency	1	1246.55	12.84	0.0004	sig.
Error	344	97.09			

significant for Seeing Problems. While there are significant differences between the levels on Seeing Problems, the differences on Consequences approach significance (.10) but fail to achieve it. However, the interaction with both measures fails even to approach significance.

The most powerful covariate on both tests is pre-treatment ideational fluency. It seems to account for a great deal of the variance which would normally be considered a part of the post-treatment originality scores.

Verbal intelligence seems to play some role in the results obtained with Consequences. As indicated earlier, it seems to be an important functional aspect of the explanation of some of the results obtained.

In view of the varying results of the test for this hypothesis, the data was scrutinized more closely. Tables VI to IX contain the descriptive statistics for such an examination. Table VI, with the combined treatment groups (W) by level ranging from post-originality means of 21.97 to 16.17 to 10.02, at first glance would seem to have a main effect for levels of originality. The results there compare well, superficially, with those of the (W) group on Seeing Problems (Table VII) where the means range from 22.88 to 19.56 to 14.96. These mean differences are significant in both cases at beyond the .001 level when the influence of the covariates is ignored.

Looking at the columns for verbal I.Q. and ideational fluency in these same tables, we find an I.Q. range for W on Consequences of 116.45 to 106.11 with the comparable I.Q. range of 113.70 to 110.14 for Seeing Problems, and an ideational fluency range on Consequences of 15.39 to 7.34, and on Seeing Problems of 17.30 to 10.72. Although the ranges are roughly equivalent for

TABLE VI

MEANS AND STANDARD DEVIATIONS BY PRE-TREATMENT LEVEL OF ORIGINALITY (HIGH, AVERAGE, LOW), TREATMENT (P,E,T, AND C), AND A SAMPLE CONSISTING OF ALL SUBJECTS IN THE FIRST THREE TREATMENT SAMPLES (W) FOR CONSEQUENCES.

Level	Sample	N	VIO		NVIO		IdFl		Pre O		Post O	
			X	S.D.	X	S.D.	X	S.D.	X	S.D.	X	S.D.
Hi	W	69	116.45	10.04	113.81	14.75	15.39	4.17	24.14	6.35	21.97	12.63
Hi	P	26	114.62	10.53	109.42	17.47	16.58	3.76	26.04	6.93	21.77	10.79
Hi	E	21	118.00	10.06	118.57	11.72	15.10	4.11	24.33	6.81	23.24	13.18
Hi	T	22	117.14	9.53	114.45	12.78	14.27	4.48	21.73	4.31	21.00	14.48
Hi	C	15	117.20	8.01	114.80	9.94	15.60	2.95	23.53	8.69	16.20	10.38
Av	W	145	112.67	11.36	111.84	12.27	10.97	3.34	10.17	3.74	16.17	9.48
Av	P	47	113.00	10.76	109.60	15.07	10.83	2.99	9.53	3.63	17.32	9.46
Av	E	56	112.41	12.72	112.87	10.51	11.14	3.68	10.64	3.74	15.52	9.15
Av	T	42	112.64	10.31	112.98	10.82	10.90	3.31	10.26	3.85	15.74	10.01
Av	C	48	110.94	14.02	112.10	13.35	10.40	3.25	9.75	3.74	15.67	7.68
Lo	W	64	106.11	12.25	106.94	12.75	7.34	3.29	2.06	1.64	10.02	7.31
Lo	P	19	111.26	13.00	107.53	12.39	6.42	4.15	1.68	1.63	9.74	7.54
Lo	E	16	103.44	8.84	105.69	13.61	6.31	2.02	1.87	1.67	11.19	7.95
Lo	T	29	104.21	12.69	107.24	12.92	8.52	2.90	2.41	1.62	9.55	6.98
Lo	C	18	105.67	13.94	104.83	14.03	7.39	3.88	2.44	4.36	11.50	8.27

TABLE VII

MEANS AND STANDARD DEVIATIONS BY PRE-TREATMENT LEVEL OF ORIGINALITY (HIGH, AVERAGE, AND LOW), TREATMENT (P,E,T AND C), AND A SAMPLE CONSISTING OF ALL SUBJECTS IN THE FIRST THREE TREATMENT SAMPLES FOR SEEING PROBLEMS

Level	Sample	N	VIQ		NVIQ		IdFl		Pre O		Post O	
			X	S.D.	X	S.D.	X	S.D.	X	S.D.	X	S.D.
Hi	W	64	113.70	10.30	109.92	12.93	17.30	4.12	22.89	5.92	22.88	12.30
Hi	P	26	114.46	12.99	106.38	15.12	17.85	4.14	22.61	6.36	26.81	13.41
Hi	E	18	111.61	9.60	111.39	10.49	16.94	3.95	22.83	5.14	21.28	9.32
Hi	T	20	114.60	6.42	113.20	11.18	16.90	4.36	23.30	6.22	19.20	12.22
Hi	C	22	110.14	13.02	111.91	13.60	17.59	3.58	23.18	7.11	19.64	10.26
Av	W	143	112.35	11.43	111.68	13.01	13.87	4.47	10.52	3.12	19.56	9.37
Av	P	44	112.39	9.91	109.36	14.69	13.02	4.12	10.41	3.13	20.86	8.98
Av	E	45	112.64	10.88	113.22	11.68	13.13	4.35	10.51	2.86	19.73	10.47
Av	T	54	112.07	13.11	112.28	12.58	15.19	4.59	10.61	3.36	18.35	8.71
Av	C	42	11.12	11.45	111.19	12.58	15.55	4.82	11.02	3.38	16.69	9.31
Lo	W	71	110.14	13.56	111.39	13.98	10.72	4.69	2.28	1.77	14.96	9.77
Lo	P	22	112.91	11.46	111.86	16.25	11.64	3.82	2.41	1.79	14.96	8.55
Lo	E	30	111.67	15.79	113.40	13.37	10.57	5.15	2.33	1.77	15.30	8.46
Lo	T	19	104.53	10.66	107.68	11.96	9.89	4.90	2.05	1.84	14.63	13.04
Lo	C	17	111.47	18.66	109.29	15.04	10.94	5.89	3.12	5.91	10.94	9.76

ideational fluency, the range is considerably greater for I.O. when the groups are divided on the basis of their scores on Consequences.

Looking at Tables VIII and IX, the reasons for the differences between the post-treatment results on the two instruments is apparent. Whereas with Consequences, there are significant correlations between verbal I.O. and post-treatment originality in 7 out of 15 possibilities, the comparable results with Seeing Problems is 0 out of 15. With ideational fluency, the results are again 7 out of 15 for Consequences compared to 4 out of 15 for Seeing Problems. Thus when the influence of these variables is controlled, the result for Consequences is to remove a major portion of the differences between levels and between treatments. Since the relationships are much weaker between the covariates and the criterion with Seeing Problems, the results, after controlling statistically for ideational fluency and verbal I.O., are that main effects remain statistically significant for treatments and levels.

An inspection of the data of Table VII indicates that in general, all training treatments produced significant gains with the Low groups. There were no differences between the effects of the treatments at that level. With the High groups, the practice treatment was the only one which was clearly superior. Four of the five post minus pre-treatment comparisons are lower. In the Average groups, the practice treatment was slightly superior to the extraction treatment which was slightly superior to the teaching treatment. The first two treatments are superior to the control group.

TABLE VIII

SIGNIFICANT CORRELATIONS AMONG VERBAL I.Q. (1), NON-VERBAL I.Q. (2), PRE-TREATMENT IDEATIONAL FLUENCY (3), PRE-TREATMENT ORIGINALITY (4) AND POST-TREATMENT ORIGINALITY (5) ACCORDING TO SAMPLES BASED UPON HIGH, AVERAGE AND LOW SCORES ON CONSEQUENCES

Level	Sample	N	R12	R13	R14	R15	R23	R24	R25	R34	R35	R45
Hi	W	69	.48*	.41*		.30				.50*		.40*
Hi	P	26	.49*	.49*		.41				.46*	.48*	.38*
Hi	E	21	.57*	.43*								.64*
Hi	T	22	.51*	.44*						.68*		
Hi	C	15	.74*							.62*		
Av	W	145	.48*	.31*	.22*	.31*	.19	.20		.38*	.21*	.20
Av	P	47	.41*			.29	.34			.38*	.29	.28
Av	E	56	.51*	.29		.29				.43*	.33*	
Av	T	42	.61*	.42*	.34	.37				.31	.33	
Av	C	48	76*	39*			.34*		.48*	.44*		
Lo	W	64	64*	.37*			.28		.29			.31
Lo	P	19	57*	.58*			.50		.49		.49	
Lo	E	16	79*			.63*		.50	.47		.49	
Lo	T	29	68*	.37						.70*		
Lo	C	18	64*	.47								

"W" represents a combination of samples from treatments 1, 2 and 3.

* indicates significance beyond the .01 level.

Other numbers indicate significance beyond the .05 level.

TABLE IX

SIGNIFICANT CORRELATIONS AMONG VERBAL I.Q. (1), NON-VERBAL I.Q. (2), PRE-TREATMENT IDEATIONAL FLUENCY (3), PRE-TREATMENT ORIGINALITY (4), POST-TREATMENT ORIGINALITY AND, ACCORDING TO SAMPLES BASED UPON HIGH, AVERAGE AND LOW SCORES ON SEEING PROBLEMS.

Level	Sample	N	R12	R13	R14	R15	R23	R24	R25	R34	R35	R45
Hi	W	64	.32*							.36*	.27*	
Hi	P	26										
Hi	E	18						.49				
Hi	T	20	.42							.42		
Hi	C	22	.74*									
Av	W	143	.55*				.18			.31*		.26*
Av	P	44	.46*		-.30							
Av	E	45	.54*									
Av	T	54	.66*							.43*	.28	.38*
Av	C	42	.69*	.30							.30	.52*
Lo	W	71	.68*	.30*			.30					
Lo	P	22	.55*									
Lo	T	19	.68*	.42			.55*	.42				
Lo	E	30	.77*	.36								.36
Lo	C	.85*								.56	.67*	.56

"W" represents a combination of samples from treatments 1, 2 and 3.

* indicates significance beyond the .01 level.

other numbers indicate significance beyond the .05 level.

By levels, both the Highs and the Averages were superior to the Lows although the Highs are not superior to the Averages in post-treatment originality.

As a further test of the second hypothesis, a series of stepwise regression analyses were performed on the results arranged according to treatments and levels of pre-treatment originality. Table X summarizes the results obtained. These reveal that, where the independent variables are verbal and non-verbal I.Q. and pre-treatment ideational fluency and originality, it is easier to account for a significant amount of post-treatment originality when Consequences is used as the measure than when Seeing Problems is used. However, even with Consequences, the results are not particularly strong. Out of 12 possible significant regressions, only 4 reach a level of significance of .05 or better, and only 9 reach a level of significance of .25 or better. The post-treatment multiple correlations with the Average group are the only ones which seem to approach consistently significant results.

In the Seeing Problems results, the control group samples produced 2 of the three significant results. None of the High group results seem predictable with those independent variables used. Appendix E contains further results.

TABLE X

ANALYSIS OF VARIANCE OF STEPWISE MULTIPLE REGRESSION ANALYSIS FOR POST-TREATMENT ORIGINALITY SCORES ON CONSEQUENCES AND SEEING PROBLEMS ARRANGED BY PRE-TREATMENT LEVELS OF ORIGINALITY (HIGH, AVERAGE, LOW) AND TREATMENTS (P, E, T AND C).

Test	Level	Group	dF	F	Prob.	Multiple R*
Consequences	Hi	P	4,21	2.508	.10	.569
	Hi	E	3,17	4.727	.05	.674
	Hi	T	4,17	1.724	.25	.537
	Hi	C	2,12	1.333		.426
	Av	P	4,42	2.106	.10	.409
	Av	E	4,51	2.618	.05	.413
	Av	T	3,38	2.618	.05	.429
	Av	C	4,43	4.122	.01	.527
	Lo	P	4,14	2.106	.10	.642
	Lo	E	4,11	2.309	.25	.676
	Lo	T	3,25	0.721		.282
	Lo	C	4,13	0.845		.454
Seeing Problems	Hi	P	4,21	0.926		.387
	Hi	E	4,13	0.400		.331
	Hi	T	2,17	0.974		.321
	Hi	C	4,17	0.126		.170
	Av	P	4,39	1.148		.325
	Av	E	3,41	1.022		.264
	Av	T	4,49	3.015	.05	.444
	Av	C	4,37	5.417	.01	.608
	Lo	P	3,18	1.123		.397
	Lo	E	4,25	1.071		.383
	Lo	T	3,15	0.411		.276
	Lo	C	4,12	3.64	.05	.740

* Multiple correlation produced by using verbal and non-verbal I.Q. and pre-treatment ideational fluency and originality.

CHAPTER VI

DISCUSSION

The results raise more problems than they solve. While providing evidence that training treatments reflecting concentrated use of fairly common teaching techniques can lead to increased performance on measures of originality used 72 hours after the treatments were ended, they call for qualifying comments concerning measuring instruments to be used, initial level of originality, individual differences, and the very structure of originality. The experimental failure to discriminate between treatments reflects in a sense the review of programs by Edwards (1967) which revealed that, while many treatments can enhance "creative" problem-solving, which elements contribute the most is still unknown. Perhaps it is too soon to say so, but it may be that any technique, even a test-retest one, which provides the opportunity to engage in divergent thinking will result in some increase in originality. Certainly, the present study sheds little light on the relative effectiveness of various techniques while providing partial support to the hypothesis that original verbal performance can be increased.

One completely unexpected result was in the varying results with the two measures of originality. The scoring system used depends primarily on quantitative elements. The only qualitative element involved is whether or not an answer is appropriate. Given that the decision has been made, scores for ideational fluency and originality are derived quantitatively by counting responses and rating their uncommonness. Unlike an

instrument such as the RAT (Mednick, 1962) which requires unusual thinking to arrive at a pre-determined answer, a scoring system like that used here would seem validly useful with a variety of problems. The results obtained strongly suggest, however, that there may be different kinds of original thinking which have been measured in this experiment.

Mackworth (1965) and Hitt (1965) both suggest a bifurcation in relation to originality (Mackworth) and creativity (Hitt). Mackworth distinguishes between the problem-solver and the problem-finder. The first is thought to choose between existing sets of mental rules while the original problem-finder is thought to detect the need for new rules based on a choice between existing and expected programs. Hitt argues, rather more weakly, that the systematic evaluation of ideas is at once complementary and essential to original thinking. While this may be so in many instances, it would seem irrelevant to the matter at hand where originality was measured numerically rather than qualitatively.

Mackworth's scheme seems more pertinent. At present, Seeing Problems is scored for conceptual foresight (cognition of semantic implications) which is defined as the ability to anticipate the needs of or the consequences of a situation (Guilford and Hoepfner, 1966). It was formerly recognized as a good marker for a factor known as "sensitivity to problems". The marking system used generally with it is to count the number of appropriate responses given. Our present use of it is extended to score it for uncommonness as well as appropriateness. By doing so, we seem to have provided some empirical support for Mackworth's speculations.

At the same time that a different type of original thinking seems to have been uncovered, the experiment suggests that it may be related quite differently to variables such as I.Q. and ideational fluency. Mednick (1962) is quite specific in relating fluency and creativity defined as scores on the RAT. For him, there is a direct relationship between the probability of a creative solution and the number of ideas or associations produced. Some support for this comes from Maltzman (1963) who used the instructions: "Write as long a story as you can in 10 minutes" to test the relationship between word fluency and judgments of originality. He found it and suggested that it might be a useful dependent variable in studies of variables influencing verbal originality. While Mednick's RAT has led to results so discrepant that its value as a measure of creativity is under serious question (cf. Dallas and Gaier, 1970; Jacobson et al., 1968) and a more gentle one (Karlin, 1967), Maltzman and his statistical definition of originality seems to be a more reliable source. Yet Clark and Mirels (1970), using Torrance tests, and studying the effect of fluency on creativity, comment upon the neglect of fluency in such studies. All sources cited find fluency significantly related to originality or creativity in their studies.

The present study found significant correlations between pre-treatment ideational fluency and originality on 10 of 15 coefficients and on 7 of 15 coefficients between pre-treatment ideational fluency and post-treatment originality when Consequences was used, and samples were based on levels and treatments (cf. Table VIII). The comparable figures for Seeing Problems

are 5 of 15, and 4 of 15 (cf. Table IX). When the samples are based only on treatments, the figures for Consequences are 4 out of 4 for each comparison. For Seeing Problems, thev are 4 out of 4 for the first and 3 out of 4 for the second. However, they are much lower in all but one of the eight cases. As we also saw in the previous chapter ideational fluency is very strongly influential in post-treatment originality scores derived from Consequences but not so much with Seeing Problem scores.

Finally in this look at problem-finding originality are the differing relationships between I.Q. and the scores from the two instruments. By treatments only, Consequences has 14 significant relationships between originality scores and I.Q.s compared to 1 for Seeing Problems. Interestingly, that one is r = -30 which suggests a most unusual relationship.

The lack of an interaction between levels of originality and treatments for either instruments can be discussed in several ways. Firstly, a hypothesis based more solidly on theoretical considerations might have produced the results predicted. Our third hypothesis lacked this theoretical derivation. Secondly, our hypothesis might have been correct but because of the non-specific effects of our treatments, the expected relationships failed to emerge. A replication might benefit consequently from a less general but more rigorous set of treatments. Thirdly, our lack of direct control of those cognitive variables which we did include in our study, plus the complete lack of consideration of personalogical factors (Dallas and Gaier, 1970) may have resulted in confounding effects

of which we are unaware. Anderson and Cropley (1966), for example, present cogent arguments for a type of non-intellectual originality. An alternative explanation is also supplied by Levy (1968). He suggests that the effects of originality training may be understood as due to changes in the person's criterion for an appropriate response rather than to increases in the associative strength of response. It may have happened in this study that the experimenter's main effect was to help some of the students to define their roles with him in a different way from pre- to post-testings. This could partly explain the control group's "growth" on Consequences. Data summarized in Appendix F indicates that a positive view of the experimenter's presence in the classrooms was generally held. A fifth possible explanation might be derived from the literature on the self-fulfilling prophecy. Although the intention was not to convey in any explicit way to the pupils that growth in originality was the desired outcome, implicit hints might have been conveyed (cf. Marwit and Marcia, 1967; Gordon and Durea, 1948; and Hurwitz and Jenkins, 1966). Finally, the work of Triandis et al (1963, 1965) suggests that creativity of dyads seems to be a function of the creativity levels of the partners. While it takes quite a leap of imagination to transpose work done on dyads to groups of 30 or so, it is not necessarily improbable that the heterogeneous talents of the various samples served both to dampen and accelerate growth in a way so confounded to require specific research on this topic alone.

In conclusion, it might be appropriate to bring in two recent and fundamental notes of caution. Dallas and Gaier (1970) remind us that a test of originality is not "originality" just as a test of intelligence is not "intelligence". Barron (1969), in a similar vein, lists three of the major objections raised by highly creative individuals regarding "creative" tests used. The first is that the tests are too superficial and in no sense do they engage the subject's deepest being, as creative work in the real world certainly does. The second is that, because they measure creative ability in fragments, as indeed factor analysts take pains to do, they provide no opportunity for what has been called "the integral quality of intellect" to manifest itself. Thirdly, "...short and closely timed tests do violence to the very essence of the creative process, which goes at its own pace, will not be hurried, is behaviorally silent for long periods of time, and is easily aborted if someone is always blowing a whistle on it" (p. 37). Despite these pessimistic notes, if originality as we have measured it is deemed worth cultivating, and if we have succeeded to the extent we have using the techniques described, then perhaps this type of thinking can be increased even more when, unlike in the present study, the purpose for using the techniques is made explicit and the time spent using them is measured in hours instead of minutes.

B I B L I O G R A P H Y

Anderson, C.C. and Cropley, A.T. "Some correlates of originality", Australian Journal of Psychology, 1966, 18, 218-229.

Arasteh, A.R. and Arasteh, J. Creativity in the Life Cycle, Vol. I: An Annotated Bibliography. Vol. II An Interpretative Account of Creativity in Childhood, Adolescence and Adulthood. Leiden: E.J. Brill, 1968.

Barron, F. Creative Person and Creative Process. New York: Holt, Rinehart and Winston, Inc., 1969.

Berlyne, D. Conflict, Arousal and Curiosity. New York: McGraw-Hill, 1960.

Berlyne, D. Structure and Direction in Thinking. New York: Wiley, 1965.

Bloom, B.S. Stability and Change in Human Characteristics. New York: Wiley, 1964.

Boersma, F.J. and O'Bryan, K. "An investigation of the relationship between creativity and intelligence under two conditions of testing", Journal of Personality, 1968, 36, 341-348.

Bruner, J.S. "On perceptual readiness", Psychological Review, 64, 123-152, 1957.

Bruner, J.S. On Knowing. Cambridge, Mass.: Howard University Press, 1962.

Bruner, J.S., Oliver, R.R., Greenfield, P.M. et al. Studies in Cognitive Growth. New York: Wiley, 1967.

Bruner, J.S., Goodnow, J.J. and Austin, G.A. A Study of Thinking. New York: John Wiley, 1956.

Christensen, P.R. A review of Pov, W.S. The Experimental Psychology of Original Thinking in Educational and Psychological Measurement, 1968, 28, 195-198.

Clapson, L.G. Test-retest reliability of divergent thinking tests. Unpublished Master's thesis, University of Saskatchewan, 1970.

Clark, P.M. and Mirels, H.L. "Fluency as a pervasive element in the measurement of creativity", Journal of Educational Measurement, 1970, 7, 83-86.

Cropley, A.J. Originality, intelligence and personality. Unpublished Doctoral dissertation, University of Alberta, 1965.

Cropley, A.J. "A note on the Wallach-Kogan tests of creativity", British Journal of Educational Psychology, 1968, 38, 197-201.

Crutchfield, R.S. "Creative thinking in children: its teaching and testing", Intelligence Perceptives 1965: The Terman-Otis Memorial Lectures, New York: Harcourt, Brace and World, 1966, 33-65.

Dacey, J. and Ripple, R. "Relationships of some adolescent characteristics and verbal creativity. Psychology in Schools, 1969, 6, 321-324.

Dallas, M. and Gaier, E.L. "Identification of creativity: the individual", Psychological Bulletin, 1970, 73, 55-73.

Dewing, K. "The reliability and validity of selected tests of creative thinking in a sample of seventh-grade West Australian Children. British Journal of Educational Psychology, 1970, 40, 35-42.

Edwards, M.O. "A survey of problem-solving courses", Journal of Creative Behavior, 1967, 2, 33-52.

Fee, F. "An alternative to Ward's factor analysis of Wallach and Kogan's 'creativity' correlation", British Journal of Educational Psychology, 1968, 38, 319-321.

Feldhusen, J.F., Treffinger, D.J. and Bahlke, S.J. "Developing creative thinking: the Purdue Creativity Program", Journal of Creative Behavior, 1970, 4, 85-90.

French, J.W., Ekstrom, R.B. and Price, L.A. Manual for Kit of Reference Tests for Cognitive Factors. Princeton, N.J., Educational Testing Service, 1963.

Getzels, J.W. "Creative thinking, problem-solving, and instruction", In Hilgard, E.R. (ed.) N.S.S.E. Yearbook, LXIII, Part I. Chicago: Chicago University Press, 1964.

Getzels, J.W. and Jackson, P.W. Creativity and Intelligence, New York: Wiley, 1962.

Gordon, W.J.J. Synectics: The Development of Creative Capacity. New York: Harper Bros., 1961.

Gordon, L.V. and Duria, M.A. "The effect of discouragement on the revised Stanford-Binet Scale", Journal of Genetic Psychology, 1948, 73, 201-207.

Guilford, J.P. and Hoepfner, R. "Sixteen divergent-production abilities at the ninth-grade level", Multivariate Behavioral Research, 1966, 1, 43-66.

Guilford, J.P. The Nature of Human Intelligence, New York: McGraw-Hill, 1967.

Helson, H. Adaptation-Level Theory: An Experimental and Systematic Approach to Behavior. New York: Harper and Row, 1964.

Houston, J.P. and Mednick, S.A. "Creativity and the need for novelty", Journal of Abnormal and Social Psychology, 1963

Hunt, J.M.V. Intelligence and Experience, New York: Ronald Free Press, 1961.

Hurwitz, S. and Jenkins, V. Effect of experimenter expectancy on performance of simple learning tasks. Unpublished paper, Howard University, 1966.

Jacobson, L.I., Flenewski, J.J., Lordahl, D.S. and Liroff, J.H. "Role of creativity and intelligence in conceptualization", Journal of Personal and Social Psychology, 1968, 10, 431-436.

Karlins, M. "Conceptual-complexity and remote-associative proficiency as creativity variables in a complex problem-solving test", Journal of Personal and Social Psychology, 1967, 6, 264-278.

Karlins, M. and Schroder, H.M. "Discovery learning, creativity, and the inductive teaching program", Psychological Reports, 1967, 20, 867-876.

Kogan, N. and Morgan, F.T. "Task and motivational influences on the assessment of creative and intellectual ability in children", Genetic Psychological Monographs, 1969, 80, 91-127.

Laughlin, P.R., Doherty, M.A. and Dunn, R.F. "Intentional and incidental concept formation as a function of motivation creativity, intelligence, and sex", Journal of Personal and Social Psychology, 1968, 8, 401-409.

Levy, L.H. "Originality as role-defined behavior", Journal of Personal and Social Psychology, 1968, 9, 72-78.

McGuire, C., Hindman, E., King, F.J. and Jennings, E. "Dimensions of talented behavior", Educational and Psychological Measurement, 1961, 21, 3-38.

Mackler, B. and Shantz, F.C. "Creativity: theoretical and methodological considerations", Psychological Review, 1965, 15, 217-238.

Maltzman, I. "On the training of originality", Psychological Review, 1960, 67, 229-242.

Maltzman, I. "Fluency and originality in written themes", Perceptual-Motor Skills, 1963, 16, 281-282.

Maltzman, I., Bogartz, W. and Breger, L. "A procedure for increasing word association originality and its transfer effects", Journal of Experimental Psychology, 1958, 56, 392-398.

Maltzman, I., Simon, S., Roskin, D. and Licht, L. "Fxperimental studies in the training of originality", Psychological Monographs, 1960, Whole No. 493.

Marwit, S.J. and Marcia, J.F. "Tester-bias and responses to projective instruments", Journal of Consulting Psychology, 1967, 31, 253-258.

Mednick, S.A. "The associative basis of the creative process", Psychological Review, 1962, 69, 220-232.

Mednick, M.T. and Mednick, S.A. "Incubation of creative performance and specific associative priming", Journal of Abnormal and Social Psychology, 1964, 69, 84-88.

Osborne, A.F. Applied Imagination, New York: Charles Scribner's Sons, 1957.

Parnes, S.J. and Harding H.F. A Source Book for Creative Thinking, New York: C. Scribner's Sons, 1962.

Piaget, J. The Psychology of Intelligence, London: Routledge and Kegan Paul, 1950.

Pribram, K.H. "Neurological notes on the art of education". In Hilgard, E.R. (ed.) N.S.S.F. Yearbook, LXIII. Part I. Chicago, University of Chicago Press, 1964.

Ray, W.S. The Fxperimental Psychology of Original Thinking, New York: Macmillan Co., 1967.

Ridley, D.R. and Birney, R.C. "Effects of training procedures on creativity test scores", Journal of Educational Psychology, 1967, 58, 158-167.

Rouse, S.T. "Fffects of a training program on the productive thinking of educable mental retardates", American Journal of Mental Deficiency, 1965, 69, 666-673.

Skinner, B.F. Science and Human Behavior, New York: Macmillan, 1953.

Suchman, J.R. "Inquiry training: building skills for autonomous discovery", Merrill-Palmer Quarterly, 1961, 7, 147-169.

Taylor, C.W. (ed.) Creativity: Progress and Potential, New York: McGraw-Hill, 1964.

Tolman, E.C. Purposive Behavior in Animals and Men, New York: D. Appleton-Century, 1932.

Tolman, E.C. "Cognitive maps in rats and men", Psychological Review, 1948, 55, 189-208.

Torrance, E.P. Guiding Creative Talent, Englewood Cliffs: Prentice-Hall, 1962.

Torrance, E.P. Education and the Creative Potential, Minneapolis: University of Minnesota Press, 1963.

Torrance, E.P., Gowan, J.C. and Demos, G.D. Creativity: Its Educational Implications, New York: Wiley, 1967.

Triandis, H.C., Bass, A.R., Ewen, R.B. and Miskell, E.F. "Team creativity as a function of the creativity of its members", Journal of Applied Psychology, 1963, 47, 104-110.

Triandis, H.C., Hall, E.R. and Ewen, R.B. "Member heterogeneity and dyadic creativity", Human Relations, 1965, 18, 33-55.

Vernon, P.E. "Creativity and intelligence", Educational Research, 1964, 6, 163-169.

Wallach, M.A. and Kogan, N. Modes of Thinking in Young Children: A Study of the Creativity-Intelligence Distinction, New York: Holt, Rinehart, Winston, 1965.

Wodtke, K.E. Review of Taylor, C.W. (ed.) Creativity: Progress and Potential, Educational and Psychological Measurements, 1964, 24, 705-719.

Yamamoto, K. "Threshold of intelligence in academic achievement of highly creative students", Journal of Experimental Education, 1964, (a), 32, 401-406.

Yamamoto, K. "Creative thinking: some thoughts on research", Exceptional Children, 1964 (b), 30, 403-410.

Yamamoto, K. "Multiple achievement battery and repeated measurements: a postscript to three studies on creative thinking", Psychological Reports, 1965, 16, 367-375.

Yamamoto, K. "An exploratory component analysis of the Minnesota tests of creative thinking", California Journal of Educational Research, 1966, 17, 220-229.

APPENDIX A

PRACTICE TREATMENT

TEACHING OBJECTIVES - PRACTICE TREATMENT

General

1. To expose pupils to divergent thinking situations.
2. To encourage pupils to do more divergent thinking.
3. To help pupils become more divergent thinkers.
4. To stimulate various types of actual classroom procedures.

Specific

1. To provide divergent thinking exercises related to the general questions "what?", "why?", "in what ways?".
2. To permit pupils to use their divergent thinking abilities.
3. To provide practice in evaluating their responses.
4. To limit teacher participation to providing exercises in a predetermined manner.
5. To restrict pupil participation as much as possible to an individual basis.

Practice

Some of you are probably wondering what my presence in your classroom means. Let me try to explain briefly because I don't have too much time.

Many people are saying that less time in school should be spent memorizing facts and much more time should be spent teaching pupils to think. However, education costs a great deal of money, and certain problems arise which must be answered before any great changes in curriculum are introduced. For example: Can you people be taught to think, or is this just something you learn on your own? Can school time devoted to learning to think really help you to become better thinkers? How should that time be spent?

So far, most of the answers given to these questions consist of talk based on opinion. The job that I've set myself is to answer some of these problems more scientifically in a way much too elaborate to go into at this time.

In order to do this research, I've asked for, and received the school's cooperation. Now, I need yours.

What's in it for you? I really don't know. I do know for certain that neither you nor your school progress will suffer. At the least, some of you will think better and at the most, all of you will.

Also certain is that society and education will benefit by knowing for sure what does or doesn't work in this area of knowledge.

You are part of 360 grade 8 pupils taking part. That's a lot of people. But let's get with it.

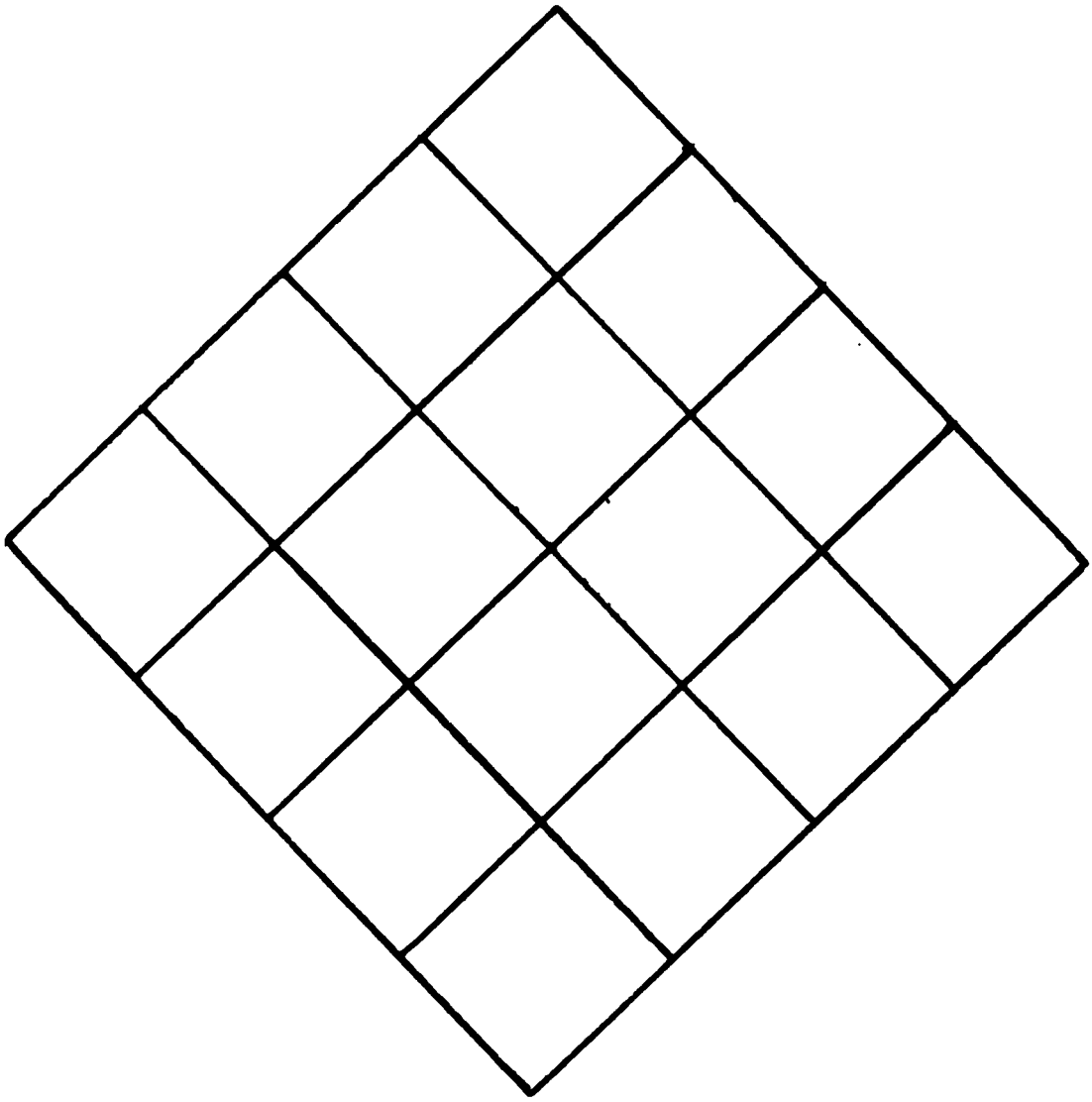
All of you have indicated an ability to answer questions which require many answers. However, like any other skill, this one should improve with practice. Therefore, what I'm going to do for the next four days with you is come in with a series of open-ended questions and give you a chance to answer them. Are there any questions before we begin?

Here are a few rules which I must insist on. During the four periods I spend with you:

1. work independently and quietly.
2. raise your hand to ask questions.
3. when it's time to listen, listen attentively.

You will need 3 or 4 loose-leaf sheets. Please put your answers down like this. (ILLUSTRATE ON BOARD) Today's set of exercises calls for imagination and speedy work. Here's the first one.

1. List as many uses as you can for a tin can. (2 mins.)
2. Think of things which might provide you with comfort on a cold, wintry day. (4 mins.)
3. How could you get across a mud puddle without getting muddy? (3 mins.)
4. Give reasons why you should stay on earth rather than go to the moon? (4 mins.)
5. Give reasons why you should go to the moon rather than stay on earth. (4 mins.)
6. (PASS OUT DIAGRAM OF SQUARES WITHIN SQUARES) Don't make any marks on this diagram. Just count the number of squares which you see there. (3 mins.)

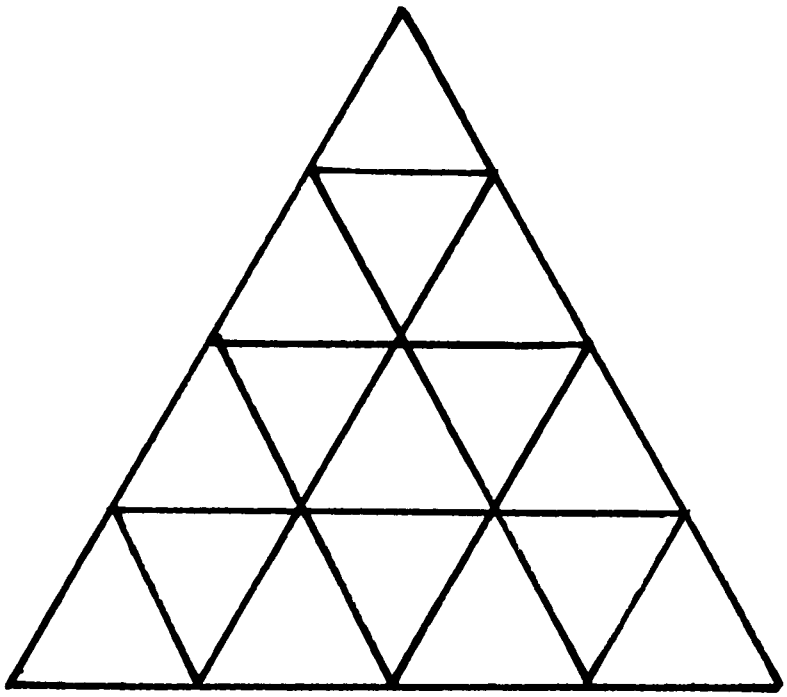


7. List some objects where you might find life. (3 mins.)
8. What forms or ways does death take? (3 mins.)
9. How could you go about making new friends in a completely strange place like the Amazon jungle? (4 mins.)
10. Go over all your answers to each problem but #6 and select your best (A) and second best (B) answers given.

Session #2

Need one sheet of paper, a pen, and diagrams of triangles.

1. DISTRIBUTE DIAGRAMS. How many triangles can you find in this figure? Record your answer. PAUSE. ILLUSTRATE.
2. Most of the animals with which we are familiar have two eyes. Imagine an animal with five eyes. How could it make use of all five eyes? (3-4 mins.)
3. List the best title you can think of for each of the following situations. A good title is usually brief, arouses interest, and gives an idea of what is to come.
   (a) a television program about a space explorer who has been left behind on a small planet. (1½ mins.)
   (b) a moving picture of a 13 year old girl who discovers a new way to bake cakes and becomes famous. (1½ mins.)
   (c) a poem about the forest at the beginning of an autumn day. (1½ mins.)
   (d) a book whose plot is concerned with the adventures of a ten year old boy on a trip up the Amazon River. (1½ mins.)
4. What forms does death take when it comes? (3 mins.)



5. Write the numbers 1-10 in a column. SHOW. I will read the same 10 words to you a number of different times. I would like you to write down quickly a different but associated word which each word read suggests to you. ILLUSTRATE WITH CAN. READ WORDS AT RATE OF 1 PER 10 SECONDS, 4-5 TIMES.

   1. summer 2. out 3. above 4. north 5. top 6. wet 7. up 8. long 9. big 10. front (from Maltzman, 1960).

6. Indicate the problem which you like the most, and the one you liked the least. Also indicate in #2-5, those answers which please you the most by ✓ , or 0 in #5.

Session #3

Need a single sheet of paper and a pen.

1. PASS OUT - DOT DIAGRAM. Don't put anything on the diagram. Copy the nine dots on your sheet of paper. Think about this problem, and when you think you have a solution, try it. "Without lifting your pencil from the paper, draw 4 straight and connected lines which will go through all nine dots, but through each dot only once." (3-5 mins.) Explain the solution and the restrictions which hampered their attempts.
2. PICTURES OF BUZZARD PASSED OUT.
   (a) If this bird could only say one thing, what do you think that would be? Put down as many alternatives as you can. (3-4 mins.)
   (b) Write down some suitable titles for the picture. Really use your imagination to make the titles as clever as you can. (2-3 mins.)

• • •

• • •

• • •

3. Write an imaginative little story entitled "The Lion That Couldn't Roar." Work quickly because there are only ____ minutes left.

AFTER #2, HAVE THE PUPILS INDICATE WHICH OF THEIR ANSWERS THEY CONSIDER TO BE THE BEST IN THE SENSE OF THE UNUSUAL.

Session #4

1. What are some of my major problems? (2 mins.)
2. Choose one of your answers to #1. List facts you know about the situation as it stands. (3 mins.)
3. Can, could or should I try to do something about it? (1 min.)
4. How or in what ways might I approach the problem? (3 mins.)
5. What really is the main problem that I'm concerned about? (2 mins.)
6. Why is it a major problem? (2 mins.)
7. What are some of the sub-problems involved here? (3 mins.)
8. What are the facts related to one of these problems? (3 mins.)
9. In what ways could I do something about solving this problem? (4-5 mins.)
10. Select those ideas from #9 which seem to offer the best chance of solving the problem, and develop a plan which might work using these ideas. (5-10 mins.)
11. IF TIME IS NEEDED. Write some headlines which you'd most like to see.

    Write some headlines which you'd least like to see.

MAKE SOME GROUP-APPROPRIATE REMARKS IN CONCLUSION.

APPENDIX B

EXTRACTION TREATMENT

TEACHING OBJECTIVES - EXTRACTION TREATMENT

General

1. To expose pupils to divergent thinking situations.
2. To encourage pupils to do more divergent thinking.
3. To help pupils become more divergent thinkers.
4. To simulate various types of actual classroom procedures.

Specific

1. To direct thinking toward divergent responses to the general questions "what?", "why?", "in what ways?", by providing multiple illustrations.
2. To direct the evaluation of the responses given.
3. To limit teacher participation to asking leading questions directed towards specific objectives.
4. To so direct participation as to involve every member of the group.
5. To make pupils aware of what is involved in divergent thinking which makes it divergent.

Extraction

Some of you are probably wondering what my presence in your classroom means. Let me try to explain briefly because I don't have too much time allotted to me.

Many people are saying that less time in school should be spent memorizing facts and much more time should be spent teaching pupils to think. However, education costs a great deal of money, and certain problems arise which must be answered before any great changes in curriculum are introduced. For example: Can you people be taught to think, or is this just something you learn on your own? Can school time devoted to learning to think really help you to become better thinkers? How should that time be spent?

So far, most of the answers given to these questions consist of talk based on opinion. The job that I've set myself is to answer some of these problems more scientifically in a way much too elaborate to go into at this time.

In order to do this research, I've asked for, and received the school's cooperation. Now I need yours.

What's in it for you? I don't really know. I do know for certain that neither you nor your school progress will suffer. At the least, some of you will think better and at the most all of you will.

Also certain is that society and education will benefit by knowing for sure what does or doesn't work in this area of knowledge.

You are part of a total of 360 grade eight pupils directly involved. That's a lot of people. But let's get with it.

One big problem facing the thinker is to decide or to know when his ideas are good, useful, interesting or new. You people have all indicated an ability to deal with questions which have more than one answer. However, if you could develop a set of standards to help you decide when your thinking is good, you should be able to become even better than you are now. Therefore, I'm going to come in for a period per day for four days to give you a chance to develop such standards and some skill in applying them. Are there any questions before we begin?

To help do this well, you might observe these rules:

1. Listen carefully to <u>everything</u> said in class, and think hard.
2. When answers are requested, answer often but briefly.
3. Raise your hand before speaking.

You will need a sheet of paper and a pen. Please do not write anything on the sheet which I am now going to pass to you.

1. #1 on that sheet contains answers given to the question: List as many uses for a Tin Can as possible. Select the 3 which you consider to be the most unexpected or unusual.

   DO A TALLY OF SELECTIONS. Do you agree with the choice of the majority? Why? How about the choice of the minority? It is likely that the "popular" choice is going to be the most unexpected or unusual? Discuss.

2. #2 on that sheet contains answers given to the question: List as many uses as possible for a <u>WHAT</u>. Write down 2 or 3 quesses. DO A

1. plant pot
   piggy bank
   cups
   sprinkler
   cookie jar

   hat
   bomb
   house for pet
   shoe
   candle holder

   drums
   ball
   pipes
   bowling pins
   mirror

   props
   heater
   popsicle maker
   gloves
   ear muffs

2. face
   sun
   clock
   eye
   ball

   bucket
   tunnel mouth
   screw
   jewel
   compass

   flower
   money
   pie
   plate
   light

   record
   ring
   badge
   clown
   gun sight

3. hit
   run
   pow-wow
   surrender
   step back or aside

4. walk to nearest residence
   go to a garage
   call a garage
   wait for a car
   borrow from yourself

5. sit
   talk
   listen
   sing
   play
   drink
   dance

6. house work
   homework
   read
   listen to radio
   listen to records
   watch t.v.
   phone friends
   work on hobbies
   sleep and eat
   write letters
   cry

7. slingshot
   explosives
   prayers
   dreaming
   getting lost
   hitch-hiking
   buying ticket
   volunteering

8. give advice
   listen
   get involved
   imitate
   sympathize
   cry
   laugh
   walk away

TALLY OF SELECTIONS. Which one suits the answer best? TALLY. The answer is a "circle". Do any of your guesses strike you as better, and why?

3. A fairly common problem facing everyone is to have another person, or group of persons, "attack" him. This may take the form of scolding, teasing, punishing, ostracizing or pounding him. #3 suggests some solutions. List any others which you figure are not contained in that list. TALLY. Are these really different from those given, or are they just the same only using different words? How? Why? When?
4. Which of the solutions in #4 to the problem "What could you do if, while on the highway, you suddenly discovered that, all the nuts on one wheel were missing?" do you think is the most imaginative? TALLY. Why? How?
5. Hand in the mimeographed sheets. Now on the sheet of loose-leaf that you have been working with, make a list of the characteristics which you think any better-than-usual answer should have. COLLECT AT END OF PERIOD.

Session #2

Need a sheet of paper, a pen, and diagrams of triangles.

1. Do #4 from Session #1.
2. This list contains things which could all be done at a _____ _____? Since this is so, what makes answering hard when the question is "did you have fun at the dance?". Jot down answers individually.

RECORD SEVERAL EXAMPLES OF SOLUTION AND DISCUSS.

point: it's sometimes hard to determine an answer because the question considers a broad area.

6. These are things you might do on a rainy afternoon when you're all alone at home. Do they seem very exciting? TALLY. You spend a few minutes trying to think of something better to do. EXAMPLES FROM CLASS. DISCUSS.

point: new ideas require hard thinking which is sometimes hard.

7. DISTRIBUTE TRIANGLES. WRITE NOTHING ON SHEETS. Count number of triangles. Answer is _____ ILLUSTRATE. Why did you stop counting?

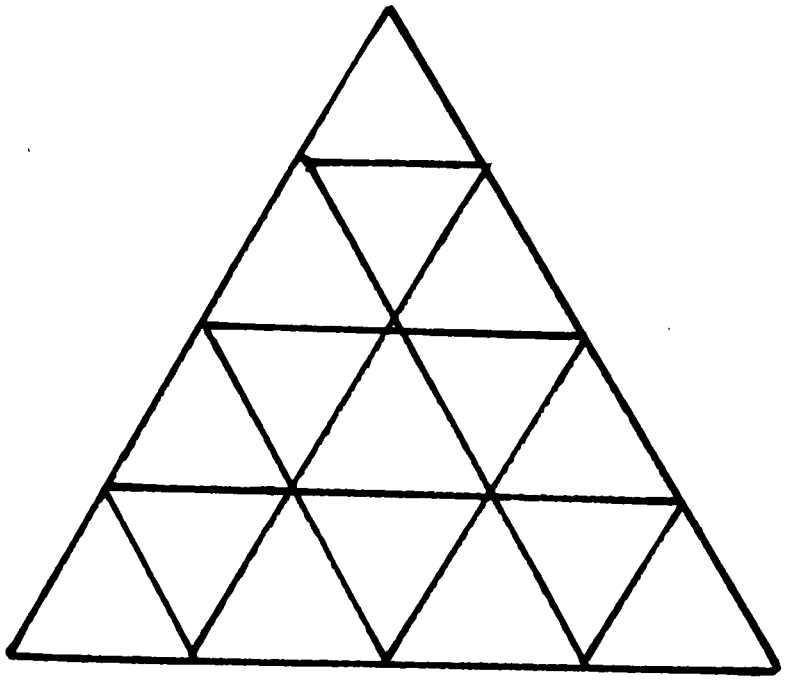
point: looking is not necessarily seeing. Best answer sometimes requires a bit of extra effort.

8. Think of the problems we've discussed and apply this thinking to the drawing up of one list entitled "what is a good idea usually like", and to another called "what is good thinking". HAND IN SHEETS.

Session #3

Need a sheet of paper and a pen.

1. When you have been asked a multi-answered question, your answers may be interesting or dull. List some of the characteristics which you think the most desirable answers should have. (3 mins.)



LIST SOME AND DISCUSS THE MERITS OF THE SUGGESTIONS. KEEP OUT OF IT EXCEPT AS MODERATOR.

2. Think hard of what thinking devices you use when answering such questions, and list as many ways as you can which might be used in answering such questions. (4 mins.)
   LIST AND DISCUSS AS ABOVE.

Session #4

1. Why do we spend so many dollars on research? HANDS. TO DEVELOP NEW IDEAS AND KNOWLEDGE.
2. Why do we have changing styles in cars and clothes? HANDS. NOVELTY IS EXCITING AND PLEASING. SOME CHANGE IS DESIRABLE.
3. Why don't we study just one or two subjects in school? HANDS. NEED DIVERSIFIED EXPERIENCE TO DEVFLOP FLEXIBILITY.
4. Why do you have to wait until you're 18 or 21 before being granted such things as voting rights, legal responsibility, army joining rights, etc. HANDS. NEED TIME TO ACCUMULATE NECESSARY KNOWLEGE.
5. What is the most essential part of a problem? HANDS. KNOW WHAT THE PROBLEM IS.

MAKE SOME GROUP-APPROPRIATE REMARKS IN CONCLUSION.

APPENDIX C

TEACHING TREATMENT

TEACHING OBJECTIVES - TEACHING TREATMENT

General

1. To expose pupils to divergent thinking situations.
2. To encourage pupils to do more divergent thinking.
3. To help pupils become more divergent thinkers.
4. To simulate various types of actual classroom procedures.

Specific

1. To provide specific techniques to facilitate divergent thinking based on simple arithmetical operations.
2. To encourage application of the techniques in evaluating responses.
3. To have teacher do most of the explaining, illustrating and formulating.
4. To let pupils engage in activity as they so desire.
5. To teach pupils to be more divergent in their thinking.

Some of you are probably wondering what my presence in your classroom means. Let me try to explain briefly because I don't have much time allotted to me.

Many people are saying that less time in school should be spent memorizing facts and much more time should be spent teaching pupils to think. However, education costs a great deal of money, and certain problems arise which must be answered before any great changes in curriculum are introduced. For example, can you people be taught to think, or is this just something you learn on your own? Can school time devoted to learning to think really help you to become better thinkers? How should that time be spent?

So far, most of the answers given to these questions consist of talk based on opinion. The job that I've set myself is to answer some of these problems more scientifically in a way much too elaborate to go into at this time.

In order to do this research, I've asked for, and received the school's cooperation. Now I need yours.

What's in it for you? I don't really know. I do know for certain that neither you nor your school progress will suffer. At the least, some of you will think better and at the most, all of you will.

Also certain is that society and education will benefit by knowing for sure what does or doesn't work in this area of knowledge.

You are part of a total of 360 grade eight pupils directly involved. That's a lot of people.

But let's get with it.

TEACHING

Session #1

Here are a few equations for your consideration:

1. No knowledge + 100% imagination = nothing very original
2. 100% knowledge + no imagination = nothing very original
3. Some knowledge + some imagination = possibility of something original

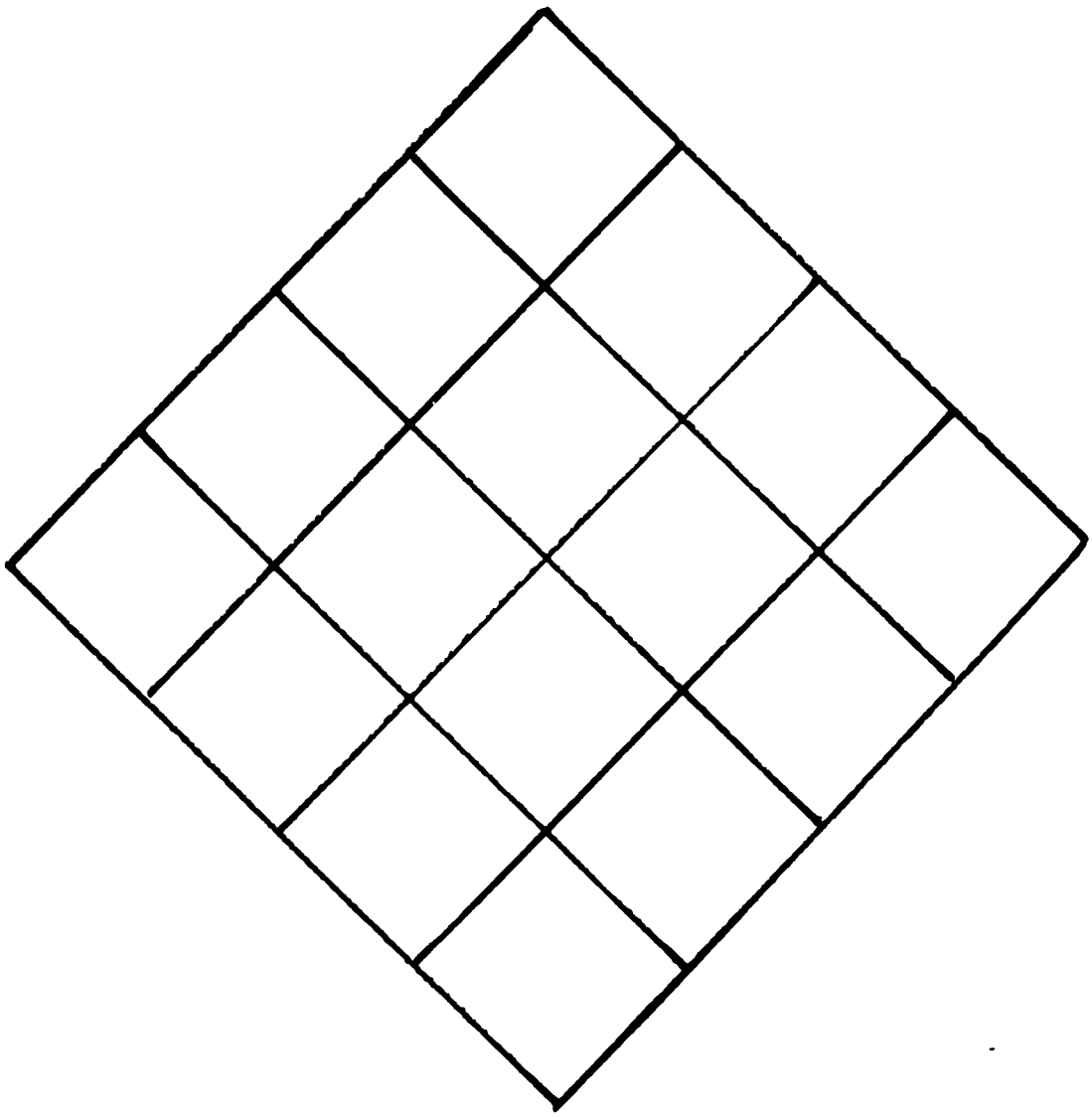
Can anyone provide examples of the first?, the second?, the third? Is there anyone who doesn't understand the equations?

Imagination is taken as the ability to manipulate knowledge--to see it differently than one usually would.

PASS OUT DIAGRAM OF SQUARES. Don't write anything on these diagrams. How many squares are there in the diagram? TALLY. DISCUSS RESULTS BRIEFLY AND APPLY TO EQUATIONS.

A useful rule to keep in mind is that <u>there's always a better way</u>. For example, compare the cars and planes of the 1930's with those of the 1960's. On the whole, the new ones are better than the old ones were in every way.

One problem in producing "different" answers is the fear we nearly all have of being criticized. In order to avoid criticism, we criticize ourselves and our thoughts <u>before</u> we let others examine them. In extreme cases, we criticize ourselves so thoroughly that we fail to even express a single thought.



However, there is an old saying that says there's a time and place for everything. Perhaps, if your aim is to think of novel ideas, the place for criticism is after you run out of ideas and not before. In other words, why not wait until all the ideas you can dig up based on your past knowledge are in before you sit in judgment of them?

For example, how many times have you been wrong when you said that something,--like a party, a movie, a book, a picnic day, a friend, a toy, or a game--was going to be good or bad? What happened in each case was that you judged something BEFORE you had finished thinking about it. ASK FOR A FEW EXAMPLES OF THIS FROM THEIR PERSONAL EXPERIENCE.

Of course, this happens to everyone. However, with some people, it happens less often than with others. Scientists, artists, judges, and inventors are all people who have taught themselves to check the facts, ideas, and opinions about a problem before judging it good or bad.

That's right. They have taught themselves, or learned, to postpone their judging until after they were through thinking of possible solutions and recalling facts and ideas. When they do this, we say that they are good, or fair, judges of the facts. Yet when they do as we often do, leap to conclusions, we say they are bad or unfair judges of the facts. EXAMPLES?

The way people think often becomes a habit. Too often, this thinking becomes un unfortunate habit. For example, they learn to think that all problems have but one right solution and one right answer. They learn to look for only that one. They become satisfied and stop thinking when they have found one solution or answer that works by eliminating the problem.

If they think too often in this way, they become what are known as conformists, or in teen-age terms, squares, zombies, or dead-beats. We know them as people who will seldom try anything new, who never have a thought of their own. You can't tell them anything because they won't listen. You can't show them anything because they won't look. You can't get through to them. HEADS DOWN ON YOUR DESK AND EYES CLOSED FOR A MINUTE OR TWO. FOR YOUR OWN PRIVATF INFORMATION, THINK, AM I LIKE THAT MOST OF THE TIME?

Fortunately for you and I and the way we live, history is sprinkled with examples of people who weren't like that. They kept looking for better ways by trying new ways and ideas. Because of them, we live in houses instead of caves, igloos and tents. We can ride in cars, trains, planes, and boats instead of walking or swimming. Instead of dying at 30 years old from disease and malnutrition, we can live healthy and nourished until our 70's. Even our clothes are due to man's dissatisfaction with the bark and leaves of trees, and the skins and hides of animals.

And of course, the world of entertainment has changed. Do you think you would even have seen or heard the Beatles, Elvis Presley, or Paul Anka, or had radio, television, records and movies if there hadn't been people who wanted things done differently and were willing to give their ideas a chance to be tried out before judging them? Again in teen-age language, these were those whom we'd call "cool-cats", "live-ones", or "real people". They're the "swingers" who pick up the beat (what's going on) and jazz it up (change or alter it) till it's like from nowhere (out of this world or never been seen before).

And how about you? Are you a square or a real people like Mozart, Galileo, Pasteur, Edison, or the Beatles who all succeeded by doing some things well but differently? So you say you're no Einstein. So who is besides Einstein?!

Do you know what group of people is probably the most imaginative of all groups you could assemble? The little pre-schoolers like your neighbor's kids or your little brothers and sisters. To them, a doll is a baby, a stick is a gun, rifle, horse, or spear. They can be grown-up mothers, cowboys, nurses, teachers, Indians, or animals as the mood moves them. When they run out of words, they make them up. My boy calls me "Bad", and calls his mother "Bummy". Most of their sentences start with Why?, How? Where? and What? They are loaded with curiosity and spend their time satisfying it. And they probably learn more in those first five years than they do in the rest of their lives.

And they're just a few years younger than you. Not so very long ago, you were just like they are. Perhaps I can help you become a little bit more like them with these lessons. And please don't say "Heaven forbid!" We don't want you to be like them except to be more curious about this world of ours. There are some things there that you might like to change. There may even be a wish on your part to change yourself.

It's true that there are many things both in yourself and in your world that you're not interested in changing. There are also a number of things that you couldn't change even if you did want to. But you can change some of the things in your world with just a little effort.

The keynote is not "Can you do it?"but "How can you do it?"

Let me illustrate this with a simple little problem. DISTRIBUTE DIAGRAMS OF TELEPHONF DIAL. Please don't write anything on these diagrams. On a separate sheet of paper fill in the following information. The diagram represents a telephone dial. On your paper please place the numbers and letter which belong in each hole. PAUSE WHILF THEY TRY THIS. Although you've looked at and used a dial on numerous occasions, you probably found it impossible or difficult to sove this problem. Why?

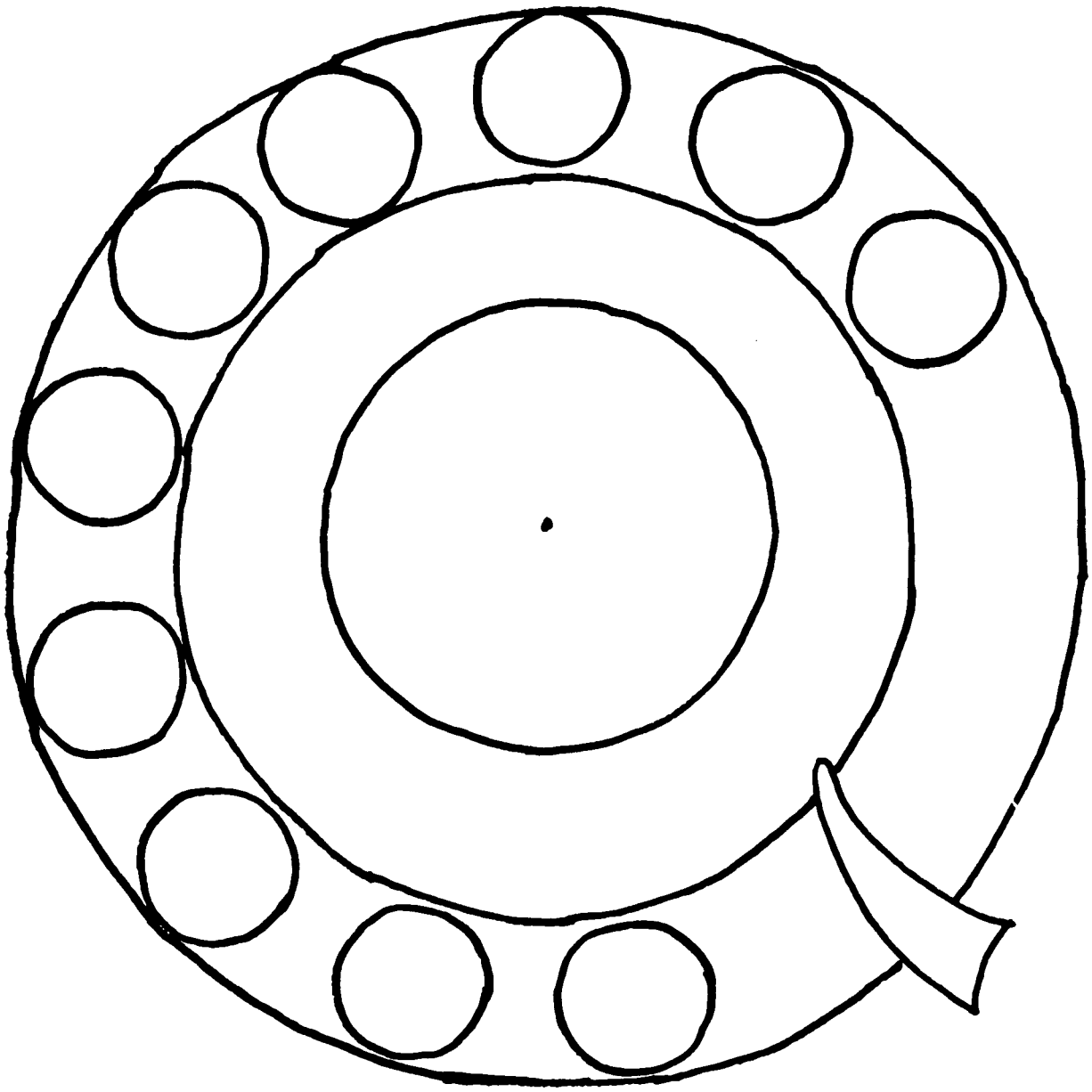
There are probably many different reasons, but an important one is your habit of not looking at things but only for things. When you dial 433-1258, you look only for those numbers. You haven't developed the habit of looking at a thing to see what it is really like. Instead, you merely look at those parts of a thing which can solve your present problem. You have closed your eyes--and your mind--to the possibility that there may be more to a thing than just the actual solution of your actual problem.

The lesson to be learned and the habit to be developed is to REALLY LOOK AT A PROBLEM AND THE SOURCE OF YOUR PROBLEM. THEN, AFTER THINKING HARD, DFCIDE WHAT IS USABLF.

Before summarizing this lesson, I'd like you to make a brief list of what you consider were the most important ideas discussed. Just spend a couple of minutes on this and then hand in your list with names attached. In this way, I can see what ideas are getting across to you.

SUMMARY

1. For original thinking, you need a combination of knowledge and imagination.



2. There's always a better way.
3. Too much criticism too soon leads to unimaginative thinking.
4. Thinking can become a habit. Conformity.
5. The habit can be either good or bad.
6. Not long ago, you were overloaded with curiosity.
7. Change is possible. The question is not Can, but How can you do it?
8. Learn to look <u>at</u> things instead of only <u>for</u> them.

Next day, we shall deal with the notion of a fresh pair of eyes guided by an old set of questions.

Session #2

> (WRITE: Give me the courage to change those things that should be changed, the strength to accept those things that should not be changed, and the wisdom to distinguish between the two).

If such a prayer could be answered on behalf of everyone, we would probably find ourselves alive in a heaven on earth. One aim of these lessons is to help you to develop the "courage to change" not only things, but, and much more important, yourself.

It may help you if you remember that nobody is ever perfect. (ILLUSTRATE ON BOARD WHILE TALKING) Few of us are at either end of a dimension which we could call ability, and which we could label from "0 to 100%". Rather, we all fall somewhere in between with some of us admittedly closer to one or the other end than others.

In the first lesson, we tried to explain that although you were all more or less frightened about being different in your thinking and actions, there were certain advantageous in being way out at some times. We discussed one track thinking, conformity, "a real people", suspended judgment, and the notion of looking at instead of looking for things. It was suggested that before judging or acting, you should look, think, and then proceed with these. The idea is to do first things first.

Here are a few points which I noted from a textbook on thinking. They deal with the favorable circumstance or aids, and blocks to original individual thinking (Haefele, 1962).

Area	Block	Aid
Perceptual	Important point seen as obvious or trivial. Real problem in the situation not even recognized.	Ability to identify important point.
Cultural	Educated to use only the given, and to achieve one answer. Thinking by rules and cliches.	Ability to search for useful material to provide alternate answers. Ability to break fixed mental attitudes.
Emotional	Tendency to conform. Over-motivation. Personal fears and phobias. Distrust of associates. Going with the first idea you get.	Nonconformity. Fascination with problems.

(p. 159)

The main ideas I would like you to keep from this is that thinkers-to-be share many problems, and second, there are ways of overcoming these in part at least.

Let's examine the notion that "originality is simply a fresh pair of eyes" in this lesson to see how that might help our thinking.

1. SENSITIVITY TO PROBLEMS. A highly creative person is one who tends to see problems where the ordinary person sees none. Hence, Henry Ford agreed with many that cars were useful things. However, the problem he saw and overcame involved the mass-production of cars so that nearly everyone earning money could afford one. Florence Nightingale knew what everybody else knew about the presence of sick and wounded people in battles but she was the first to see the usefulness of women being trained specially to care for them. In school, the creative pupil is not the one who sees his job done once he has done his assignments. Instead, he goes on to study in detail those things which interest him the most.

These people have all developed what is called constructive discontent. This means that they weren't content to accept things as they were but that they wanted to do something about changing them.

2. THE ART OF QUESTIONING. Asking the right questions often helps to determine what kind of answers you'll get. Let's look briefly at three types of questions.

(i) Fact-finding. What do I know about this? We often ignore our knowledge because the question "sounds" different and new, or too simple. Recall the square and your problems with it.

(ii) Decision or Judgment. "Can or Could or Should I...?" This type of question calls for a "yes", "no","maybe" answer. It tries to decide in what direction our activities will go. For example: Could I pass without studying?

If "yes" - stop studying

If "no" - continue studying

If "maybe" - get more information about the problem or continue as before.

(iii) Creative. "How or in what ways can I...?" This type of question calls for ideas. It tries to lead to the discovery of the maximum number of ideas bearing on a problem. Often when it is asked, people stop after their first idea. However, even when an idea can solve a problem, it needn't be a very good one. For example, to the question, "How can we stop crime?", the answer "Destroy all people" would work but it probably wouldn't satisfy many people if applied.

What have we been saying? All questions involve facts. Start with these, mix in some imaginative thinking, and...who knows? something worthwhile may be the result.

3. FACT-FINDING. Once you know that you have a problem, the next step is gathering pertinent information about the problem-area. Can you ever get "all" the facts? (PAUSE) Never. But one can try to get as many as possible within the limits imposed by the situation. This may involve a question of worth. How much is the solution worth is one question too seldom asked. As a result, some people take hours on a problem which merits mere minutes of their time, while others spend minutes where hours seem called for. There's quite a difference between buying a car or house and buying a package of gum for example.

So how do you go about finding facts? Look at the problem. Try to remember what you have learned about this type of difficulty. Think of alternative information which might fit, and then solve it (maybe).

4. DEFINITION OF THE PROBLEM. This is a crucial stage in thinking. It very often happens that a problem well-defined is half solved. For example, how many squares in the diagram? The crucial point to consider is, what is a square? Once this is realized, the problem is very easily solved.

How do we go about defining a problem? It's hard to say. However, here are some hints which might help.

(i) Do we want better mousetraps or fewer mice? Ask the key question. For years, we have tried to trap and kill coyotes, rats and mice. Result:-no very great change. Recently, I read an account from the U.S. which reported success in coyote control by feeding them not poison but special hormone pills which prevent reproduction. The result:-a rapidly diminishing coyote population and a rapidly rising rat and mouse population. Next: feed special hormone pills to rats and mice to prevent their reproduction. Result: a lot of useless traps.

(ii) Ask what else the problem could mean? "How to write a letter" could become "How to communicate". This leads to a much broader answer or at least possible answer. The question "Why?" leads to such things as the elimination of mice. By focusing attention on the purpose of the question being asked, you are led to a pertinent answer.

5. BREAKING DOWN THE PROBLEM is the next step. Often the problem you are dealing with is much too broad. Break it down into sub-problems. For example: "How can I get more time out of the house at night" is a big problem. An easier one to solve is "How can I get out tonight"?

6. List ideas following the deferment-of-judgment principle we discussed last day. That is, let the ideas flow until they stop. Then look back and select the one which seems most likely to succeed.

Tomorrow, we'll go into details of how to get better ideas.

So far today, you've done a lot of listening, and, I trust, thinking. To see how the lessons are going, would you please list briefly the main points of the two lessons which stick out in your mind. (3 minutes)

SUMMARY OF SESSION 2

1. Be on the lookout for problems. Be sensitive to problems by developing constructive discontent.
2. Practice asking questions.
   "What?" leads to fact-finding.
   "Can, Could, or Should I" lead to decision or judgment for direction of action.
3. Find as many pertinent facts as time allows.
4. Define the problem by looking for the Main meaning of it.
   "How" leads to ideas for solving.
   "Why" leads to reason solution is desired.
5. Break the problem down into sub-problems.
6. List as many ideas as you can which bear on the problem.

Session #3

Finish session #2 from bottom of page ____

We've now discussed some thinking habits and techniques for attacking problems. Today, we shall consider how to go about getting better ideas.

The number one complaint on the ordinary thinker's parade of laments is "I can't think of anything". Perhaps the expression is not strange to you either. Yet the same people who say such things can easily tell a good, pleasing, and interesting idea from a poor, unexciting dull one. Among the things which this seems to suggest is that you've got "it" up there someplace but you're having trouble getting it down. Let's see how the following little example helps you to overcome this most serious block to effective thinking.

For at least 8 years, you people have been becoming experts in arithmetic. During this time, you have mastered certain simple, basic intellectual operations. For the moment, let's just consider a few of these in relation to a common little problem.

You start with 6 oranges. What, arithmetically, can you do with them?

	PRODUCT	OPFRATION
1.	You have 100%	magnified quantity
2.	You have 1/2 a dozen	minimized quantity
3.	You have 8 oranges	added a quantity
4.	you have 4 oranges	subtracted a quantity
5.	you have 4 oranges and 2 apples	substituted e.g. $\frac{1}{2} + \frac{1}{4} = 6/12 + 3/12$
6.	you have 2 oranges	divided a quantity

	PRODUCT	OPERATION
7.	you have 18 oranges	multiplied a quantity
8.	you have 1 + 2 + 3 oranges	rearranged them

As you see, arithmetic at this level is simple. How about other problems? How does this fit in?

MIMEOGRAPHED SHEET WITH 9 SQUARES. THESE ARE NUMBERED, THERE IS A LITTLE SQUARE IN #1.

Perform each operation as I tell you, only change the square around each time. Put a "rearranged" square in each cell of the table.

On the back of the sheet you have just been working on, summarize the operations which you used in converting that square to something different. Hand the sheets in.

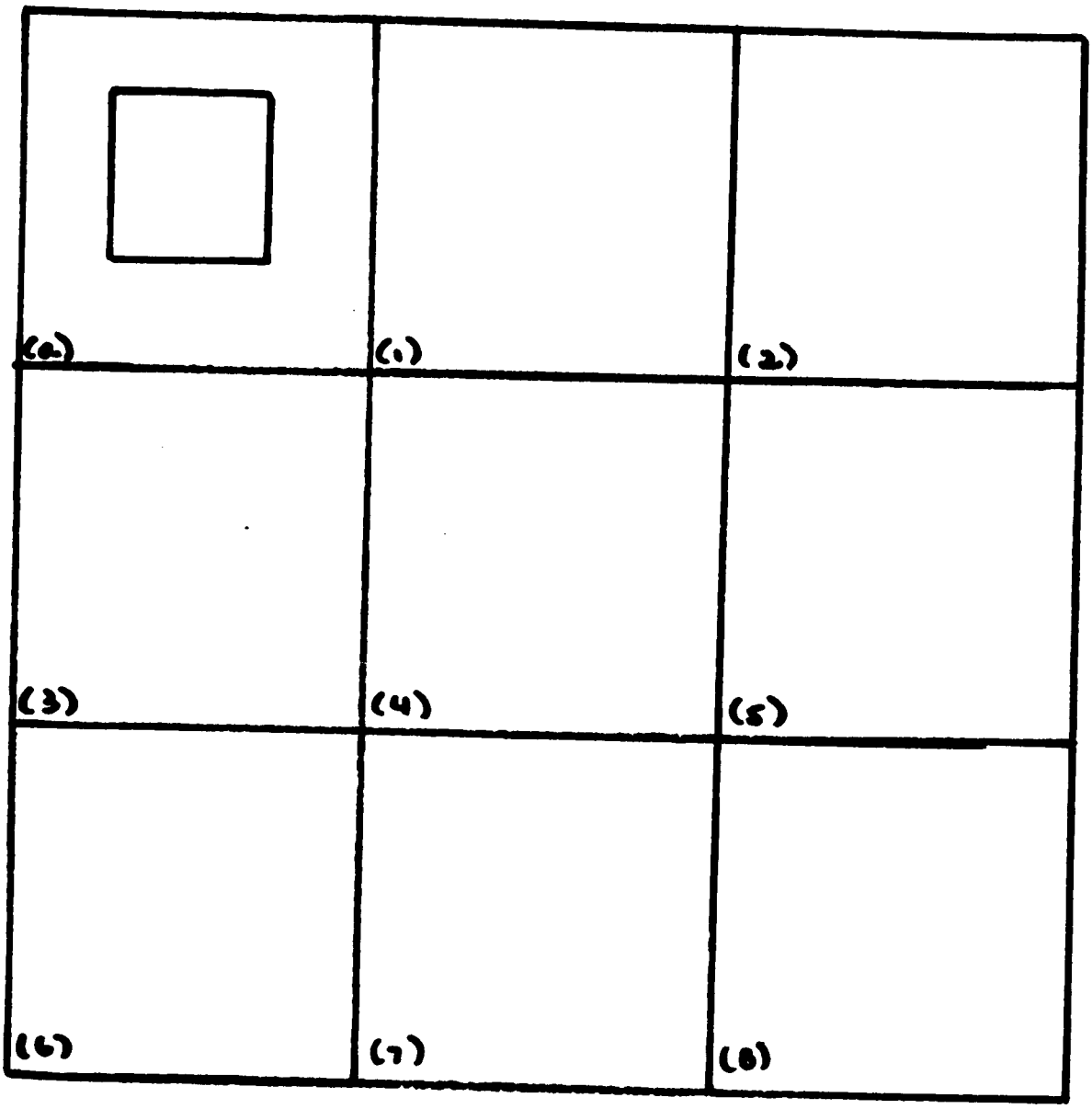
Tomorrow, we'll examine the general application of these operations.

Session #4

Yesterday, we ended the lesson with a discussion of some operations with which you were already very familiar and which were offered as the means of taking a giant step towards more imaginative thinking. Today, we are going to see how the ideas we've been tossing around actually work. In a sense, we will be putting our theories to work.

Select one of the following situations which you think you'd like to work on:

I feel that I'm doing rather poorly: at home
in school
socially
physically
personality-wise


(0)
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)

Strategy: Use a sheet of paper to jot down your ideas.

1. What do I know about the situation?
2. Can, could, or should I try to do something about it?
3. In what ways?
4. Main Problem: What?
   Why?
5. Sub-problems?
6. Facts?
7. Ideas? Refer to mimeographed sheets.
8. Choose those solutions which you think might succeed.

Do you think your solution is now better than the one you would have arrived at had you not followed this procedure?

MAKE GROUP-APPPROPRIATE REMARKS IN CONCLUSION.

OPERATIONS

Magnification				
minimizing				
Addition				
Subtraction				
Substitution				
Multiplication				
Division				
Rearranging				
Magnification				
Minimizing				
Addition				
Subtraction				
Substitution				
Multiplication				
Division				

APPENDIX D

INSTRUCTIONS TO THE EXAMINER

INSTRUCTIONS TO THE EXAMINERS

If someone should ask, you are testing for school related abilities and traits such as verbal power and intelligence. The measures are contributing to a doctorate study being done from the University of Alberta.

The first tests given and their order should be:

1. Consequences (10 minutes)
2. Seeing Problems (6 minutes)

Proper timing of these tests is essential. Read the page of instruction with the groups and answer questions as fully as you can without revealing what specifically is being measured.

The following tests may be given in any order which the examiner chooses. Each however must be completed at one sitting. The tests and their time-taking requirements are:

1. Lorge-Thorndyke Verbal Intelligence 35 minutes
2. Lorge-Thorndyke Non-verbal Intelligence 35 minutes

The main requirement to observe in giving any of these tests is that of time. Since group comparisons are to be made from the results, it is highly desirable that the time limits be strictly adhered to in all sessions.

Thank you for your cooperation.

APPENDIX E

SOME DESCRIPTIVE STATISTICS

TABLE E1

Correlation Matrices for Practice Group

Consequences	1	2	3	4	5
1. Verbal Intelligence	1.000	.429	.349	.171	.307
2. Non-verbal Intelligence		1.000	.227	.109	.250
3. Pre-ideational Fluency			1.000	.753	.528
4. Pre-originality				1.000	.459
5. Post-originality					1.000

Seeing Problems	1	2	3	4	5
1. Verbal Intelligence	1.000	.429	-.040	-.012	.141
2. Non-verbal Intelligence		1.000	.074	-.126	.090
3. Pre-ideational Fluency			1.000	.554	.349
4. Pre-originality				1.000	.387
5. Post-originality					1.000

Correlations above .205 are significant beyond the .05 level. Those above .267 are significant beyond the .01 level.

TABLE E2

Correlation Matrices for Extraction Groups

Consequences	1	2	3	4	5
1. Verbal Intelligence	1.000	.606	.467	.356	.342
2. Non-verbal Intelligence		1.000	.313	.273	.206
3. Pre-ideational Fluency			1.000	.661	.409
4. Pre-originality				1.000	.478
5. Post-originality					1.000

Seeing Problems	1	2	3	4	5
1. Verbal Intelligence	1.000	.606	.194	.022	.058
2. Non-verbal Intelligence		1.000	.118	.001	.110
3. Pre-ideational Fluency			1.000	.487	.132
4. Pre-originality				1.000	.269
5. Post-originality					1.000

Correlations above .205 are significant beyond the .05 level. Those above .267 are significant beyond the .01 level.

TABLE E3

Correlation Matrices for Teaching Groups

Consequences	1	2	3	4	5
1. Verbal Intelligence	1.000	.641	.513	.454	.405
2. Non-verbal Intelligence		1.000	.241	.288	.231
3. Pre-ideational Fluency			1.000	.631	.346
4. Pre-originality				1.000	.416
5. Post-originality					1.000

Seeing Problems	1	2	3	4	5
1. Verbal Intelligence	1.000	.641	.310	.295	.151
2. Non-verbal Intelligence		1.000	.311	.211	.072
3. Pre-ideational Fluency			1.000	.516	.313
4. Pre-originality				1.000	.210
5. Post-originality					1.000

Correlations above .205 are significant beyond the .05 level. Those above .267 are significant beyond the .01 level.

TABLE E4

Correlation Matrices for Control Group

Consequences	1	2	3	4	5
1. Verbal Intelligence	1.000	.745	.424	.315	.242
2. Non-verbal Intelligence		1.000	.348	.278	.360
3. Pre-ideational Fluency			1.000	.725	.287
4. Pre-originality				1.000	.249
5. Post-originality					1.000

Seeing Problems	1	2	3	4	5
1. Verbal Intelligence	1.000	.745	.259	.401	.111
2. Non-verbal Intelligence		1.000	.261	.091	.084
3. Pre-ideational Fluency			1.000	.486	.413
4. Pre-originality				1.000	.378
5. Post-originality					1.000

Correlations above .217 are significant beyond the .05 level. Those above .283 are significant beyond the .01 level.

TABLE E5

Correlation Matrices for the Total Sample

Consequences	1	2	3	4	5
1. Verbal Intelligence	1.000	.586	.435	.318	.328
2. Non-verbal Intelligence		1.000	.270	.215	.245
3. Pre-ideational Fluency			1.000	.699	.405
4. Pre-originality				1.000	.414
5. Post-originality					1.000

Seeing Problems	1	2	3	4	5
1. Verbal Intelligence	1.000	.586	.178	.078	.121
2. Non-verbal Intelligence		1.000	.174	.022	.075
3. Pre-ideational Fluency			1.000	.514	.279
4. Pre-originality				1.000	.300
5. Post-originality					1.000

Correlations above .103 are significant beyond the .05 level.
Those above .135 are significant beyond the .01 level.
Those above .172 are significant beyond the .001 level.

TABLE E6

PERCENT VARIANCE IN POST-TREATMENT ORIGINALITY ACCOUNTED FOR IN STEPWISE REGRESSION ANALYSIS BY SELECTED VARIABLES FOR SAMPLES ARRANGED BY TREATMENTS AND LEVELS OF ORIGINALITY

Test	Level	Group	N	VIQ	Non VIQ	IdFl	Pre 0	R^2
Conseq.	Hi	P	92	4.0	0.9	8.5	1.6	14.99
	Hi	E	93	1.8	7.2	2.1	0.08	10.97
	Hi	T	93		0.9	9.4		10.28
	Hi	C	81	0.3	0.2	0.3	2.0	2.87
	Av	P	92	2.7	0.4	1.4	5.95	10.53
	Av	E	93		3.9	0.8	2.3	6.96
	Av	T	93	2.8	1.2	1.6	14.1	19.75
	Av	C	81	0.6	1.7	7.4	27.3	36.93
	Lo	P	92	0.2	10.6		4.95	15.77
	Lo	E	93	0.9	0.2	0.9	12.6	14.63
	Lo	T	93	0.2		6.9	0.6	7.60
	Lo	C	81	3.6	1.7	5.4	44.2	54.82
Seeing Prob.	Hi	P	92	4.0	1.0	8.5	2.0	15.0
	Hi	F	93	1.6	7.2	2.1	0.1	11.0
	Hi	T	93		0.9	9.4		10.3
	Hi	C	81	0.3	0.2	0.3	2.0	2.9
	Av	P	92	2.7	0.4	1.4	6.0	10.5
	Av	E	93		3.9	0.8	2.3	7.0
	Av	T	93	2.8	1.2	1.6	14.1	19.75
	Av	C	81	0.6	1.7	7.4	27.3	36.9
	Lo	P	92	0.2	10.6		5.0	15.8
	Lo	E	93	0.9	0.2	0.9	12.6	14.6
	Lo	T	93	0.2		6.9	0.6	7.6
	Lo	C	81	3.6	1.7	5.4	44.2	54.8

APPENDIX F

TREATMENT EVALUATION QUESTIONNAIRE AND RESULTS

TREATMENT EVALUATION QUESTIONNAIRE

Take a little piece of paper and record your answer to the following questions. Do not put your name on the paper.

1. Do you think you learned anything about thinking during these 4 lessons? YES MAYBE NO

2. Did you find the lessons interesting? YES NO

3. If we were to do this again, would you have preferred MORE, FEWER, SAME number of lessons?

4. Do you think that exactly the same material would have been taught AS WELL, BETTER, POORER by some other teacher?

Answers by Location

		Army	City	Rural	Totals
1.	Yes	53	58	42	153
	Maybe	32	29	29	89
	No	13	8	11	32
2.	Yes	75	87	73	235
	No	23	8	8	39
3.	More	46	75	47	168
	Same	18	13	20	51
	Fewer	34	7	14	55
4.	Poorer	50	60	47	157
	As Well	41	31	31	103
	Better	7	4	3	14

Answers by Experimental Treatment Groups

		Practice	Extraction	Teaching	Totals
1.	Yes	45	55	53	153
	Maybe	28	29	32	89
	No	18	6	8	32
2.	Yes	76	76	83	235
	No	15	14	10	39
3.	More	52	49	67	168
	Same	16	21	14	51
	Fewer	23	20	12	55
4.	Poorer	54	45	58	157
	As Well	33	40	30	103
	Better	4	5	5	14