PREDICTIVE VALIDITY OF INTELLIGENCE FOR THE DRAWING COMPLETION TEST (DCT) UNDER DIFFERENT CONDITIONS OF INSTRUCTION

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY

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1963

ABSTRACT

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by Gerald G. Griffin

The problem of this study consisted mainly of two parts. The first part was to determine the effect four different Group Conditions, each one presenting different instructions designed to either induce no special motivation or learning set, induce special motivation only, induce a special learning set only, or induce both a special motivation and a special learning set, would have upon mean Drawing Completion Test (DCT) scores. The second part was to determine the relationship or predictive validity of intelligence (as determined by correlation coefficients) between the DCT scores obtained under each of the four different Group Conditions and the scores of an independent measure of intelligence, the College Qualification Tests (CQT).

The subjects for this study were 120 beginning psychology students who were members of four separate psychology 151 classes selected at random from Michigan State University. These four classes, consisting of approximately 30 students each, were randomly assigned to the four different Group Conditions previously described. The instructions of the control group (Group Condition I) were designed so as

to induce no special motivation or learning set. The instructions of Group Condition II were designed to induce special motivation by informing the subjects in the group that the DCT was a new type of intelligence test and that they should try to do their best in their responses because these responses would be scored and used for future evaluation. Group Condition III provided a learning set by special instruction in the form of a lecture, but this instruction induced no special motivation. The instructions of Group Condition IV induced both a special motivation and provided the special type of learning set presented to Group Condition III. The subjects in each of the four groups were given approximately 30 minutes to complete their responses to the DCT. The subjects were asked to code their completed DCT blanks. These blanks were then collected and scored by the investigator using Kinget's scoring scale. The investigator had no knowledge when scoring the completed DCT blanks as to which Group Condition each one belonged.

Two reliability studies were conducted during this investigation using the Kendall Coefficient of Concordance. The first reliability study involved ten scorers, trained in using the Kinget scoring scale, who had scored 19 completed DCT blanks selected from various studies. The reliability coefficient of this study was .903. The second reliability study involved three of the ten scorers of the first study who had scored 40 completed DCT blanks selected at random and thoroughly intermixed, 10 from each Group

Condition, from the present study. The reliability coefficient of this study was .870. A mean DCT score was found for each Group Condition and a simple analysis of variance was applied to this data. T-tests between all Group Conditions were made. The overall difference between the mean DCT scores of the four different Group Conditions was found to be highly significant as was the difference between the mean DCT scores for all possible sets of Group Condition comparisons. It was shown by a simple analysis of variance, using CQT scores as a criterion, that the mean intelligence of the four different groups were statistically equal. The DCT scores obtained from the subjects under each Group Condition were correlated with the subjects CQT scores, and these correlations were statistically compared at the .05 level. The CQT-DCT correlation coefficients for Group Conditions I, II, III, and IV were .63, .85, .53, and .17 respectively. The first three were significant, the last was not. The comparisons between the differences of the correlation coefficients of Group Conditions II and I, II and III, II and IV, and I and IV, were statistically significant. The differences between the correlation coefficients of Group Conditions I and III, and III and IV, were not statistically significant.

The specific conclusions of this investigation are: (a) The drawing responses of subjects to the DCT are significantly affected, both overall and between each possible pair of Group Condition comparisons when the DCT, in addition

to be administered under the Group Condition with instructions inducing neither special motivation or a special learning set, is administered under the three additional Group Conditions of different instruction designed to either induce special motivation, provide a definite learning set, or bring about both conditions in combination. (b) The DCT has predictive validity for intelligence when administered under the instructional conditions of induced motivation, when administered under the instructional conditions of no induced motivation or special learning set, and when administered under the instructional conditions of a special learning set. Of these three types of instruction the one producing scoring responses with the highest predictive validity for intelligence is the one inducing special motivation brought about by informing the subjects that the DCT is a new intelligence test and that their responses to it will be evaluated. The instruction second highest in this respect is the one which induces neither a special motivation nor provides a special learning set (the control group).

The general conclusion of this investigation is that comparison of DCT scores of intelligence among different subjects is reliable only if the DCT has been administered to the subjects under the same conditions.

Approved by:

Thesis Chairman

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By

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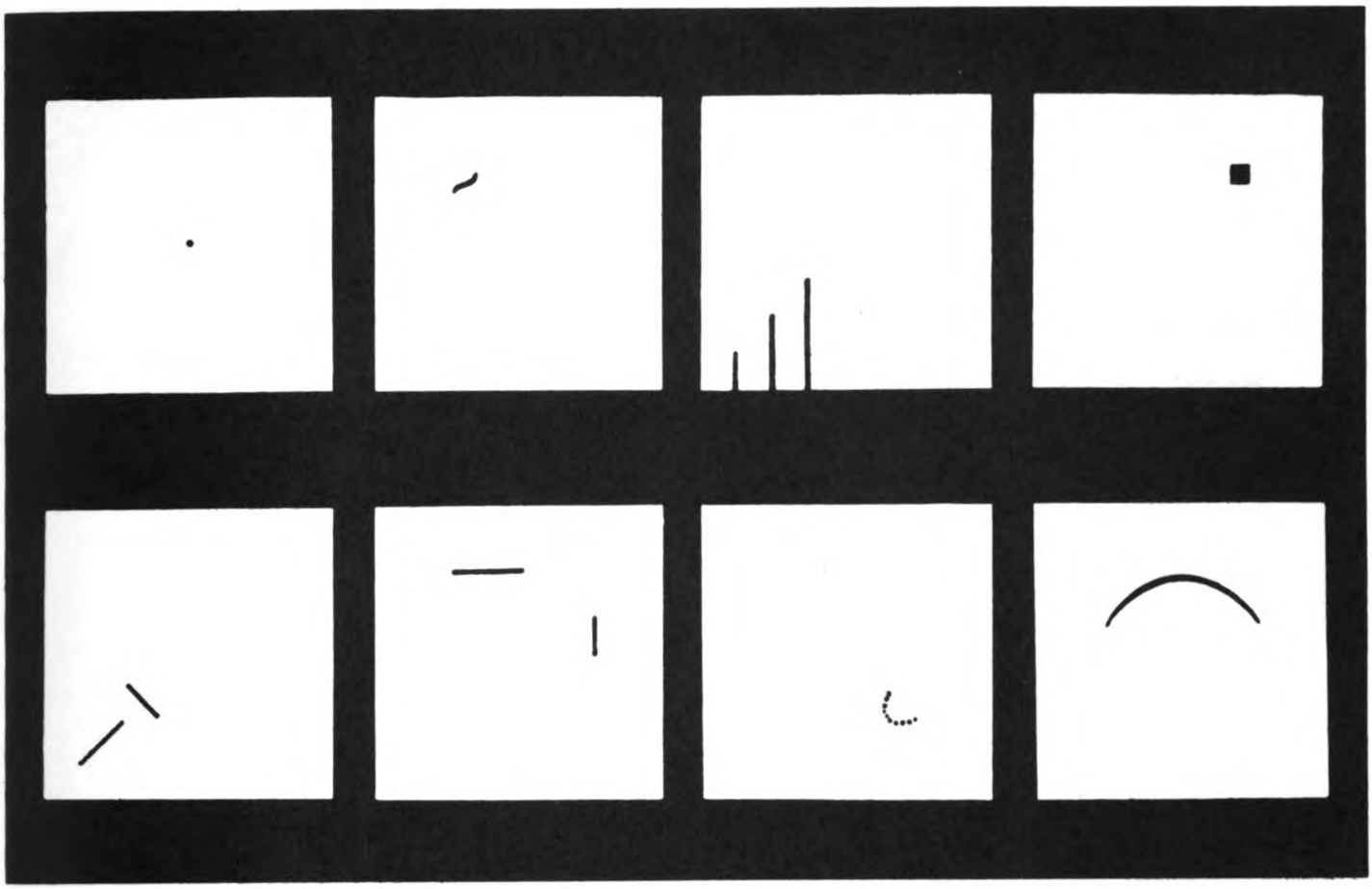
A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1963



Drawing Completion Test

ACKNOWLEDGMENTS

I wish to express my sincere gratitude and appreciation to my Program Chairman, Dr. G. Marian Kinget, for the interest, encouragement, and instruction she has expended on my behalf in connection with this study. In addition, I am especially grateful to my statistical advisor, Dr. Robert E. McMichael, for the very helpful assistance and time he has rendered me in the analysis of my study and its data. Also, I wish to express my thanks to Dr. Irwin Kremen, for the consideration he has made available to this study. My special appreciation goes to my wife, Dolores, for the many drafts of this thesis which she typed, as well as to Mr. Ward Harris and Mr. William Pieper, fellow Graduate Students, for the assistance they rendered me in the collection of data for Group Conditions I and II of this study.

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CHAPTER I

INTRODUCTION

The major goal of this study was to determine the predictive validity of intelligence for the Drawing Completion Test (DCT), as a result of correlating DCT scores with the scores of an independent measure of intelligence, under four different conditions of instruction involving the variables of motivation and learning. A DCT blank is exhibited following the title page of this report. This blank consists of eight square fields, 1.5 inches by 1.5 inches, each of which contains different line or line structures which are referred to as stimuli. The square fields are arranged four across and two down. Subjects are asked to take these stimuli and make them into a drawing of anything they wish. The DCT was originally developed by Wartegg (1934) as a clinical tool for investigating personality. In the past decade, however, consideration has been given to the DCT as a measure of intelligence. The hypothesis that the DCT could be used as a measure of intelligence originated with Kinget (1952). The use of a drawing test for this purpose was not a novelty originating with the DCT since similar efforts had previously been made by Schuyter (1904), using his own drawing tests on age norms, and by

Goodenough (1926) and Berdie (1945), using the Draw-A-Man Test. Jones and Rich (1957) also worked with the Draw-A-Man Test in estimating the intelligence of the aged. The DCT, however, has two distinct advantages over the Goodenough and other drawing tests. First, the interpretation of free drawings has been too unilaterally focused upon content, that is upon the properly projective aspects, while their execution, or expressive aspect, has remained largely unexplored. The scoring system of the DCT, though, deals with execution as well as content variables. Second, the DCT provides for highly diversified standard situations which are absent in other drawing tests.

In 1962 Kinget devised an objective scale for measuring a subject's functional level of intelligence using the DCT (Appendix B, page 36). This scale is based upon stimulus integration and drawing organization. Stimulus integration refers to the manner in which the subject responds to the form qualities of the stimuli while drawing organization refers to content and the characteristics of execution. Using this scale, Hayes (1962) found that drawing organization and stimulus integration, as measured by the DCT, correlated .78 with the Wechsler Scale of the California Mental Maturity Test. Kinget's scale is the same one used by the investigator to score the completed DCT blanks obtained in the present study.

The College Qualification Tests (CQT) were selected by the investigator as the criterion measure of intelligence

with which the DCT would be correlated for purposes of determining its predictive validity for intelligence. The CQT correlates .75 with the California Mental Maturity Test (Office of Evaluation Services, Michigan State University, 1962), .82 with the School and College Ability Tests (College Qualification Tests Manual, 1957), and .78 with the American Council on Education Psychological Examination (College Qualification Test Manual, 1957). One means of accounting for the high correlations among these measures is to postulate that a common element of intellectual ability is being measured by all of them. The intelligence which the DCT is asserted to have measured in this study is this inferred common element of intellectual ability, and is defined and measured in terms of CQT scores.

The general questions which the investigator sought to answer as a consequence of the present study were as follows:

1. What happens to the qualities of the drawing responses, as reflected by how they are scored using Kinget's scoring scale, when the DCT is administered under different conditions of instruction?
2. What are the correlations between the DCT and CQT scores (predictive validity for intelligence) under these different conditions of instruction, and are these correlations significant?
3. Under which condition of instruction would the most reliable drawings of intelligence, or

highest predictive validity (highest correlation between DCT and CQT scores), be obtained, and would this correlational value be significantly different from the DCT-CQT correlation values obtained for the other Group Conditions?

The investigator felt that the two variables of motivation and learning would have significant effects on the drawings to the DCT. It seemed plausible that with induced motivation or knowledge about how intelligence is measured from drawings (a definite learned set), or both, a subject would score higher on the DCT than he would in the absence of such induced motivation or learned set. To test this assertion the investigator set up three different Group Conditions under which the DCT would be administered, each with a different set of instructions designed to either induce special motivation (Group Condition II), induce special learning (Group Condition III), or both (Group Condition IV). These three Group Conditions were compared to a control group condition (Group Condition I) that provided instructions which induced no special motivation or learned set aside from what would be expected to exist when groups are asked to respond to the DCT without any knowledge of the nature of the test or its use.

The general expectations which the investigator thought would be confirmed by this study were as follows:

1. The drawing scores of subjects to the DCT would be significantly affected by the instructions of

the Group Condition under which the DCT was administered. More specifically, the drawing scores of subjects under Group Condition II would be significantly higher than the drawing scores of subjects under Group Condition I; the drawing scores of subjects under Group Condition III would be significantly higher than the drawing scores of subjects under either Group Condition I or II; and the drawing scores of subjects under Group Condition IV would be significantly higher than the drawing scores of the subjects under either Group Condition I, II, or III.

2. The DCT would correlate significantly with the CQT under Group Conditions I and II.
3. Group Condition II would product more reliable drawings of intelligence than Group Condition I, and Group Conditions III and IV would produce less reliable drawings of intelligence than Group Condition I, with Group Condition IV producing the least reliable of the two.

CHAPTER II

METHOD

Subjects

The subjects for this study were 120 beginning psychology students who were members of four separate introductory psychology classes. These classes were selected at random from the thirty-two which were taught at Michigan State University in the spring of 1962, and these four classes were randomly assigned to the four different Group Conditions of the experiment. There were approximately thirty students in each of the classes, of which approximately one-half were females. These students were available as subjects as a partial fulfillment of their course requirements. The experiment was conducted in the subjects' regular classrooms during their regular scheduled class hours for introductory psychology.

Materials

The test materials involved in this experiment were a pencil and a Drawing Completion Test blank. A copy of the test blank, with illustrated responses, is exhibited in Appendix A, page 34.

Procedure

The instructions of Group Condition I (the control group) were not designed to induce any special motivation or to provide any special learning set. These instructions were given to the group by the experimenter and were as follows:

> We are asking you to take this drawing test to help us with research we are doing. This test will not affect your grade in this class or in any way affect your university standing. Your instructor will not see the test results. Since this is research we may want to contact some of you later. For this reason will you put your name and student number on the back of the test blank. Also on the back, will you please put the number 1 in the upper right hand corner. On the front of the test blank you will find eight squares. In each square you will find a stimulus. What we want you to do is to take the stimulus in each of the eight squares and make it into a drawing of anything you wish. You should have eight drawings when you are through. You can respond to the stimuli in any order you wish, only please number the squares in the order that they are responded to. You have approximately thirty minutes to complete the drawings. Please do not look at your neighbor's paper but give only your own responses.

The instructions of Group Condition II were designed to induce special motivation but were not designed to provide a special learning set. These instructions consisted primarily of informing the subjects that the drawing test they were taking was an intelligence test. The instructions given by the experimenter were as follows:

> We are asking you to take this drawing test to help us with research we are doing with a new type of test. Since this is research we may want to contact some of you later. For this reason will you put your name and student number on the back of the test blank. Also on the back, will you please put the number 2 in the upper right hand corner. Now, this test is a new type of intelligence test. It is important that you do your best on this test for the scores are going to be recorded

as well as compared to your College Qualification Test scores. These scores will be used for future evaluations. On the front of the test blank you will find eight squares. In each square you will find a stimulus. What we want you to do is to take the stimulus in each of the eight squares and make it into a drawing of anything you wish. You should have eight drawings when you are through. You can respond to the stimuli in any order you wish only please number the squares in the order that you respond to them. You have approximately thirty minutes to complete the drawings. Please do not look at your neighbor's paper but give only your own responses.

Group Condition III had a special type of learning set induced by a twenty-five minute lecture on, "The Measurement of Intelligence from Drawings." This lecture emphasized stimulus integration and drawing organization as the primary criteria used in measuring functional intelligence from drawings. The lecture discussion on stimulus integration centered around the following topics, with drawing illustrations of each given on the blackboard by the experimenter:

1. Relation of the stimulus to the completed drawing
2. Originality of the stimulus integration
3. Functional significance of the stimulus in the drawing
4. Attributes of the stimulus responded to
    a. rounded, wavy stimuli normally bring responses of movement and life
    b. straight, angular stimuli normally bring technical-construction and mechanical type response

The lecture discussion on drawing organization centered around the following topics, with drawing illustrations of each given on the blackboard by the experimenter:

1. Context of the picture, its detail, and its total affect
2. Perspective--representation of third dimension

3. Static and Dynamic aspects; absence or presence of life and movement
4. Originality of the entire drawing

After the lecture the experimenter presented the DCT blanks and gave the same instructions to this group that were given to Group Condition I, except that group III subjects were told to put the number 3 on the back of their test blanks rather than the number 1. This, then, constituted the condition of learned set but no induced motivation.

Group Condition IV was given both the instructions for providing a special learning set (as given to Group Condition III) and the instructions for inducing special motivation (as given to Group Condition II). The same twenty-five minute lecture which was given to Group Condition III to provide them with a special type of learning set was also given to Group Condition IV. Following this lecture Group Condition IV was given the same instructions as Group Condition II to induce special motivation, except that group IV subjects were told to put the number 4 on the back of their test blank rather than the number 2.

After the groups had completed their drawing tests, the tests were collected, all intermixed together by Group Condition, and scored according to the objective scoring scale devised by Kinget (see Appendix B, page 36). The scoring of each test blank was done by the author who had been trained in scoring the completed DCT blanks by use of the Kinget scoring scale. The author had no knowledge, while he was scoring the tests, of which tests belonged to

which group (each group's test blanks were identified on the back by the code 1, 2, 3, or 4). Each of the drawing responses to the eight squares of the test blank had a possible 6 points or 48 points per test blank. The Kendall Coefficient of Concordance inter-scorer reliability of ten scorers who had been trained in scoring completed DCT blanks using Kinget's scoring scale, based upon 19 completed DCT blanks not taken from this study, was .903 (see Appendix C, page 42). The Kendall Coefficient of Concordance inter-scorer reliability of two trained scorers and the investigator's original scoring of 40 completed and intermixed DCT blanks taken from this study (10 from each Group Condition selected randomly) was .870 (see Appendix C, page 42).

Design

A mean score was found for each Group Condition and a simple analysis of variance was computed to determine if there was a statistically significant difference between the means. The .05 level of significance was chosen for this test. If a significant F-value was obtained it was decided to do t-tests based on the Q-distribution to see where the significant differences between Group Conditions existed. The .05 level of significance was again used for these tests. The CQT scores were used as an independent measure of intelligence. To determine if the DCT drawing scores were actually predicting intelligence the DCT scores obtained from the subjects under each Group Condition were correlated with the subjects CQT scores. Also, to determine

which Group Condition produced the most reliable scores of intelligence the Pearson Product Moment Correlation made between the DCT and CQT scores for each Group Condition were statistically compared. The testing of correlational significance and significant differences between correlations was done at the .05 level. Since the direction of change to take place was predicted beforehand, that is since it was predicted that the DCT-CQT correlation of Group Condition II would be greater than Group Condition I, and that Group Conditions III and IV would be less than Group Condition I, a one-tailed test was used in testing for significant differences between these correlations.

CHAPTER III

RESULTS

Statistical Analysis of the DCT and CQT Scores

The raw DCT scores for the students in each of the four Group Conditions are presented in Appendix D, page 44. The results of the F-max test applied to the appropriate variances of this data was 1.64. This was not significant at the .05 level and therefore the hypothesis of homogeneity of variance was acceptable. A simple analysis of variance (Appendix E, page 47) was applied to these scores to determine if the difference between the means across the four Group Conditions was statistically significant. Table 1 presents a summary of this analysis.

TABLE 1.--Summary Table of the Analysis of Variance of DCT Scores for the Four Group Conditions

Source of Variation	df	SS	MS	F	Significance at .05 Level
Group Conditions (GC)	3	4148.2	1382.7	42.3***	2.68
Within Group Conditions	116	3796.0	32.7		
Total	119	7944.2			

***Significant at the .001 level.

Clearly the Group Condition under which the subjects took the DCT in this study did influence their performance on the test. Thus the general expectation that the drawing scores of subjects to the DCT would be significantly affected by the Group Conditions under which the DCT was administered is supported.

Next, a statistical comparison of differences between means for all possible comparisons of the four different Group Conditions was made. To do this the Critical Difference (CD) was computed (see Appendix E, page 47). The CD value at the .05 level is 3.87 and at the .01 level it is 4.7. Referring to Table 2 it will be observed that significant differences exist between all possible comparisons of Group Condition means. Therefore, the specific

TABLE 2.--Table of Differences of Group Condition Means

Group Means		24.4	30.1	35.4	40.1
		$\overline{X}_I$	$\overline{X}_{II}$	$\overline{X}_{III}$	$\overline{X}_{IV}$
24.4	$\overline{X}_I$				
30.1	$\overline{X}_{II}$	5.7**			
35.4	$\overline{X}_{III}$	11.0**	5.3**		
40.1	$\overline{X}_{IV}$	15.7**	10.0**	4.7**	

**Significant at the .01 level.

expectations that (1) the drawing scores of subjects under Group II would be significantly higher than the drawing scores of subjects under Group Condition I; (2) the

drawing scores of subjects under Group Condition III would be significantly higher than the drawing scores of subjects under either Group Condition I or II; and (3) the drawing scores of subjects under Group Condition IV would be significantly higher than the drawing scores of the subjects under either Group Condition I, II, or III, are all supported.

The raw CQT scores for each of the students of the four different classes used in this study were obtained from the Student Services Counseling Center at Michigan State University (Appendix F, page 49). Group Condition I, the control group, had a mean CQT score of 133.2. Group Condition II, the one with instructions to induce special motivation but no special type of learning set, had a mean CQT score of 131.5. Group Condition III, the one with instructions to provide a special type of learning set but no special induced motivation, had a mean CQT score of 130.0. Group IV, the one with instructions designed to induce special motivation and provide a special type of learning set, had a mean CQT score of 134.9. These scores were all near the fiftieth percentile of the distribution on which the CQT norms were based. To show that the differences disclosed in the previous DCT analysis of variance were due to the instructions of each Group Condition, rather than to initial differences among the four groups associated with differences in their CQT scores, a simple analysis of variance was applied to the raw CQT scores (see Appendix F, page 50).

Table 3 presents the summary of this analysis.

TABLE 3.--Summary Table of the Analysis of Variance of CQT Scores for the Four Group Conditions

Source of Variation	df	SS	MS	F	Significance at .05 Level
Between Group Condition (GC)	3	379.1	126.4	.193	2.68
Within Group Condition (W)	102	66,122.9	654.3		
Total	105	67,122.0			

Clearly there is no difference in the average intelligence of the subjects who participated under each of the four different Group Conditions.

The analysis of the CQT and DCT scores for the four Group Conditions is summarized in Table 4. This table interestingly compares the two sets of scores. The drawing responses of the subjects, as reflected by each Group Condition's mean DCT score, vary significantly with the instructions of the specific Group Condition under which the DCT is administered, while the intelligence of the groups (as evidenced by each Group Condition's mean CQT score) is statistically the same.

TABLE 4.--Comparison of CQT and DCT Group Mean Scores

Group Condition	I	II	III	IV
CQT Mean Scores	133.2	131.5	130.0	134.9
DCT Mean Scores	24.4	30.1	35.4	40.1

CQT and DCT Correlations for the Group Conditions

Table 5 presents the correlation coefficients for the sets of CQT and DCT scores for each of the four Group Conditions (the computations for these coefficients are presented in Appendix G, page 51).

TABLE 5.--CQT and DCT Correlation Coefficients for the Four Group Conditions

Group Condition	Correlation Coefficient
I	.63
II	.85
III	.53
IV	.17

The correlation coefficients for Group Condition I, II, and III are statistically significant at the .05 level while the correlation coefficient for Group Condition IV is not statistically significant at the .05 level (see Appendix G, page 51). Thus the general expectation that the DCT correlates significantly with the CQT under Group Conditions I and II is

supported. Table 6 presents all the possible comparisons, using z^1 transformation scores (see computations of Appendix G, page 60), between the four pairs of Group Condition correlation coefficients.

TABLE 6.--Standard Scores Based on the z^1 Transformation Scores of the Group Condition Correlation Coefficients

Correlation Coefficient		.63	.85	.53	.17
		r_I	r_{II}	r_{III}	r_{IV}
.63	r_I				
.85	r_{II}	-1.71*			
.53	r_{III}	.50	2.28*		
.17	r_{IV}	1.93*	3.84**	1.49	

*Significant at .05 level.
**Significant at .01 level.

The correlation coefficients presented in Table 5 support the validity of the DCT, under Group Conditions I, II, and III, as a predictor of intelligence when intelligence is defined by CQT scores. The higher the correlation coefficient between any set of CQT and DCT scores the more reliable is the Group Condition of that set for measuring intelligence using the DCT. Conversely, the lower this coefficient the less reliable is the Group Condition for measuring intelligence using the DCT. Referring to Table 5 it will be observed that the Group Condition with the

highest correlation coefficient is Group Condition II. Table 6 reveals that the difference between the correlation coefficient of Group Condition II and the control group (Group Condition I) is a statistically significant difference at the .05 level using a one-tailed test. Thus the general expectation that Group Condition II would produce more reliable drawings of intelligence than Group Condition I is supported. Table 5 also discloses that Group Condition IV has the lowest correlation coefficient, with Group Condition III having the next lowest coefficient. Table 6 reveals that the difference between Group Condition IV and the control condition is significant but that the difference between Group Condition III and the control condition is not significant. Thus the general expectation that Group Conditions III and IV would produce less reliable drawings of intelligence than Group Condition I is supported. However, the expectation that Group Condition IV would produce less reliable drawings of intelligence than Group Condition III is not supported, although by referring to Table 6 it can be seen that the necessary significance (standard score of 1.645) to give this expectation statistical support is almost reached.

CHAPTER IV

DISCUSSION

The interpretation to be presented in this section is based upon the investigator's belief that the causality for the significant differences found in mean group responses and group correlations is due primarily to the differences in instruction for each of the Group Conditions and not to artifacts or other operating variables existing in the Group Conditions which were unknown to the investigator. These latter possibilities should be and have been considered, but the investigator feels that the available data and information concerning the investigation favor an interpretation in terms of motivational and learning variables induced by special instructions.

One of the major assumptions made in this study was that, in addition to the parameter of intelligence, all other primary parameters of variation among subjects and Group Conditions of consequence to this study, save the instructional variables of induced motivation and learned set, were being controlled by the experimental design. Actually, the variables of induced motivation and learning set were assumed to have varied among the Group Conditions while what was being varied were instructions. The investigator assumed that these instructions were sufficient to

vary motivation and learning set. With these assumptions in mind, and in view of the results of this statistical analysis, the most plausible deduction to be derived from the comparison made by Table 4, and one which the data supports, is that the absence or presence of the independent variables (instructions designed to induce motivation and learning set) existing either independently or in combination as characterized by each Group Condition, are the most probable significant factors influencing the subject's drawing response in each case.

The special induced motivation (that which was assumed to have existed in Group Condition II) referred to in this study is the desire or need (assumed a priori) on the part of the subject to do his serious best with the task at hand, namely, that of responding appropriately and dilligently to the DCT in the manner he feels is designed to make the most favorable impression upon the scorer. The instructions for the control condition (the one which existed for Group Condition I) failed to induce (uniformily at least) this particular desire or need. In contrast, the instructions given to the subjects of Group Condition II were designed to bring about this desire or need. The difference of this induced motivation was sufficient enough to produce a significant difference in the DCT intelligence scores of these two equally intelligent groups of subjects.

If a learning session is given to another equally intelligent group of subjects (as was the case with Group

Condition III), which illustrates for them the type of drawing responses that are scored high for intelligence, but at the same time is assumed to do nothing to induce special motivation, this group's DCT intelligence scores are significantly higher than the group which was given instructions designed to induce special motivation only. One plausible explanation for this, and one which the investigator feels appropriate, is that this latter condition provides a definite means to a goal (if this goal happens to be clearly discriminated by the subject), and this means (a definite knowledge of what type of drawings are regarded as depicting high intelligence) has more of an effect on a subject's drawing responses than does a special desire or need operating within him to make highly intelligent drawings in the absence of any definite knowledge of how to do so. In other words, although a special desire or need (induced motivation) is effective in producing responses to the DCT which are scored significantly more highly intelligent than responses made to the DCT under conditions where this desire or need is lacking, an awareness of the type of responses which are scored high for intelligence (even though it may not be recognized that an intelligence test is involved), results in responses to the DCT which are rated even more significantly higher in intelligence than either of the other two conditions. The means alone accomplishes more than either no motivation or just motivation alone. Group Condition IV produced the responses to the DCT which

were rated significantly higher in intelligence than any of the other three Group Conditions because the condition of this group not only specified definitely what the goal was, and provided the desire or need to accomplish this goal, but it also provided the means (direction) by which this goal could be reached.

So far we have been discussing how different instructions influence the nature of a subject's drawing responses to the DCT with respect to how these responses will be scored for intelligence. No mention has been made up to this point, however, as to how well the intelligence scores obtained on the DCT match the level of functioning intelligence of the individual as revealed by an independent measure of intelligence such as the CQT, under each of these different conditions of instruction. The correlational analysis shows that of the four Group Conditions under which the DCT were administered, the condition of induced motivation alone (Group Condition II) produced responses which were scored the most reliable in reflecting the subject's functional level of intelligence as measured by his CQT score. The condition which was second best as being reliable in reflecting a subject's functional level of intelligence was the control condition (Group Condition I), the instructions of which provided no special induced motivation or special type of learning set. The condition which was third most reliable in reflecting a subject's functional level of intelligence was the one in which the instructions provided

a special type of learning set concerning drawing responses (Group Condition III). The least reliable condition was the one involving instructions which were designed to both induce special motivation and provide a special type of learning set (Group Condition IV).

The question arises as to what are the operating factors which cause the instructions of one condition to produce responses which are more or less reliable in predicting intelligence than the instructions of the other conditions? At this state the investigator favors the following explanation:

Taking the DCT under conditions of instruction designed to induce motivation alone results in the most reliable responses of intelligence because these are the instructions which produce drawings by the subjects that are characterized more by homogeneity and uniformity of group effort toward a common goal under conditions which minimize (it is assumed) interfering influences which tend to obscure one's level of functioning intelligence, while at the same time it maximizes one's desire to perform maximally in the best manner he is capable. Such an effort on the part of the subjects is brought about first by the fact that the subjects are near a maximum in their desire to perform in a serious manner, thus diminishing considerably the possibility of distractions or the tendency in some subjects to "goof-off," and second by the fact that no known factors are operating to determine the type of responses the subject will make except his own

functional level of intelligence. The condition of no induced motivation or special learning set also has this second fact operating (and apparently a very important one), but in the absence of a desire or need to do one's best, distractions and "goofing-off" interfer with a subject seriously and fully bringing his functional level of intelligence to bear on the drawings he is making. In the pilot study preceeding the present study the investigator observed this difference in responding between two such groups of subjects taking the DCT, one under the condition of no induced motivation or special learning set and the other under the condition of induced motivation.

Moving on to the variable of learning it was seen from the analysis of the results that even though the condition of a learned set on how to make drawings to a drawing test, which will be scored high in intelligence, produces drawings which receive a significantly higher mean score than either of the conditions of no induced motivation or learned set, and motivation alone, the scores produced by this variable are less reliable in indicating the true functional level of a subject's intelligence than the other two conditions because a definite factor exists which obscures the operation of the subject's functional level of intelligence in making his responses to the DCT. Instead of the drawings reflecting the subject's natural level of functioning intelligence they are reflecting more the influence of his previous learning concerning the type of drawing responses which are scored

highly intelligent. This obscuring influence is present regardless of whether the subject (in Group Condition III) related this learning directly to the DCT and realized that this was one of the drawing tests from which intelligence is measured. Thus the drawing responses produced by Group Condition III reflect less of the subject's natural level of intellectual functioning and more of special learning influences. Instead of the subject's responses reflecting his functional level of intelligence then, as was the case for the subjects in Group Conditions I and II, they are reflecting to a large degree the influences of his special learning. In this case the scorer is scoring more of a learning influence and less of an intellectual influence. For this reason the CQT-DCT correlation for this group is lower than that of Group Conditions I and II.

One objection to the foregoing interpretation might be that the more intelligent subjects should learn more than the less intelligent ones, and consequently, this additional learning should be detected in the responses of the more intelligent subjects, thus enabling them to maintain their proper relationship with respect to the less intelligent subjects. If this were the case then the DCT-CQT correlations for Group III should be little different from that of Group Condition I. This would be a valid objection if the learning of the material presented by the instructions of Group III was highly difficult so that the more intelligent subjects could be differentiated from the less intelligent

ones on the basis of what they learned. In a sense this expectation might appear to receive some support since the difference in the correlation coefficients of Group Condition I and III was not statistically significant. However, the investigator does not feel that much unequal learning took place. The material presented for learning was uncomplicated enough so that all members of the class could learn it equally as well if they were attentive at all during the lecture. Therefore, the learning could have easily been almost equally the same for all subjects.

In dealing with the condition of both induced motivation and a special type of learning set (Group Condition IV) we have the same obscuring influence of learning overshadowing the distribution or range of functional intelligence in this group. But now this influence is much more marked because the subjects are told definitely that the DCT is an intelligence test (there can be no question about it as was the case in Group Condition III), so that in addition to their learning set directing them as to how to produce highly intelligent type drawings they also have induced in them the desire or need to produce these drawings more so than existed in Group Condition III. As a result the subjects concentration on the instructions and their learning concerning these drawings is much keener and goal orientated than was the case in Group Condition III. As a consequence of all of this the subjects' natural levels of intellectual functioning are evidenced even less in their

responses under this Group Condition. The near equal learning hypothesis advocated by the investigator to the possible objection discussed in the previous paragraph applies even better here since the difference in the correlational coefficients between Group Conditions I and IV is significant. It appears that the addition of the induced motivation brings the learning influence more sharply to bear in the subjects' responses than was the case in Group Condition III where just the learning influence alone existed. Again, it is the influences of special learning, sharpened by the effects of special motivation, which is being scored in these responses, and less of the influence of the subject's natural level of functioning intelligence. As a result Group Condition IV produces drawings to the DCT which have the highest mean score of intelligence of the four Group Conditions employed in the study while at the same time the scores for these drawings tend to be the least reliable in predicting intelligence as measured by CQT scores.

CHAPTER V

SUMMARY

The primary concern of this investigation may be stated as follows: (1) To determine the effect four different Group Conditions, each one presenting different instructions designed to either induce no special motivation or learning set, induce special motivation only, induce a special learning set only, or induce both a special motivation and a special learning set, would have upon Drawing Completion Test (DCT) scores. (2) To determine the relationship or predictive validity of intelligence (as determined by correlation coefficients) between the DCT scores obtained under each of the four different Group Conditions and the scores of an independent measure of intelligence, the College Qualification Tests (CQT). To accomplish these goals four classes of beginning psychology students, consisting of approximately 30 students each, were each assigned to one of the four Group Conditions. The tests were administered, collected, and scored using Kinget's scoring scale. Two separate reliability studies (the latter study of which was based on 40 randomly selected DCT blanks from the present investigation) produced Kendall inter-scorer reliability coefficients of .903 and .870 for Kinget's scoring scale when applied to completed DCT blanks. The

proper statistical analysis, based upon analysis of variance and computation and comparison of correlation coefficients, was carried out.

Based upon the results of the statistical analysis the following specific conclusions to this investigation are made as follows: (a) The drawing responses of subjects to the DCT are significantly affected, both overall and between each possible pair of Group Condition comparisons, when the DCT, in addition to being administered under the Group Condition with instructions inducing neither special motivation or a special learning set, is administered under the three additional Group Conditions of different instruction designed to either induce special motivation, provide a definite learning set, or bring about both conditions in combination. (b) The DCT has predictive validity for intelligence when administered under Group Condition I (instructional conditions inducing no special motivation or learning set), when administered under Group Condition II (the instructional conditions of special induced motivation), and when administered under Group Condition III (the instructional conditions of a special learning set). Of these three types of instruction the one producing scoring responses with the highest predictive validity for intelligence is the one inducing special motivation brought about by informing the subjects that the DCT is a new intelligence test and that their responses to it will be evaluated. The instruction second highest in this respect is the one which

induces neither a special motivation nor provides for special learning set (the control group).

The general conclusion of this investigation is that comparison of DCT scores of intelligence among different subjects is reliable only if the DCT has been administered to the subjects under the same conditions.

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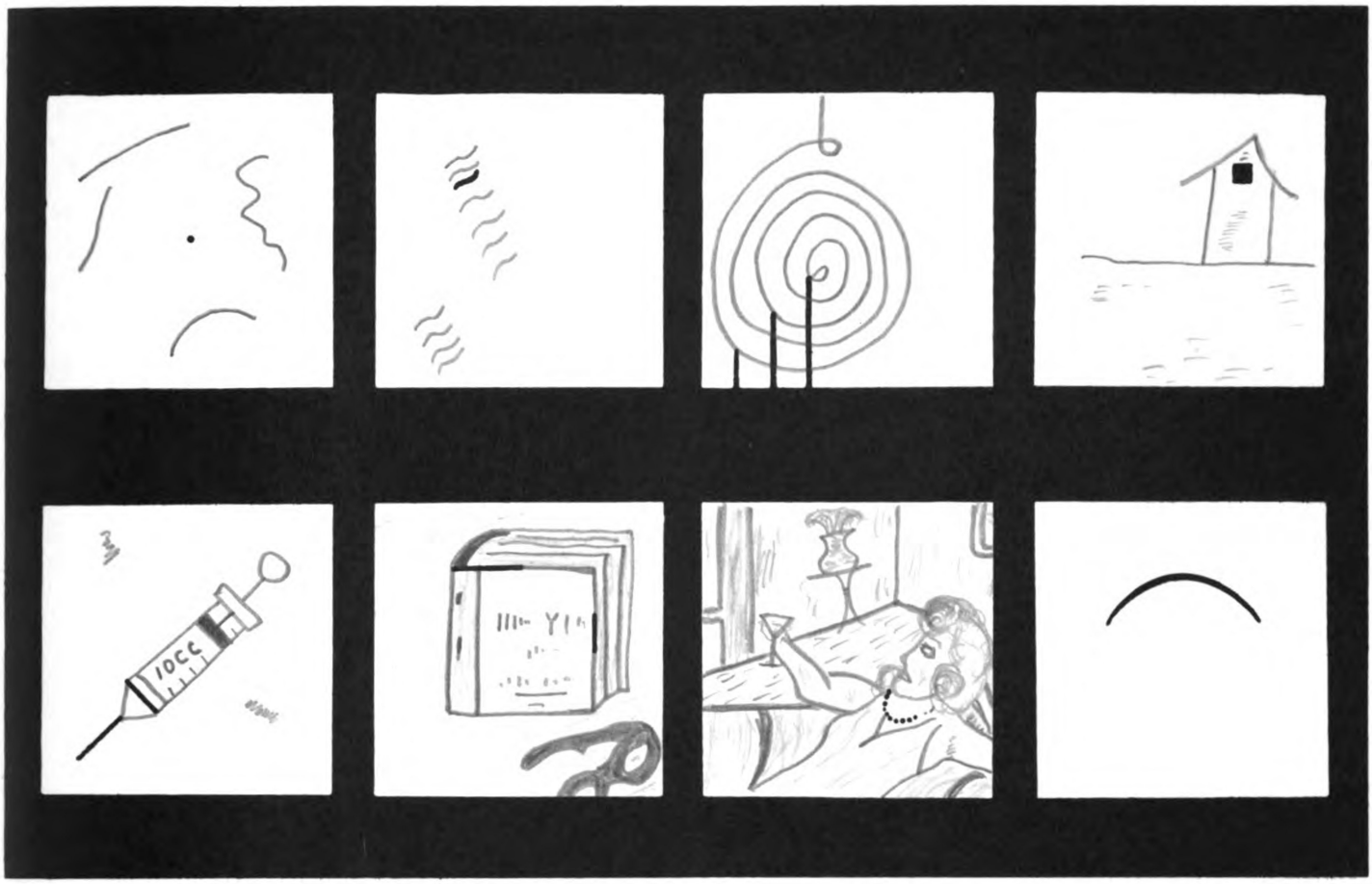
APPENDICES

APPENDIX A

THE DRAWING COMPLETION TEST (DCT) BLANK

A. B. C. D.



E. F. G.

Figure 1.--Drawing Completion Blank
with Illustrated Responses

APPENDIX B

KINGET'S SCORING SCALE FOR THE DCT AND A LIST OF STIMULI-ATTRIBUTES

Kinget's Scoring Scale for the DCT

Response Category	Corresponding Response Score
Complete disregard of stimulus	0
Near-complete disregard of stimulus	1
Relative disregard of stimulus	2
Minimum integration of stimulus	3
Good integration of stimulus	4
Very good integration of stimulus	5
Outstanding integration of stimulus	6

Operational Definitions of the Response Categories

1. Complete disregard of stimulus:

   Random strokes, scribbles or drawings without any relation to the stimulus. No dimensionality context, detail, or perspective (perspective refers to the objects in the drawing being presented in their proper relations to one another). For illustration see Fig. 1-A, page 34.

2. Near-complete disregard for the stimulus:

   Lines or line structures which reproduce or evoke some attribute (see page 40) of the stimulus without integrating or connecting the stimulus (e.g. rudimentary duplication). Very little dimensionality context, detail, and no perspective. For illustration see Fig. 1-B, page 34.

3. Relative disregard of stimulus:

Attempt at integration or, at least, connection of the stimulus with a theme which is representational but incompatible with any of the attributes (see page 40) of the stimulus. Poor dimensionality context, detail, and no perspective. For illustration see Fig. 1-C, page 34.

4. Minimum integration of stimulus:

Stimulus is an intrinsic part of a representational drawing which brings out at least one of the attributes (see page 40) of the stimulus. That is, at least one stimulus quality is responded to such that the stimulus is integrated into a drawing in some meaningful manner. There is two dimensionality, but no perspective. There is adequate proportion and detail. For illustration see Fig. 1-D, page 34.

5. Good integration of stimulus:

Two or more attributes (see page 40) of the stimulus are brought out in the drawing. The stimulus is given good functional prominence. The function of the stimulus is clear and its integration is quite meaningful. In addition, the drawing has one or more of the following characteristics:

(a) appropriate context. Context refers to everything surrounding the object constructed from the given stimuli.

(b) adequate detailing (sufficient detailing to give the drawing clear and full meaning).

(c) adequate organization (plane or depth). This is a combination of two-dimensional and three-dimensional responses usually suggesting life, mechanical form or abstraction. The drawing presents some perspective, adequate proportion, and detail.

For illustration see Fig. 1-E, page 34.

6. Very good integration:

Two or more stimulus attributes (see page 40) are responded to and the stimulus attributes are very well integrated in the drawing. That is, the stimulus integration is appropriate to the stimulus attribute and represents good form and meaning. Organic responses (responses dealing with living objects such as people or animals) are made to the curved stimuli of drawings 1, 2, 7, and 8 while technical-mechanical responses are made to drawings 3, 4, 5, and 6. In addition the drawing shows one or more of the following characteristics:

(a) appropriate context.

(b) Pregnant, economic representation. The response is a very full presentation of life, mechanical movement, or abstraction, and contains good detail.

(c) High form niveau. (i.e. harmony between context and execution). This refers to depth drawing and means that the response is primarily in three dimension and has proportion plus linear perspective.

For illustration see Fig. 1-F, page 34.

7. Outstanding integration of the stimulus:

All of the characteristic outlined under the very good integration category above plus either of the following:

(a) originality (unique or rare drawing)

(b) marked degree of Physiognomy (everything in the drawing of a human figure that reveals something about the person represented: his age, profession, or character), of Style (manner in which objects are made that conveys something about the object), of Atmosphere (pertains to the emotional quality indirectly expressed by the drawing, especially by landscapes or situations other than human scenes), or of (recognizable) Symbolism.

For illustration see Fig. 1-G, page 34.

List of Stimuli-Attributes for the Drawing Completion Test

			OBJECTIVE Attributes	PROJECTIVE Attributes
CURVED ORGANIC (female)	Small-delicate	1.	central, round, small	delicate, light, drifting, unimposing, "easy"
		7.	tightly structured, half-circular	delicate, "precious," fancy, fuzzy, "complicated," "difficult," prickly
	Large-fluent	2.	symmetrically-sinuous, round-edged	flexible, loose, alive, soft, waving, flowing, crawling, moving
		8.	large, flat-curved, tapered-off edges	smooth, fluent, "vast," restful, "natural," sheltering (cover-like)
STRAIGHT MECHANICAL (male)	Dynamic	3.	structured, equidistant, regularly increasing	rigid, strict, progressive, methodical, mounting, constructive
		5.	structured, straight, opposing, diagonally oriented	"shooting," pointing, conflictuous, mechanical-constructive
	Static	4.	square, black	solid, heavy, somber, static, material
		6.	structured, unequal length and irregular distribution	mechanical-constructive, object-like, matter-of-fact, plain, static

APPENDIX C

COMPUTATIONS FOR THE INTER-SCORER RELIABILITY OF TEN TRAINED SCORERS FOR NINETEEN COMPLETED DCT BLANKS, AND FOR THE INTER-SCORER RELIABILITY OF THREE TRAINED SCORERS FOR FORTY COMPLETED DCT BLANKS

Inter-scorer Reliability Using the Kendall Coefficient of Concordance: W

A. W for Nineteen Completed DCT Blanks, from Various Sources, which were Scored by Ten Trained Scorers

$$W = \frac{SS}{1/12\ k\ (N - N)} = \frac{51.254}{1/12\ (10)\ (19 - 19)} =$$

$$\frac{51,254}{.083\ (100)\ (6859-19)} = \frac{51,254}{8.3\ (6840)} =$$

$$\frac{51,254}{56,772} = .903$$

B. W for Forty Completed DCT Blanks, Selected at Random from the Present Study, which were Scored by Three Trained Scorers

$$W = \frac{SS}{1/12\ k\ (N - N)} = \frac{41,749.91}{1/12\ (3)\ (40 - 40)} =$$

$$\frac{41,749.91}{1/12\ (9)\ (64,000-40)} = .870$$

APPENDIX D

DCT TOTAL RAW SCORES FOR GROUP CONDITIONS I, II, III, AND IV

DCT Total Raw Scores

Subject	Group Condition I	II	III	IV
1	32	24	32	40
2	30	43	30	41
3	25	21	28	28
4	0	26	32	42
5	17	37	39	39
6	30	33	32	33
7	23	23	36	39
8	17	35	34	44
9	25	28	44	37
10	20	26	32	37
11	24	31	43	45
12	28	34	34	38
13	23	26	30	43
14	21	24	42	33
15	22	34	44	29
16	25	30	37	42
17	25	26	34	42
18	31	43	25	47
19	19	29	34	42
20	29	31	38	34
21	18	30	44	47
22	31	25	34	47
23	25	26	27	43
24	29	32	39	39
25	23	35	42	47
26	31	37	39	42
27	32	29	31	38
28	33	30	33	46
29	20	25	31	44
30	23	30	43	35
Total	731	903	1063	1203
	$\bar{X}$ 24.4	$\bar{X}$ 30.1	$\bar{X}$ 35.4	$\bar{X}$ 40.1

APPENDIX E

STATISTICAL ANALYSIS COMPUTATIONS OF THE RAW DCT SCORES BASED UPON A SIMPLE ANALYSIS OF VARIANCE

Mean DCT Scores for the Students Participating Under the Four Group Conditions

Subject	Group I	Group II	Group III	Group IV	
1	32	24	32	40	
2	30	43	30	41	
3	25	21	28	28	
4	0	26	32	42	
5	17	37	39	39	
6	30	33	32	33	
7	23	23	36	39	
8	17	35	34	44	
9	25	28	44	37	
10	20	26	32	37	
11	24	31	43	45	
12	28	34	34	38	
13	23	26	30	43	
14	21	24	42	33	
15	22	34	44	29	
16	25	30	37	42	
17	25	26	34	42	
18	31	43	25	47	
19	19	29	34	42	
20	29	31	38	34	
21	18	30	44	47	
22	31	25	34	47	
23	25	26	27	43	
24	29	32	39	39	
25	23	35	42	47	
26	31	37	39	42	
27	32	29	31	38	
28	33	30	33	46	
29	20	25	31	44	
30	23	30	43	35	
n_j	30	30	30	30	N=120
T_j	731	903	1063	1203	T=3900
$\overline{X}$	24.4	30.1	35.4	40.1	
$\Sigma d^2 =$	1279	871	865	781	
$\Sigma d^2/n-1 =$	44.10	30.03	29.83	26.93	
ΣX^2	19,091	28,051	38,531	49,021	$\Sigma\Sigma X^2$=134,694
T_j^2	534,361	814,506	1,129,969	1,447,209	ΣT_j^2 = 3,926,045

$$\Sigma T_{j/n}^2 = \frac{3,926,045}{30} = 130,898.2$$

$$T^2 = (3900)^2 = 15,210,000; \quad T^2/_n = \frac{15,210,000}{120} = 126,750.0$$

Statistical analysis to test the null hypothesis that the means of these four groups are equal:

$$SS_{GC} = \frac{\Sigma T_j^2}{n_j} - \frac{T^2}{N} = 130,898.2 - 126,750.0 = 4,148.2$$

$$SS_T = \Sigma\Sigma X^2 - \frac{T^2}{N} = 7,944$$

$$SS_W = SS_T - SS_C = 3,796.0$$

Source of Variation	df	SS	MS	F	Significance at .05 Level
Group Conditions (GC)	3	4,148.2	1382.7	42.3	2.68
Within Group Conditions (W)	116	3,796.0	33.0		
Total	119				

F-Max Test to Test for Homogeneity of Variance Among the DCT Scores

$$H_o: \quad \sigma^2_{GCI} = \sigma^2_{GCII} = \sigma^2_{GCIII} = \sigma^2_{GCIV}$$

$$F_{max} = \frac{S^2 \text{ max}}{S^2 \text{ min}} = \frac{44.10}{26.93} = 1.637$$

With k = 4 and n = 30 the significant F-max value at the .05 level = 2.61. Therefore, 1.637 is not significant and the hypothesis that the variances of the four Group Conditions are the same is acceptable.

Critical Difference (CD)

$$CD = Q = \sqrt{\frac{MS_W}{n}} = 3.69 \sqrt{\frac{33.0}{30}} = 3.69 \sqrt{1.10} = 3.69 \times 1.05 = 3.87$$

APPENDIX F

STATISTICAL ANALYSIS COMPUTATIONS OF THE RAW CQT SCORES BASED UPON A SIMPLE ANALYSIS OF VARIANCE

Raw CQT Scores for the Students Participating Under the Four Group Conditions

Group I		Group II		Group III		Group IV	
Subject	CQT	Subject	CQT	Subject	CQT	Subject	CQT
2	156	1	102	1	109	1	167
3	97	2	168	2	86	2	157
5	100	4	106	4	99	3	111
6	151	6	118	5	116	4	164
10	124	7	99	6	104	5	149
11	112	8	177	7	147	6	110
12	153	9	140	10	90	7	95
14	148	11	129	11	166	8	143
15	148	12	142	12	112	9	134
16	144	13	110	13	140	10	138
17	122	14	93	14	151	11	133
18	163	15	169	15	184	12	111
20	135	16	150	16	113	13	132
21	140	17	109	17	137	14	110
22	143	18	173	18	133	15	159
23	135	19	130	19	109	16	122
24	152	20	132	20	112	17	149
25	93	21	143	21	154	18	128
26	142	22	129	22	128	19	120
27	160	23	121	23	91	20	140
28	175	24	132	24	149	21	179
29	99	25	172	25	141	22	136
30	72	27	106	26	166	23	164
		28	140	27	148	24	108
		29	105	28	92	25	115
		30	124	29	184	26	136
				30	148	27	135
						28	93
						29	167
						30	141
Total	3064		3419		3509		4046
N	23		26		27		30
$\bar{X}$	133.2		131.5		130.0		134.9
n_j	23		26		27		30
T_j	3064		3419		3509		4046
ΣX^2	423,498		465,243		477,215		560,276
M_j	133.2		131.5		130.0		134.9
T_j	9,388.096		11,689,561		12,313,081		16,370,116
T^2/n_j	408,178.1		449,598.5		456,040.0		545,670.5

$N=106$

$T=14,038$

$\Sigma\Sigma X^2=1,926,232$

$M-132.9$

$\Sigma \frac{T^2}{n_j} =$

$1,859,487.1$

Statistical Analysis to test the null hypothesis that the means of these four groups are equal.

$$SS_{BG} = \frac{T^2}{n_j} - \frac{T^2}{N} = 1,859,487.1 - \frac{(14,038)^2}{106} = 1,859,487.1-$$

$$1,859,108.0 = 379.1$$

$$SS_T = \Sigma\Sigma X^2 - \frac{T^2}{N} = 1,926,232.0 - 1,859,108.0 = 67,124.0$$

$$SS_W = SS_T - SS_{BG} = 67,122.0 - 379.1 = 66,745.9$$

Source of Variation	df	SS	MS	F	Significance at .05 Level
Between Group Conditions (GC)	3	379.1	126.3	.193	2.68
Within Group Conditions (W)	102	66,745.0	654.4		

APPENDIX G

STATISTICAL COMPUTATIONS FOR DETERMINING THE CQT-DCT CORRELATION COEFFICIENTS AND STANDARD SCORES BETWEEN THE SIX POSSIBLE COMPARISONS OF GROUP CONDITION CORRELATION COEFFICIENTS

Group Condition I DCT Standard Scores and Standard Deviation

Subject	Group Condition I DCT Scores (X)	DCT Deviation $(X-\bar{X})$	$(X-\bar{X})^2$	Standard Score Z $(\frac{X-\bar{X}}{4.6})$
2	30	4.3	18.49	.93
3	25	- .7	.49	- .15
5	17	-8.7	75.69	-1.89
6	30	4.3	18.49	.93
10	20	-5.7	32.49	-1.24
11	24	-1.7	2.89	- .37
12	28	2.3	5.29	.50
14	21	-4.7	22.09	-1.02
15	22	-3.7	13.69	- .80
16	25	- .7	.49	- .15
17	25	- .7	.49	- .15
18	31	5.3	28.09	1.15
20	29	3.3	10.89	.72
21	18	-7.7	58.52	-1.67
22	31	5.3	28.09	1.15
23	25	- .7	.49	- .15
24	29	3.3	10.89	.72
25	23	-2.7	7.29	- .59
26	31	5.3	28.09	1.15
27	32	6.3	39.69	1.37
28	33	7.3	53.29	1.59
29	20	-5.7	32.49	-1.24
30	23	-2.7	7.29	- .59
Total	592	$\Sigma (X-\bar{X})^2 = 495.70$		

N = 23

$\bar{X}$ 25.7

$$\sigma = \sqrt{\frac{\Sigma (X-\bar{X})^2}{N}} = \sqrt{\frac{495.7}{23}} = \sqrt{21.60} = 4.6$$

$$Z = \frac{X-\bar{X}}{\sigma} = \frac{X-\bar{X}}{4.6}$$

Group Condition I CQT Standard Scores and Standard Deviation

Subject	Group Condition I CQT Scores (X)	CQT Deviation $(X-\bar{X})$	$(X-\bar{X})^2$	Standard Score Z $\frac{X-\bar{X}}{25.8}$
2	156	22.8	519.84	.88
3	97	-36.2	1310.44	-1.40
5	100	-33.2	1102.24	-1.29
6	151	17.8	316.84	.69
10	124	- 9.2	84.64	- .36
11	112	-21.2	449.44	- .82
12	153	19.8	392.04	.76
14	148	14.8	219.04	.57
15	148	14.8	219.04	.57
16	144	10.8	116.64	.42
17	122	-11.2	125.44	- .43
18	163	29.8	888.04	1.16
20	135	1.8	3.24	.07
21	140	6.8	46.24	.26
22	143	9.8	96.04	.38
23	135	1.8	3.24	.07
24	152	18.8	353.44	.73
25	93	-40.2	1616.04	-1.56
26	142	8.8	77.44	.34
27	160	26.8	718.24	1.04
28	175	41.8	1747.24	1.62
29	99	-34.2	1169.64	-1.33
30	72	-61.2	3745.44	-2.37
Total	3064	$\Sigma(X-\bar{X})^2$ = 15,319.92		

N = 23

$\bar{X}$ 133.2

$$\sigma = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}} = \sqrt{\frac{15,319.92}{2}} = \sqrt{666.08} = 25.8$$

$$Z = \frac{X-\bar{X}}{\sigma} = \frac{X-\bar{X}}{25.8}$$

Group Condition II DCT Standard Scores and Standard Deviation

Subject	Group Condition II DCT Scores (X)	DCT Deviation $(X-\bar{X})$	$(X-\bar{X})^2$	Standard Score Z $(\frac{X-\bar{X}}{5.1})$
1	24	- 6.1	37.21	-1.20
2	43	12.9	166.41	2.53
4	26	- 4.1	16.81	- .80
6	33	2.9	8.41	.57
7	23	- 7.1	49.70	-1.39
8	35	4.9	24.01	.96
9	28	- 2.1	4.41	- .41
11	31	.9	.81	.18
12	34	3.9	15.21	.76
13	26	4.1	16.81	- .80
14	24	- 6.1	37.21	-1.20
15	34	3.9	15.21	.76
16	30	- .1	.01	- .02
17	26	- 4.1	16.81	- .80
18	43	12.9	166.41	2.53
19	29	- 1.1	1.21	- .22
20	31	.9	.81	.18
21	30	- .1	.01	- .02
22	25	- 5.1	26.01	1.00
23	26	- 4.1	16.81	- .80
24	32	1.9	3.61	.37
25	35	4.9	24.01	.96
27	29	- 1.1	1.21	- .22
28	30	- .1	.01	- .02
29	25	- 5.1	26.01	-1.00
30	30	- .1	.01	- .02
Total	782	$\Sigma(X-\bar{X})^2 = 675.15$		

$N = 26$

$\bar{X} = 30.1$

$$\sigma = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}} = \sqrt{\frac{675.15}{26}} = \sqrt{25.97} = 5.1$$

$$Z = \frac{X-\bar{X}}{5.1}$$

Group Condition II CQT Standard Scores and Standard Deviation

Subject	Group Condition II CQT Scores (X)	CQT Deviation $(X-\bar{X})$	$(X-\bar{X})^2$	Standard Score Z $(\frac{X-\bar{X}}{23.9})$
1	102	-29.5	70.25	-1.23
2	168	36.5	1332.25	1.53
4	106	-25.5	650.25	-1.07
6	118	-13.5	182.25	- .56
7	99	-32.5	1056.25	-1.36
8	177	45.5	2070.25	1.90
9	140	8.5	72.25	.36
11	129	- 2.5	6.25	- .10
12	142	10.5	110.25	.44
13	110	-21.5	462.25	- .90
14	93	-38.5	1482.25	-1.61
15	169	37.5	1406.25	1.60
16	150	18.5	342.25	.77
17	109	-22.5	506.25	- .94
18	173	41.5	1722.25	1.74
19	130	- 1.5	2.25	- .06
20	132	.5	.25	.02
21	143	11.5	132.25	.48
22	129	- 2.5	6.25	- .10
23	121	-10.5	110.25	- .44
24	132	.5	.25	.02
25	172	40.5	1640.25	1.69
27	106	-25.5	650.25	-1.07
28	140	8.5	72.25	.36
29	105	-26.5	702.25	-1.11
30	124	- 7.5	56.25	- .31
Total	3419	$\Sigma(X-\bar{X})^2$ = 14,844.50		

$N = 26$

$\bar{X} = 131.5$

$$\sigma = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}} = \sqrt{\frac{14,844.50}{25}} = \sqrt{570.94} = 23.9$$

$$Z = \frac{X-\bar{X}}{\sigma} = \frac{X-\bar{X}}{23.9}$$

Group Condition III DCT Standard Scores and Standard Deviation

Subject	Group Condition III DCT Scores (X)	DCT Deviation $(X-\overline{X})$	$(X-\overline{X})^2$	Standard Scores Z $(\frac{X-\overline{X}}{25.8})$
1	32	- 3.4	11.56	- .65
2	30	- 5.4	29.16	-1.04
4	32	- 3.4	11.56	- .65
5	39	3.6	12.96	.69
6	32	- 3.4	11.56	- .65
7	36	.6	.36	.12
10	32	- 3.4	11.56	- .65
11	43	7.6	57.76	1.46
12	34	- 1.4	1.96	- .27
13	30	- 5.4	29.16	-1.04
14	42	6.6	43.56	1.27
15	44	8.6	73.96	1.65
16	37	1.6	2.56	.31
17	34	- 1.4	1.96	- .27
18	25	-10.4	108.16	-2.00
19	34	- 1.4	1.96	- .27
20	38	2.6	6.76	.50
21	44	8.6	73.96	1.65
22	34	- 1.4	1.96	- .27
23	27	- 8.4	70.56	-1.62
24	39	3.6	12.96	.69
25	42	6.6	43.56	1.27
26	39	3.6	12.96	.69
27	31	- 4.4	19.36	- .85
28	33	- 2.4	5.76	- .46
29	31	- 4.4	19.36	- .85
30	43	7.6	56.76	1.46
Total	957	$\Sigma(X-\overline{X})^2$	= 734.72	

$N = 27$

$\overline{X} = 35.4$

$$\sigma = \sqrt{\frac{\Sigma(X-\overline{X})^2}{N}} = \sqrt{\frac{734.72}{27}} = \sqrt{27.21} = 5.2$$

$$Z = \frac{X-\overline{X}}{\sigma} = \frac{X-\overline{X}}{5.2}$$

Group Condition III CQT Standard Scores and Standard Deviation

Subject	Group Condition III CQT Scores (X)	CQT Deviation $(X-\overline{X})$	$(X-\overline{X})^2$	Standard Score Z $(\frac{X-\overline{X}}{28.0})$
1	109	-21.0	441.00	-7.50
2	86	-44.0	1936.00	-1.57
4	99	-31.0	961.00	-1.11
5	116	-14.0	196.00	- .50
6	104	-26.0	676.00	- .93
7	147	17.0	289.00	.61
10	90	-40.0	1600.00	-1.43
11	166	36.0	1296.00	1.29
12	112	-18.0	324.00	- .64
13	140	10.0	100.00	.36
14	151	21.0	441.00	.75
15	184	54.0	2916.00	1.93
16	113	-17.0	289.00	- .61
17	137	7.0	49.00	.25
18	133	3.0	9.00	.11
19	109	-21.0	441.00	- .75
20	112	-18.0	324.00	- .64
21	154	24.0	576.00	.86
22	128	- 2.0	4.00	- .07
23	91	-39.0	1521.00	-1.39
24	149	19.0	361.00	.68
25	141	11.0	121.00	.39
26	166	36.0	1296.00	1.29
27	148	18.0	324.00	.64
28	92	-38.0	1444.00	-1.36
29	184	54.0	2916.00	1.93
30	148	18.0	324.00	.64
Total	3509	$\Sigma(X-\overline{X})^2$ = 21,175.00		

$N = 27$

$\overline{X} = 130.0$

$$\sigma = \sqrt{\frac{\Sigma(X-\overline{X})^2}{N}} = \sqrt{\frac{21,175.00}{27}} = \sqrt{784.26} = 28.0$$

$$Z = \frac{X-\overline{X}}{\sigma} = \frac{X-\overline{X}}{28.0}$$

Group Condition IV DCT Standard Scores and Standard Deviation

Subject	Group Condition IV DCT Score (X)	DCT Deviation $(X-\bar{X})$	$(X-\bar{X})^2$	Standard Score Z $(\frac{X-\bar{X}}{5.1})$
1	40	- .1	.01	- .02
2	41	.9	.81	.18
3	28	-12.1	146.41	-2.37
4	42	1.9	3.61	.27
5	39	- 1.1	1.21	- .22
6	33	- 7.1	50.41	-1.39
7	39	- 1.1	1.21	- .22
8	44	3.9	15.21	.76
9	37	- 3.1	9.61	- .61
10	37	- 3.1	9.61	- .61
11	45	4.9	24.01	.96
12	38	- 2.1	4.41	- .41
13	43	2.9	8.41	.57
14	33	- 7.1	50.41	-1.39
15	29	-11.1	123.21	-2.18
16	42	1.9	3.61	.37
17	42	1.9	3.61	.37
18	47	6.9	47.61	1.35
19	42	1.9	3.61	.37
20	34	- 6.1	37.21	-1.20
21	47	6.9	47.61	1.35
22	47	6.9	47.61	1.35
23	43	2.9	8.41	.57
24	39	- 1.1	1.21	- .22
25	47	6.9	47.61	1.35
26	42	1.9	3.61	.37
27	38	- 2.1	4.41	- .41
28	46	5.9	34.81	1.16
29	44	3.9	15.21	.76
30	35	- 5.1	26.01	-1.00
Total	1203	$\Sigma(X-\bar{X})^2$ =	780.70	

$N = 30$

$\bar{X} = 40.1$

$$\sigma = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}} = \sqrt{\frac{780.70}{30}} = \sqrt{26.02} = 5.1$$

$$Z = \frac{X-\bar{X}}{} = \frac{X-\bar{X}}{5.1}$$

Group Condition IV CQT Standard Scores and Standard Deviation

Subject	Group Condition IV CQT Scores (X)	CQT Deviation $(X-\overline{X})$	$(X-\overline{X})^2$	Standard Score Z $(\frac{X-\overline{X}}{22.1})$
1	167	32.1	1030.41	1.45
2	157	22.1	488.41	1.00
3	111	-23.9	571.21	-1.08
4	164	29.1	846.81	1.32
5	149	14.1	198.81	.64
6	110	-24.9	620.01	-1.13
7	95	-39.9	1592.01	-1.81
8	143	8.1	65.61	.37
9	134	- .9	.81	- .04
10	138	3.1	9.61	.14
11	133	- 1.9	3.61	- .09
12	111	-23.9	571.21	-1.08
13	132	- 2.9	8.41	- .13
14	110	-24.9	620.01	-1.13
15	159	24.1	580.81	1.09
16	122	-12.9	166.41	- .58
17	149	14.1	198.81	.64
18	128	- 6.9	47.61	- .31
19	120	-14.9	222.01	- .67
20	140	5.1	26.01	.23
21	179	44.1	1944.81	2.00
22	136	1.1	1.21	.05
23	164	29.1	846.81	1.32
24	108	-26.9	723.61	-1.22
25	115	-19.9	396.01	- .90
26	136	1.1	1.21	.05
27	135	.1	.01	.01
28	93	-41.9	1755.61	-1.90
29	167	32.1	1030.41	1.45
30	141	6.1	37.21	.28
Total	4046	$\Sigma(X-\overline{X})^2$	= 14,605.50	

$N = 30$

$\overline{X} = 134.9$

$$\sigma = \sqrt{\frac{\Sigma(X-\overline{X})^2}{N}} = \sqrt{\frac{14,605.50}{30}} = \sqrt{486.85} = 22.1$$

$$Z = \frac{X-\overline{X}}{22.1}$$

Group Condition I CQT-DCT Correlation Coefficient
Computation and Significance

Subject	x (DCT deviation)	y (CQT deviation)	x.y
2	4.3	22.8	98.04
3	- .7	-36.2	25.34
5	-8.7	-33.2	288.84
6	4.3	17.8	76.54
10	-5.7	- 9.2	52.44
11	-1.7	-21.2	36.04
12	2.3	19.8	45.54
14	-4.7	14.8	- 69.56
15	-3.7	14.8	- 54.76
16	- .7	10.8	- 6.48
17	- .7	-11.2	7.84
18	5.3	29.8	157.94
20	3.3	1.8	5.94
21	-7.7	6.8	- 52.36
22	5.3	9.8	51.94
23	- .7	1.8	- 1.26
24	3.3	18.8	62.04
25	-2.7	-40.2	108.54
26	5.3	8.8	45.76
27	6.3	26.8	168.84
28	7.3	41.8	305.14
29	-5.7	-34.2	194.94
30	-2.7	-61.2	165.24
		$\Sigma x \cdot y =$	1712.52

$$r_I = \frac{\Sigma x \cdot y}{N \cdot \sigma_x \cdot \sigma_y} = \frac{1712.52}{23\ (4.6)\ (25.8)} = \frac{1712.52}{2729.64} = .63$$

Testing H_o: $r_I = 0$

df = n-2 = 23-2 = 21

Significance at .05 level = .41

Therefore, reject H_o and conclude r_I of .63 is significant.

Group Condition II CQT-DCT Correlation Coefficient
Computation and Significance

Subject	x (DCT deviation)	y (CQT deviation)	x·y
1	- 6.1	-29.5	179.95
2	12.9	36.5	470.85
4	- 4.1	-25.5	104.55
6	2.9	-13.5	- 39.15
7	- 7.1	-32.5	230.75
8	4.9	45.5	222.95
9	- 2.1	8.5	- 17.85
11	.9	- 2.5	- 2.25
12	3.9	10.5	40.95
13	- 4.1	-21.5	88.15
14	- 6.1	-38.5	234.85
15	3.9	37.5	146.25
16	- .1	18.5	- 1.85
17	- 4.1	-22.5	92.25
18	12.9	41.5	535.35
19	- 1.1	- 1.5	1.65
20	.9	.5	.45
21	- .1	11.5	- 1.15
22	- 5.1	- 2.5	12.75
23	- 4.1	-10.5	43.05
24	1.9	.5	.95
25	4.9	40.5	198.45
27	- 1.1	-25.5	28.05
28	- .1	8.5	- .85
29	- 5.1	-26.5	135.15
30	- .1	- 7.5	.75
		$\Sigma x \cdot y =$	2705.00

$$r_{II} = \frac{\Sigma x \cdot y}{N \cdot \sigma_x \cdot \sigma_y} = \frac{2705.00}{26\ (5.1)\ (23.9)} = \frac{2705.00}{3169.14} = \frac{.85}{}$$

Testing H_o: $r_{II} =$

df = n-2 = 26-2 = 24

Significance at .05 level = .39

Therefore, reject H_o and conclude r_{II} of .85 is significant.

Group Condition III CQT-DCT Correlation Coefficient Computation and Significance

Subject	x (DCT deviation)	y (CQT deviation)	x·y
1	-3.4	-21.0	71.4
2	-5.4	-44.0	237.6
4	-3.4	-31.0	105.4
5	3.6	-14.0	- 50.4
6	-3.4	-26.0	88.4
7	.6	17.0	10.2
10	-3.4	-40.0	136.0
11	7.6	36.0	273.6
12	-1.4	-18.0	25.2
13	-5.4	10.0	- 54.0
14	6.6	21.0	138.6
15	8.6	54.0	464.4
16	1.6	-17.0	- 27.2
17	-1.4	7.0	- 9.8
18	-10.4	3.0	- 31.2
19	-1.4	-21.0	29.4
20	2.6	-18.0	- 46.8
21	8.6	24.0	206.4
22	-1.4	- 2.0	2.8
23	-8.4	-39.0	327.6
24	3.6	19.0	68.4
25	6.6	11.0	72.6
26	3.6	36.0	129.6
27	-4.4	18.0	- 79.2
28	-2.4	-38.0	91.2
29	-4.4	54.0	-237.6
30	7.6	18.0	136.8
		$\Sigma x \cdot y$ =	2079.4

$$r_{III} = \frac{\Sigma x \cdot y}{N \cdot \sigma_x \cdot \sigma_y} = \frac{2,079.4}{27\ (5.2)\ (28.0)} = \frac{2,079.4}{3,931.2} = .53$$

Testing H_o: $r_{III} = 0$

df = n-2 = 27-2 = 25

Significance at .05 level = .38

Therefore, reject H_o and conclude r_{III} of .53 is significant.

Group Condition IV CQT-DCT Correlation Coefficient
Computation and Significance

Subject	x (DCT deviation)	y (CQT deviation)	x·y
1	- .1	32.1	- 3.21
2	.9	22.1	19.89
3	12.1	-23.9	289.19
4	1.9	29.1	55.29
5	- 1.1	14.1	- 15.51
6	- 7.1	-24.9	176.79
7	- 1.1	-39.9	43.89
8	3.9	8.1	31.59
9	- 3.1	- .9	2.79
10	- 3.1	3.1	9.61
11	4.9	- 1.9	9.31
12	- 2.1	-23.9	50.19
13	2.9	- 2.9	- 8.41
14	- 7.1	-24.9	176.79
15	-11.1	24.1	266.40
16	1.9	-12.9	- 24.51
17	1.9	14.1	26.79
18	6.9	- 6.9	- 47.61
19	1.9	-14.9	- 28.31
20	- 6.1	5.1	- 31.11
21	6.9	44.1	299.88
22	6.9	1.1	7.59
23	2.9	29.1	84.39
24	- 1.1	-26.9	29.59
25	6.9	-19.9	137.31
26	1.9	1.1	2.09
27	- 2.1	.1	- .21
28	5.9	-41.9	247.21
29	3.9	32.1	125.19
30	- 5.1	6.1	31.11
		Σ x·y =	562.10

$$r_{IV} = \frac{\Sigma x \cdot y}{N \cdot \sigma_x \cdot \sigma_y} = \frac{562.10}{30(5.1)\ (22.1)} = \frac{562.10}{3381.30} = .17$$

Testing H_o: $r_{IV} = 0$

df = n-2 = 30-2 = 28

Significance at .05 level = .36

Therefore, H_o is not rejected and it is concluded that r_{IV} of .17 is not significant.

Testing the Statistical Significance between the Six Possible Pairs of Group Correlation Coefficients using Standard Scores (Z) Based Upon z^1 Transformation Scores.

1. $H_o : r_I - r_{II} = 0$

$$\sigma_{z^1_I - z^1_{II}} = \sqrt{\frac{1}{23-3} + \frac{1}{26-3}} = \sqrt{\frac{1}{20}} = \frac{1}{23}$$

$$= \sqrt{.050 + .043} = \sqrt{.093} = .3$$

z^1_I of .63 = .741; z^1_{II} of .85 = 1.256

$$Z = \frac{z^1_I - z^1_{II}}{\sigma_{z^1_I \; z^1_{II}}} = \frac{.741 - 1.256}{.3} = -\frac{.515}{.3}$$

$$= \underline{-1.71}$$

This is significant at the .05 level using a one-tailed test so we reject the H_o and conclude that r_I is significantly greater than r_{II} .

2. $H_o: r_I - r_{III} = 0$

$$\sigma_{z^1_I - z^1_{III}} = \sqrt{\frac{1}{23-3} + \frac{1}{27-3}} = \sqrt{\frac{1}{20} + \frac{1}{24}}$$

$$= \sqrt{.050 + .042} = \sqrt{.092} = .3$$

z^1_I of .63 = .741; z^1_{III} of .53 = .590

$$Z = \frac{.741 - .590}{.3} = \frac{.151}{.3} = \underline{.50}$$

This is not significant at the .05 level and, therefore, we tentatively accept H_o that r_I is not significantly greater than r_{III} .

3. H_o: $r_{II} - r_{III} = 0$

$$\sqrt{z^1_{II} - z^1_{III}} = \sqrt{.043 + .042} = \sqrt{.0850} = .292$$

$$z^1_{II} = 1.256; \quad z^1_{III} = .590 \quad Z = \frac{1.256 = .590}{.292}$$

$$= \frac{.666}{.292} = \underline{2.28}$$

This is significant at the .05 level using a one-tailed test so we reject the H_o and conclude that r_{II} is significantly greater than r_{III} .

4. H_o: $r_I - r_{IV} = 0$

$$\sqrt{z^1_I - z^1_{IV}} = \sqrt{\frac{1}{20} + \frac{1}{27}} = \sqrt{.050 + .037} = \sqrt{.087}$$

$$= .295$$

z^1_I of .63 = .741; z^1_{IV} of .17 = .172

$$Z = \frac{.741 - .172}{.295} = \frac{.569}{.295} = \underline{1.93}$$

This is significant at the .05 level using a one-tailed test so we reject the H_o and conclude that r_I is significantly greater than r_{IV} .

5. H_o: $r_{II} - r_{IV} = 0$

$$\sqrt{z^1_{II} - z^1_{IV}} = \sqrt{.043 + .037} = \sqrt{.080} = .282$$

$$Z = \frac{1.256 - .172}{.282} = \frac{1.084}{.282} = \underline{3.84}$$

This is significant at the .05 level using a one-tailed test so we reject the H_o and conclude that r_{II} is significantly greater than r_{IV} .

6. H_o: $r_{III} - r_{IV} = 0$

$$\sqrt{z^1_{III} - z^1_{IV}} = \sqrt{.042 + .037} = \sqrt{.079} = .281$$

$$Z = \frac{.590 - .172}{.281} = \frac{.418}{.281} = 1.49$$

This is not significant at the .05 level so we tentatively accept H_o and conclude that r_{III} is not significantly greater than r_{IV}, although it is close to being significant.