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THE INTERACTION EFFECT OF STUDENT ANXIETY AND STUDENT PERCEPTION OF TEACHER STYLE ON ACHIEVEMENT

BY

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ABSTRACT

The present study was designed to determine if an interaction effect exists between student perception of his teacher's style and the student's anxiety level on achievement. The major hypothesis was that there is an interaction. The remaining hypotheses concerned the nature of this interaction, and stated that the resulting regression lines of student achievement on anxiety, nested within the two teacher styles, are curvilinear.

Three instruments: SPOTS (Student Perception of Teacher Style), IPAT Anxiety Questionnaire, and IPS (Introductory Physical Science) Achievement Test Chapters 6 - 8 Form B, were used to obtain the data. The tests were administered to a sample of 644 male and female Grade 10 science students attending schools in suburban Winnipeg. Nine different teachers had volunteered themselves and their classes. A final sample of 158 students who perceived their teacher as indirect, and 125 who perceived their teachers as direct were employed in this study.

The results showed that there is a significant disordinal interaction between student perception of teacher style and student anxiety on achievement. It was determined that the best fit regression equation for student achievement is curvilinear. It was found that a curvilinear relationship exists between student anxiety level and achievement when the students perceived their teacher as direct. When the students perceived their teacher as indirect the relationship was linear.

Results also indicated that within the range of obtained anxiety scores, students scoring below 15.14 achieved better results under a perceived indirect style, while students scoring above 18.04 achieved better under a perceived direct style.

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CHAPTER I

INTRODUCTION

Learning within the classroom is a process that involves at least two units, the teacher and the student. The dynamics between these units help in setting the classroom climate, or, the environment of learning. Flanders (1967) refers to classroom climate as "the qualities that consistently predominate most teacher-pupil contacts" (p. 104). Flanders emphasized the interrelationships of teacher and student within the learning process. As no two students are alike in needs and reactions and because most teachers face classrooms of more than one student at a time, the relationships between teacher and students are very complex. The teacher may be called upon to react differently to individual students. Teachers may even need to choose varying teaching styles in order to satisfy the different needs of the student.

The Problem

Cronbach and Snow (1977) explained that learning is a continuous search by the educator for new educational styles, hoping for improved results.

> [The teacher] seeks the best style of instruction for a given purpose. Since learners differ, the search for generally superior styles should be supplemented by a search for ways to fit the instruction to each kind of learner. One can expect interactions between learner characteristics and instructional style.(p. 1)

An interaction is said to be present when a situation has one effect on one kind of person and a different effect on another. This effect may be either positive or negative. The teacher's function is to utilize different styles for different students in order to achieve optimum student achievement results. On what basis can a teacher choose a style of teaching which will best satisfy the individual student? The choice of style must be made on specific criteria — those which differentiate one student from another. Bracht (1970) suggests various student variables that might interact with teacher style. One of these was student general anxiety level. Cronbach and Snow (1977) explain that a function of educational research is to locate interactions of individual differences among learners with instructional treatments, that is, aptitude by treatment interaction (ATI). In this paradigm aptitude may be, as suggested by Bracht (1970) and reiterated by Cronbach and Snow (1977), the student variable anxiety, and treatment may be teacher style, as suggested by Cronbach and Snow (1970). Aptitude and treatment are independent variables having an effect upon some dependent variable. In a school situation the dependent variable is frequently student achievement. Thus, an ATI study involving teaching style and student anxiety might assist the teacher in choosing a particular style for a particular student by establishing criteria on which to base his judgement.

The Variables

Independent Variables in the ATI Paradigm

The independent variables in the ATI paradigm are aptitude and treatment, each of which will be defined below.

Aptitude. Cronbach and Snow (1977) defined aptitude as, "any characteristic of a person that forecasts his probability of success under a given treatment" (p. 6). Snow (1976) stated that personality variables might predict response to instruction within a given setting. Bracht (1970) said that anxiety, as a personality variable, has an effect upon learning and is therefore considered to be an aptitude. Thus anxiety may be used as an aptitude within the ATI paradigm.

Two types of anxious people have been identified: state anxious and trait anxious people. Spielberger (1966) has presented a conceptual distinction between state and trait anxiety. State anxiety refers to the temporary experience of anxiety and is characterized by the phrase, "anxious now." Trait anxiety refers to a stable elevation in the level of anxiety as it describes an individual. It is part of his personality characteristics and may be characterized by the phrase, "anxious person."

Cronbach and Snow (1977) stated: "While states must be brought into theoretical explanations of the consequences of trait anxiety, state measures can rarely be used practically in education" (p. 394).

Thus the student variable (aptitude within the ATI paradigm) is trait anxiety, which gives a measure of the student's general anxiety level.

Treatment. Cronbach and Snow (1977) explained that treatment covers any manipulative variable, including teacher style of instruction.

Early research using teacher style as an independent variable was carried out by Anderson (1941) and later Cogan (1958). Both defined teacher style in terms of dominative and integrative teacher behaviours. Flanders (1963), using similar characteristics of teaching style, changed the terminology to direct and indirect teaching styles. All research methods used in analyzing teacher style employed a trained observer technique. This presents several problems, such as: (a) a foreign person must enter the classroom, which might create teacher-student inhibitions; (b) a very highly trained observer is necessary; (c) a long period of time is usually deemed to be necessary in order to assume reliable measurement of teacher style; and, (d) this technique assumes that the teacher reacts as direct or indirect in terms of the whole class, whereas he might in fact be direct in style to one student and indirect in style to another. Therefore his behaviour may be deemed to be a function of his perception of the individual needs of each student.

One student related facet of ATI research is the concern for individual differences. The assumption here is that students within the same class may view the same teacher's style differently. If this assumption is made it would be reasonable to infer that students' perceptions of their teacher's style may be a potent variable in determining the outcome of a given instructional segment. Perceptual psychology would suggest that the nominal stimulus (in this case the actual directness or indirectness of a teacher's style) is of less importance than the functional stimulus (in this case the individual student's perception of the teacher's style as direct or indirect). Therefore it is proposed in this

study that students' perceptions of teacher style constitute the appropriate treatment variable rather than a corresponding index of teacher style derived from observer data.

Hypothesis

An interaction is expected to exist between student general anxiety and student perception of teacher style on achievement. This interaction may be ordinal or disordinal. An ordinal interaction, as depicted by Figure 1 is when two regression lines converge but do not meet on the graph.

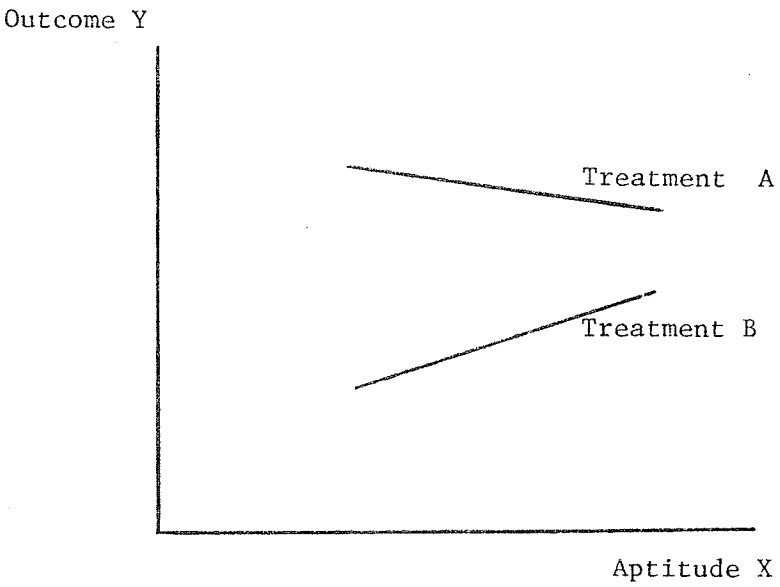

Figure 1. An ordinal interaction.

A disordinal interaction, as depicted by Figure 2, is when two regression lines converge and cross on the graph.

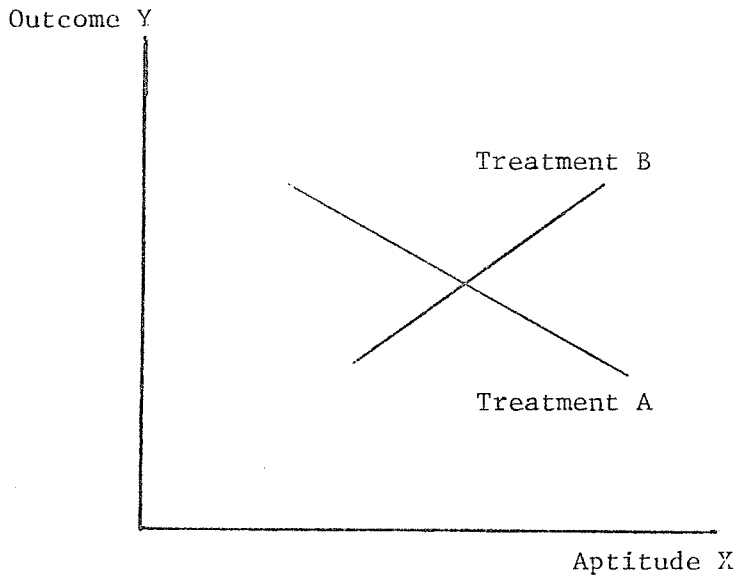

Figure 2. A disordinal interaction.

Cronbach and Snow (1977) argue that an ordinal interaction must be considered an interaction as it suggests "that the regression lines do cross, somewhere outside of the range of the sample" (p. 33). They go on to say that an ordinal interaction may be of importance with regards to program analysis and costs of instruction and therefore must be taken into serious consideration. Therefore the main hypothesis of this study or any ATI study is that there is an interaction between aptitude and treatment.

From this hypothesis a graph can be constructed depicting the interaction, either ordinal or disordinal, of the regression lines. By reading the graph added information is available. The graph will answer questions such as: (a) Can a high anxious student who perceives his teacher as direct achieve better results than one who perceives his teacher as indirect? and (b) Can a low anxious student who perceives his teacher as indirect achieve better results than one who perceives his

teacher as direct? Schools might be able to use this information in student classroom placement and within class groupings. Teachers might be able to use this information in making decisions about their interpersonal relationships with students if the research expectations are achieved.

CHAPTER II

A REVIEW OF THE LITERATURE

Introduction

Research involving teacher-student classroom relationships evolved from the early work of Anderson (1941). His research on classroom climate and his classification of teacher style into dominative and integrative categories led researchers to the use of the modern notion of aptitude by treatment interaction (ATI). Researchers, following Anderson's lead, examined classroom climate relative to two main variable categories; teacher variables and student variables. Modern research led by Cronbach and Snow (1967, 1969, 1976, 1977), combines these two independent variables in order to study their interactive effect on some dependent variable, which in the school setting often is student achievement.

The Effect of the Independent Variables on Achievement

Teacher Style. In order to assess the teacher aspect of classroom climate, Anderson (1941) introduced the terms dominative and integrative when referring to teacher style. He described the dominative teacher as:

1) Expresses or lectures about his own ideas or knowledge
2) Gives direction or orders
3) Criticizes or depreciates pupil behaviour
4) Justifies his own position of authority. (p. 106)

The integrative teacher was described as:

1) Accepts, clarifies and supports ideas and feelings of his students

2) Praises and encourages the pupils

3) Asks questions to stimulate pupil participation

4) Asks questions to orient pupils to schoolwork,(p. 106)

Several investigators chose to change Anderson's two category names of dominative and integrative. Cogan (1954) changed them to inclusive for an integrative style and preclusive for a dominative style. He designed an elaborate study of 33 teachers and 987 grade-school students. The students rated their teacher as inclusive or preclusive. Cogan found that, on the whole, pupils who rated their teacher as inclusive did more work for that teacher and had greater success. As an additional result he found that not all students classified their teacher in the same category. Students within the same class differed in their view of the teacher's style. Unfortunately Cogan didn't attempt to determine why this occurred.

Flanders and Amidon (1960), as reported by Amidon and Hough (1967), changed the category names of dominative and integrative to direct and indirect, respectively. Their interpretation of the terms direct and indirect were almost identical to Anderson's interpretation of dominative and integrative, however, Flanders and Amidon were more concise in their version. Their description of a direct teacher was:

1) Lectures

2) Gives direction

3) Criticizes or justifies authority. (p. 123)

The indirect teacher description was:

1) Accepts pupil's feelings
2) Praises and/or encourages
3) Accepts ideas
4) Asks questions. (p. 122)

Flanders (1960), as reported by Amidon and Hough (1967), suggested that, "When goals are unclear the effect of the indirect influence is to stimulate the expression of pupil's interest, curiosity and appreciation of several learning goals in terms of the method required to reach them" (p. 111). Under a direct influence he suggested that, "When goals are unclear, the result is to increase or to maintain the existing dependence of pupils on the teacher's control. Under these circumstances the direct influence restricts the alternative reactions to a pupil's overt compliance" (p. 112). This suggests that certain students may fair better under a particular teacher style. A student who needs to be dependent upon a teacher might possibly achieve better results under a direct influence than under an indirect influence. Thus one style may be better for a particular type of student than the other style.

Flanders' method of determining teacher style was to employ a trained observer technique. This technique has specific limitations. It necessitates the presence of an observer in the classroom which might inhibit both teachers and students. The observer must be highly trained. Flanders (1960) said that the prime problem in training observers is converting them into machines and then keeping them in that condition even

though it might deteriorate due to the unending variety of judgements that arise and require consistent treatment.

Another method of teacher style measurement is a student rating scale. Tuckman (1970) argues that one student may perceive a teacher to be direct while another student sitting in the same class may perceive the same teacher to be indirect. A crucial issue to this investigation is a suggestion made by Tuckman. Tuckman suggested that the directness or indirectness of a teacher is really relative to the student's own perceptions. He used a ten-point operational definition of directive teaching, which is as follows:

1) Formal planning and structuring of course work,

2) Minimization of informal work or small group work,

3) Rigid structuring of small groups as is employed,

4) Rigid structuring of individual and class activities,

5) Emphasis of factual knowledge or knowledge derived from sources of authority,

6) Use of absolute and justifiable punishment,

7) Minimization of the opportunity to make and to learn from mistakes,

8) Maintenance of formal relationships with students,

9) Assumption for total responsibility for grades,

10) Maintenance of formal classroom atmosphere.(p. 395)

The SPOTS (Student Perception of Teacher Style) is a 17-item rating scale designed by Tuckman. It calls for the student to rate his teacher on a nine-point directiveness scale. An example of this scale is

as follows (adapted from Tuckman, 1975, p. 397):

The teacher

1 2 3	4 5 6	7 8 9
Makes you do what he wants you to do most of the time.	Makes you do what he wants you to do sometimes.	Lets you make your own decisions most of the time.

Barnett (1972), in a study using SPOTS on a sample of 135 students studying Grade 10 biology, found that students who attained better achievement grades rated their teachers as non-direct by attributing to them scores at the top end of Tuckman's scale. The correlation that Barnett found between high achievement and indirect teaching style was .39.

Research on classroom climate focused on two variable groups: teacher variables and student variables. One independent variable, teacher style, has already been considered; the second independent variable, student anxiety, follows.

Anxiety. Sorenson (1964) said: "The emotions, which largely form the personality structure are the motivating forces which direct the use of one's energies. . . . Emotion-laden behavior often occurs as a response to anxiety" (p. 312). Sorenson defines anxiety as, "a state of mind characterized by tension, fear, and worry. It is a general feeling of apprehension, of discontent and distress" (p. 313). Anxiety as a personality variable has an effect on school achievement. Most researchers agree that anxiety at high levels has a debilitating effect on intellectual functioning. Castaneda (1956) wrote, "Anxiety at an intense level exerts a disorganizing effect diminishing the power of discrimination

and critical thinking" (p. 227).

The effect of anxiety level on intellectual functioning was researched in many studies. Waite et al. (1958) found that low anxious subjects mastered a pair associate learning task more rapidly than did high anxious subjects. Denny (1966) and Easterbrook (1959) found that in concept learning high anxious students had a limited perceptual field and showed less incidental learning. Reubush (1963) found a low negative correlation of -.12 between anxiety and IQ. Korchin and Levine (1957) analyzed types of errors and rate of learning verbal material. They found that the more anxious subjects differed little from non-anxious subjects in the amount learned when dealing with simple and logically associated material. When difficult or unfamiliar material was presented the differences between the two groups was significant. Their interpretation was:

> In the situation in which the subject has to make novel adjustments and cannot utilize existing behaviour patterns, the possibility of failure and the consequent loss of self esteem can further release anxiety and further reduce the subject's ability to develop appropriate behaviour.(pp. 223, 240)

Leah Gold Fein (1963) found that high levels of anxiety, as measured by Cattell's IPAT Anxiety Questionnaire were associated with relative failure in nursing school training. She found evidence of a curvilinear relationship between anxiety and achievement. Spence and Spence (1966) also obtained a curvilinear relationship between anxiety and intellectual functioning, with high anxiety levels hindering intellectual functioning.

Thus anxiety at high levels can affect school achievement. Since

evidence has been obtained of a curvilinear relationship, anxiety might be, to a point, an aid to achievement. Anxiety above an optimum level would be debilitating, but until that optimum level is achieved, anxiety might facilitate learning. Some basic questions arising from these data are: Under what conditions can the high anxious child achieve high results? Is there an interaction between teacher style and student anxiety level and does this effect achievement?

The Interaction Between Teacher Style and Student Anxiety

Cronbach (1967), Gagne (1967), Snow (1976), and Cronbach and Snow (1977) have suggested that no single instructional method produces maximum learning for all students. With a common set of goals some students will perform more successfully with one instructional program, while other students will be more successful with an alternate program. Withall (1951) demonstrated that a greater degree of general progress can be expected in a warm assuring climate, while Grimes and Allinsmith (1960) found that such support is to no avail in the absence of structure (discussed later). It follows, then, that maximum student achievement can be expected only when instruction is varied to meet the individual needs of each student. Cronbach (1967) states that these individual needs of the student interact with a particular style of instruction. An interaction occurs when under one treatment the results are better for one type of student, but that another treatment would be better for another type of student. Cronbach calls this interaction aptitude by treatment interaction (ATI).

According to Salomon (1971) ATI research can be perceived as

fulfilling two functions. The first is a rather pragmatic one, namely improving instruction and student achievement. The second function of ATI is to develop better explanatory principles concerning the nature of instruction. In order to accomplish this Salomon suggests:

> ATI research, by gradually constructing a matrix of learning situations and learner's characteristics, may facilitate the development of a theory of instructions.(p. 328)

Smith and Wood (1956), and Alpert and Haber (1960) suggest that certain emotional characteristics of students may interact with methods of teaching and affect achievement. In order to research this suggestion Grimes and Allinsmith (1961) studied compulsivity, anxiety, and school achievement within two school structures, direct and indirect. They used Anderson's definition of direct and indirect teacher styles. They argued that individual differences such as emotional needs may dispose pupils to find that one or another method of teaching makes learning more palatable, easier, and more satisfying. In their study they placed elementary school children in either a direct influence or an indirect influence. They found that high anxious children taught via an indirect style scored more poorly in relation to high anxious children taught under a structured setting. In addition, the high anxious children in a structured setting achieved higher mean scores than low anxious children. Cronbach (1971), using Grimes and Allinsmith's statistics, searched for an interaction and found it to be ordinal in that the regression lines were not parallel, and would cross outside of the range of the graph.

Other studies that considered the interaction of personality and style of instruction were conducted by Wispe (1953), Smith (1956), and

McKeachie (1958). Each of these studies involved university students who were over the age of 18 and under 20. Each study reported finding a type of student who appeared to demand a high degree of structuring in the learning situation in order to make optimum progress. Wispe (1953), as reported by Grimes and Allinsmith (1961), described this student as dependent and personally insecure. She theorized that this type of student should be placed in a structured style of classroom. Wispe explained that to this type of student a permissive style is a place where, "intellectual confusion is heaped upon personal anxiety" (p. 300).

Noll (1955) investigated the relationship between anxiety and the learning and retention of verbal matter. His study focussed on first year university students. He found that when the task became structured, the anxious subjects performed as well as, or better than, the low anxious group. Peterson (1974), as reported by Snow (1976), found that a clear structure worked very well for students who showed high trait anxiety, while little teacher structuring worked well for students of low trait anxiety. Peterson used the Spielberger State-Trait Anxiety inventory in order to determine trait anxiety. His subjects were Grade 10 students in four social studies classes with the number of subjects being 92. He obtained a disordinal interaction, but one of the problems of generalizing from this study is that the number of subjects was relatively low.

Hummel-Rossi, and Merrifield (1977) found that teachers interacted differently with different personality types. They were more rigid and directing with the more anxious students. This was assumed to be necessary because of the anxious students' need for security of knowing

exactly what is expected from them. The decision of which teacher style to employ for which student personality type was made entirely by the teacher. Their decision was entirely subjective and not based on prior research. This leads to the necessity of providing some form of research to test whether different student personality types need different styles of teaching.

Shands (1954) theorized that there are two factors that may be effective in relieving anxiety: (a) the availability of a pattern of behaviour (the structured school offers a definitive pattern); and, (b) the availability of a pattern of relationship (the dependence upon another person in the classroom usually means the teacher). Grimes and Allinsmith (1961) and Peterson (1974) placed students within direct or indirect styles of instruction. They found that the condition of structure is so potent that it had a significant beneficial effect upon the achievement of the anxious child. Grimes and Allinsmith researched elementary school children while Peterson employed high school subjects.

Each of these studies have indicated that an interaction exists between the student variable, anxiety, and the teacher's style of instruction, either direct or indirect. Their method of measuring the student's anxiety level was by using anxiety questionnaires such as the Spielberger State-Trait Anxiety Inventory, Cattell's IPAT Anxiety Questionnaire, the Taylor Manifest Anxiety Scale and the Children's Manifest Anxiety Scale. Their method of identifying teacher style was either by using a trained observer technique; or, by defining direct and indirect style and carefully placing students within each style. None of these studies have employed the student's own perception of his teacher's

style. Lowenfield (1956) and Spence (1957) hypothesized that each person restructures any stimulus into a unique pattern that fits his own expectations and conceptions. A child's personal reconstruction of stimuli may be vastly different from another person's as a consequence of his personality. For instance, when a teacher kindly remarks, "I know you will do well," some children may perceive severe threat.

Cronbach and Snow (1977) wrote: "The student's perception of his teacher may be just as significant a source of interaction as the teacher's actual style" (p. 508). Winne (1977) said that an area of ATI that has been little examined in research is the student's own preference for one or another kind of teaching style. This suggests the need to research the area of the student's own perception of his teacher's style. Unfortunately little research has been carried out on this topic. One study that has produced an interaction effect and has employed, to some degree, the student's own perceptions, was carried out by Dowaliby and Schumer (1973). In this study Dowaliby taught one section of junior college Psychology. The treatment was held constant with the class being taught in a style that blended the direct and indirect styles. Midway through the term anxiety was assessed and the students responded on a seven-point scale of agreement-disagreement to, "I would rate this as a lecture type class." The number of subjects originally was 51. The middle group, those who rated the class as neither direct nor indirect, was discarded lowering the number to 30. A significant interaction was obtained between student perception of teacher style and his anxiety level. The dependent variable was test achievement. On the basis of such low numbers of subjects the results are difficult to assess.

Summary

The research presented seem directly applicable to the problem of this study and justifies forecasting the interaction between student anxiety and his perception of his teacher's style. This interaction would then have a strong effect on student classroom achievement. Studies examining the effect of teacher style upon student achievement have shown that teacher style does have an effect. Studies examining the role of student anxiety have shown that under certain conditions anxiety can aid the student in producing successful achievement scores, but that under other conditions anxiety has a debilitating effect upon achievement. Two studies pointed to the curvilinearity of the anxiety/achievement graphed regression line where anxiety will aid a student up to a specific level where it will then be too strong and will interfere with achievement.

There have been few studies that have researched the interaction between teacher style and student anxiety, and even fewer researching the interaction between the student's perception of his teacher's style with his own anxiety level. The lack of available research points to the need for this type of study and suggests that there may be a significant interaction between these two independent measures.

The purpose of this study is to examine the relationship between student anxiety level, his personal perception of his teacher's style and their possible interactive effect upon the dependent variable, achievement.

CHAPTER III

METHODOLOGY EMPLOYED IN THE STUDY

This chapter is divided into five sections. Section A explains the sampling procedure used in this study; Section B discusses the procedures employed in obtaining the research data; Section C gives the rationale for and describes the instruments used within the study; Section D expresses the expectations of the study in hypothesis form; and, Section E describes the statistical treatment employed.

A. Sample

Six hundred and forty-four Grade 10 IPS (Introductory Physical Science) students and their teachers from various school divisions surrounding the City of Winnipeg were chosen for this study. This age group of students was chosen as the SPOTS (Student Perception of Teacher Style) rating scale was validated on samples from Grades 10 and 11. It was also felt that if pertinent information could be derived from this research it would be to the school's benefit to have this data during the first year of high school so that treatments could be altered for succeeding years.

Letters were sent to each IPS teacher throughout the various school divisions surrounding the City of Winnipeg. Those who volunteered to take part were contacted and told the nature of this study. All were asked for complete honesty and secrecy, and were promised complete

confidentiality. All students who took part in the study were 15 or 16 years old. Students were also given the choice of taking or not taking part, and were requested and promised the same things as their teachers.

Nine teachers having 28 classes volunteered. The SPOTS and the IPAT (Institute for Personality and Ability Testing) Anxiety Scale were administered to the students without their teacher present. The results for each class were arranged into three categories: Those students who perceived their teacher to be indirect, those students who perceived their teacher to be direct, and those who perceived their teacher to be neither indirect nor direct. Students rating their teacher as neither indirect nor direct were eliminated from the study. The remaining subjects were counted and if more than half the class was eliminated due to categorization, then that class was withdrawn from the study. It was felt that if less than half the class was employed it would be difficult to make decisions concerning differences between and within classes. Six classes were eliminated as more than half the class perceived their teacher as neither direct nor indirect. A further two classes were withdrawn as the number of students within each of these classes was too small to allow for an assessment of between or within class differences. This left 20 classes. It is important to note that no teacher was completely eliminated. This shows that students do perceive their teacher's style differently. From the remaining 20 classes, categorization eliminated 144 students, leaving 283 students for this study. Of the nine teachers, three had three classes each, five had two classes each, and one teacher was left with one class.

Cronbach and Snow (1977) suggest that the number of subjects in an aptitude by treatment interaction (ATI) design be no less than 100 per treatment. "We cannot recommend that an experimenter take seriously the failure of an appreciably observed ATI to reach significance unless N — per treatment reaches the neighbourhood of 100" (p. 57). When the 283 students were divided into treatments it was found that 128 perceived their teacher to be direct, while 155 perceived their teacher as indirect. The numbers per treatment (N — per treatment) involved in this study satisfy Cronbach and Snow's minimum number of 100.

TABLE 1

SUBJECTS INVOLVED WITHIN THE STUDY

Teacher	Students			
	Class 1	Class 2	Class 3	Total
1	13	10		23
2	15	13		28
3	19	14	15	48
4	16	17	12	45
5	12	15		27
6	14	16		30
7	16	12	14	42
8	12	16		28
9	12			12
Total	139	113	41	283

The Rationale for Categorical Divisions. Categorization permits the study to isolate two different teacher styles, indirect and direct. The scores on the SPOTS test are divided into three groups. One group of scores depict an indirect style, one group a direct style, and a third group being between direct and indirect. This third group is eliminated allowing for an analysis of student achievement within a particular teacher style. If SPOTS scores were placed on a continuum it would be more difficult to evaluate scores within each separate treatment. On a continuum results can be discussed in terms of treatments that are more direct or more indirect, thus presenting problems in defining directness and indirectness. Using categories eliminated this problem and allowed for better interpretation of results within each treatment.

B. The Measuring Instruments

Three instruments were employed in this study. They are: the IPAT Anxiety Scale Questionnaire, the Student Perception of Teacher Style (SPOTS), and the Introductory Physical Science (IPS) Test 3, Chapters 6-8, Form B.

IPAT Anxiety Scale Questionnaire. The IPAT was constructed by Cattell (1963) as a simple, quick, and effective method of arriving at a general anxiety score. It is an immediate outgrowth of a series of 14 replicated researches with the longer IPAT 16 PF test. The IPAT Anxiety Scale Questionnaire consists of five subparts which, when added together, give a total general anxiety score. Construct validity was estimated at .85 to .90. This was determined by Cattell (1963) by

combining in multiple correlation the five subparts. Another method of estimating construct validity is from the correlation of the actual 40 scale items with total score on the scale. Tadashi and Tsushima (1965), using a sample of 347 Japanese university students, obtained a multiple correlation of .92.

Reliability (Cattell, 1963) ranged between .93 and .87 on a test-retest method with one and two week intervals, respectively. On tests of homogeneity using the Spearman-Brown split-half method (Cattell, 1963), Cattell obtained scores of .91 and .84, respectively. Bendig (1960), using Ferguson's variation of the Kuder-Richardson formula of reliability, obtained scores of .83, .80, and .81 on three separate determinations. Both Cattell and Bendig obtained their results from using university students as subjects. Wheeler (1965) obtained test-retest reliability scores of .91, and .88 over a one and two week period using high school students.

Cohen in Buros (1970) wrote, "For a quick measure of general anxiety level in adolescents and adults, for screening purposes, this test has no peer" (p.65).

Student Perception of Teacher Style (SPOTS). In order to develop a practical, reliable, and valid measure of teacher directiveness, Bruce Tuckman (1970) devised a rating scale with which students could rate the directiveness of their own teacher. The scale began as a 32 item, nine point scale but was reduced to a 17 item nine point scale. The internal consistency of the SPOTS was established by correlating the mean SPOTS score of each item for each teacher with the grand mean score for each teacher. Correlations ranged from .45 to .91. Tuckman (1970) created

two other scales, (a) the Observer Rating Scale (ORS), and the Teacher Style Checklist (TSC). Both were used by trained observers to judge the style of each of the teachers. SPOTS scores and ORS scores were correlated and a coefficient of .53 was obtained. Between TSC and SPOTS a coefficient of .31 was obtained, while .75 was the coefficient between ORS and TSC.

SPOTS was created and written particularly for the high school student. Tuckman (1970) tested SPOTS on 11th and 12th grade students. Barnet (1972) obtained similar results of inter-judge reliability only he used 10th grade students. He found a .58 correlation between SPOTS and a trained observer rating using Tuckman's ORS.

Introductory Physical Science (IPS), Test 3, Chapters 6-8, Form B. IPS was particularly chosen as it lends itself very well to objective methods of assessing achievement. Also, teachers utilize the standardized testing forms produced by the authors of the course. The students have become accustomed to this style of testing and to the type of questions employed on these tests. Therefore, to continue to use this method of assessing achievement would presumably create fewer adjustment problems than if they were confronted by a test of a different style and technique.

The organizers of the IPS Grade 10 science course produced two series of tests to be administered after chapters and/or units were completed. The Education Development Center (1968) reported that forms A and B were quite consistent with each other, with a correlation of .94. The tests are short and employ a multiple choice method of choosing answers thus negating teacher bias.

C. Procedure

The three tests that were employed for this study were: Cattell's IPAT Anxiety Questionnaire, Self Analysis Form (1963); Tuckman's SPOTS rating scale (1970); and, IPS tests for Chapters 6-8, Form B (1968) were all suitable for group testing.

The students wrote the IPAT Anxiety Questionnaire and the SPOTS tests in one sitting of 50 minutes with all students completing the tests within a two week time span at the end of January, 1977. Teachers were not present during this sitting. The IPS test was teacher administered on the completion of the required chapters. As the teachers completed the necessary material at various times during the school term, it was impossible to control the time of the year. All tests were completed by the 15th of May, 1977. The teachers marked their class's tests and passed on a copy of the scores for this study. Teacher bias in marking was eliminated by the nature of the IPS test. It is a multiple choice test with only one correct answer.

D. Hypotheses

Research conducted by Wispe (1953), Grimes and Allinsmith (1960), Wine (1976), Tuckman (1970), Barnet (1972), and Cronbach and Snow (1977), suggests that an interaction between student perception of teacher style and student anxiety level on achievement will exist. Furthermore, research conducted by Spence and Spence (1966) suggests that the regression lines obtained will be curvilinear. Therefore, the hypotheses in this study are:

H_1 : The full regression equation is curvilinear;

H_2 : There is an interaction between student perception of teacher style and student anxiety on achievement;

H_3 : The regression line for the indirect teacher is curvilinear;

H_4 : The regression line for the direct teacher is curvilinear.

Models Employed in the Study. There are eleven possible models used in this study. Models (1) and (2) are the full models denoting linear interaction, and curvilinear interaction. Model (3) depicts the full model without curvilinear interaction which may have to be tested for significance. Models (4) through (7) depict the individual regression lines both in linear and quadratic form. Models (8) through (11) depict the individual regression lines for the confidence limits in both quadratic and linear form.

Model (1), full model, linear form is

$$Y' = a + b_1x_1 + b_2x_2 + b_3(x_1x_2) .$$

Model (2), full model quadratic form is

$$Y' = a + b_1x_1 + b_2x_2 + b_3x_x^2 + b_4(x_1x_2) + b_5(x_1x_2^2) .$$

Model (3), full model without the quadratic interaction term is

$$Y' = a + b_1x_1 + b_2x_2 + b_3x_2^2 + b_4(x_1x_2)$$

For each model

Y' = predicted achievement score on IPS test,

a = a constant,

b_1 = the regression weight for teacher style,

x_1 = the effect coding for teacher style where an indirect teacher

was coded as 1 and a direct teacher was coded as -1 ,

b_2 = the regression weight for anxiety,

x_2 = the score for anxiety,

b_3 = the regression weight for the square of anxiety, the quadratic term,

x_2^2 = the square of anxiety forming the quadratic,

b_4 = the regression weight for the linear interaction,

(x_1x_2)=the interaction of teacher style and anxiety,

$(x_1x_2^2)$=the quadratic interaction.

Model (4), linear form for the indirect style is

$$Y_I' = a + b_1x .$$

Model (5), quadratic form for the indirect style is

$$Y_I' = a + b_1x + b_2x^2 .$$

Model (6), linear form for the direct style is

$$Y_D' = a + b_1x .$$

Model (7), quadratic form for the direct style is

$$Y_D' = a + b_1x + b_2x^2$$

where:

Y_I' = the predicted score for students perceiving their teacher to be indirect,

Y_D' = the predicted score for students perceiving their teacher to be direct,

a = a constant,

b_1 = the regression weight for anxiety,

x = the score for anxiety,

b_2 = the regression weight for the quadratic term,

x^2 = the quadratic form, anxiety squared.

Model (8), linear form indirect with constant is

$$Y_I' = a + b_1x + W .$$

Model (9), quadratic form indirect with constant is

$$Y_I' = a + b_1x + b_2x^2 + W .$$

Model (10), linear form direct with constant is

$$Y_D' = a + b_1x + W .$$

Model (11), quadratic form direct with constant is

$$Y_D' = a + b_1x + b_2x^2 + W ,$$

where W is a constant to be added to the equation to form new regression lines denoting the confidence limits about the initial regression line. The confidence level is taken at 95%.

Testing the Hypotheses. The first two statistical hypotheses are derived from the full regression model quadratic form, model (2). The hypotheses are statistically stated and refer to the same hypotheses stated earlier.

$H_1 : b_3 , b_5 \neq 0$ from model (2) .

$H_2 : b_4 , b_5 \neq 0$ from model (2) .

The remaining two hypotheses use models (5) and (7), respectively.

$H_3 : b_2 \neq 0$

$H_4 : b_2 \neq 0$

The statistical significance test employed is the F ratio, which tests the null hypotheses. The null hypotheses for the above hypotheses are:

H_{o_1} : b_3 , b_5 = 0 from model (2),

H_{o_2} : b_5 = 0 from model (2),

H_{o_3} : b_2 = 0 from model (5),

H_{o_4} : b_2 = 0 from model (7).

Kerlinger and Pedhazur (1973) state that, in order to test curvilinearity, the proportion of variance accounted for by the teaching styles must be determined first. Then the linear and quadratic trends are tested for significance, and finally, the curvilinear interaction must be tested for significance. The proportion of variance is denoted by R^2 . The R^2 for each model is denoted by R^2 and the model number subset to it; example, $R_{(1)}^2$ is the proportion of variance for model (1). The test for significance for curvilinearity is F ratio and is determined by formula (1). Formula (1) is:

$$F = \frac{(R_{(2)}^2 - R_{(1)}^2) / df_{(1)}}{(1 - R_{(2)}^2) / df_{(2)}}$$

where:

F = the obtained F score,

$R_{(2)}^2$ = the proportion of variance of predicted achievement using model (2),

$R_{(1)}^2$ = the proportion of variance of predicted achievement

using model (1),

$df_{(1)}$ = the degrees of freedom for the numerator which is determined by the number of predictors for $R_{(2)}^2$ minus the number of predictors for $R_{(1)}^2$.

$df_{(2)}$ = the degrees of freedom for the denominator which is determined by subtracting the number of predictors for $R_{(2)}^2$ from the total sample number, n , and then subtracting one for the constant.

If F is significant at the .05 level H_{o_1} is rejected, and the regression line is curvilinear. Model (2) becomes the full model employed in the study. If F is not significant then the regression line is assumed to be linear, and model (1) is the full model employed in the study.

The test for curvilinear interaction uses a formula similar to formula (1). It is also an F ratio and is denoted by formula (2). Formula (2) is:

$$F = \frac{(R_{(2)}^2 - R_{(3)}^2) / df_1}{(1 - R_{(2)}^2) / df_2} \quad .$$

If F is significant at the .05 level H_{o_2} is rejected, and there is a significant curvilinear interaction. If F is not significant, there is assumed to be no curvilinear interaction, and the regression lines would then be parallel.

If there is an interaction then the individual regression lines for each teacher style are produced and tested for curvilinearity. The F ratio is used to test model (4) against model (5), and model (6) against model (7). Formula (3) tests models (4) and (5) while formula (4) tests models (6) and (7). Formula (3) is:

$$F = \frac{(R_{(5)}^2 - R_{(4)}^2) / df_1}{(1 - R_{(5)}^2) / df_2}$$ and

formula (4) is:

$$F = \frac{(R_{(7)}^2 - R_{(6)}^2) / df_1}{(1 - R_{(7)}^2) / df_2} .$$

If F is significant at the .05 level for both formula (3) and (4), then both regression lines are curvilinear. If one or both F scores are not significant, then one or both of the regression lines are linear.

The Point of Intersection. If there is an interaction, then the regression lines will cross. The interaction may be either ordinal or disordinal. If it is ordinal, then the point of intersection of the two regression lines will be beyond the range of the graph. If the interaction is disordinal, then the point of intersection will be on the graph. The point of intersection can be determined by one of three formulae. One formula is used if both regression lines are linear, one if both are curvilinear, and the third if only one line is curvilinear. Formula (5), both lines linear is

$$X = - \frac{a_D - a_I}{b_D - b_I} .$$

Formula (6), both lines curvilinear is

$$X = \frac{- (b_{1_D} - b_{1_I}) \pm \sqrt{(b_{1_D} - b_{1_I})^2 - 4(b_{2_D} - b_{2_I})(a_D - a_I)}}{2 (b_{2_D} - b_{2_I})} .$$

Formula (7), one line curvilinear is

$$X = \frac{-(b_{1_D} - b_{1_I}) \pm \sqrt{(b_{1_D} - b_{1_I})^2 - 4\,(b_{curv})(a_D - A_I)}}{2\,(b_{curv})}$$

where:

X = the point of intersection of the two regression lines on the x - axis,

b_{1_D} = the regression weight for the anxiety score in the direct teaching style (b_{1_I} for indirect),

b_{2_D} = the regression weight for the anxiety score in the indirect teaching style (b_{2_I} for direct),

b_{curv} = the regression weight of the curvilinear regression line whether it be indirect or direct,

a_D = the constant given for the direct teacher style,

a_I = the constant given for the indirect teacher style.

Confidence Limits. Confidence limits are established by producing two new regression lines around each of the original lines. This is done by producing a new constant W which is added to the models for indirect and direct styles. Models (8) through (11) depict these new regression lines. Once it has been determined which of the models to employ for the individual regression lines, then W is added to them. W is determined by obtaining the critical value of F of each of the models at the .95 confidence level. The df for the F value is the number of subjects minus the number of variables for that particular regression line minus one. The formulae for obtaining W are:

Formula (8), for the indirect style is

$$W_I = \pm \sqrt{F(MS_{res})\left(\frac{1}{N_I}\right)} \quad \text{and,}$$

Formula (9), for the direct style is,

$$W_D = \pm \sqrt{F(MS_{res})\left(\frac{1}{N_D}\right)} \quad .$$

where:

W = a constant,

F = the critical value with df = 1, (N-5-1), and the level of confidence = .95,

MS_{res} = the mean square residual,

N = the number of subjects in each group, respectively.

These new lines are graphed and the intersection of these lines produce regions where there is a significant difference between the two styles.

Level of Significance. In order to be consistent with tradition, and with Cronbach and Snow's suggestions, the level of significance for each F score obtained is set at .05.

Assumptions. The two basic assumptions in using the F ratio are normality and homoscedasticity. Since the bivariate normal model is an ideal, this is rarely, if ever, achieved. Norris and Hjelm (1961) tested, and found that normality is not needed when using an F ratio especially if the number of subjects within the study is quite large. The number given by Norris and Hjelm as the minimum required number of subjects is 60. Kirk (1968) and Hayes (1963) agree with Norris and Hjelm,

as they consider the F ratio to be so robust as to not be affected by the lack of normality. The second assumption of homoscedasticity is also considered by Kirk to be unimportant. He states that due to the robust nature of the F ratio, the F distribution is relatively unaffected by heterogeneity of variance (1968, p. 62).

In any case, both normality and homoscedasticity were tested. A table was produced giving the skewness and kurtosis of each of the continuous variables, achievement score and anxiety score. The skewness and kurtosis of each is then tested for significance. Homoscedasticity is also tested by using the statistic, Cochran's C (Kirk, 1969, p. 62).

Teacher Differences. There were nine different teachers participating in this study. The teachers may adopt different rates of speed for their classes and some may utilize more in depth material for their classes. This may cause a difference in learning between the different classes and might affect student achievement. In order to check on this possibility a table will be produced which will provide information concerning the differences between teachers.

E. Summary

Research involving student perception of teacher style and student anxiety level has produced the following hypothesis.

1) The full regression lines for achievement on student anxiety under student perception of their teacher's style will be curvilinear.

2) There is a significant interaction effect between student perception of teacher style and his anxiety level.

3) The regression line for the indirect style will be curvilinear.

4) The regression line for the direct style will be curvilinear.

This study examines each of these hypotheses, obtains separate regression lines for each treatment, and depicts the graph of these regression lines. Regions of confidence are established and information depicting teacher differences is given.

CHAPTER IV

DATA AND STATISTICAL ANALYSIS

Introduction

Chapter IV provides the statistical findings and presents an analysis of these findings. All models and formulae are taken from Chapter III using the same numerical designations for each model and formula.

The Descriptive Statistics. All means and standard deviations (SD) will be provided in Tables 2 and 3. Table 2 gives the descriptive statistics for the full regression model (1), while Table 2 gives the statistics for the individual regression lines models (4) through (7).

TABLE 2

DESCRIPTIVE STATISTICS, MODEL (1)

Variable		Mean	SD
Achievement	Y	65.439	15.6947
Anxiety	x_2	22.9895	12.3054
Style	x_2	.0941	.9903
Int	x_1x_2	- 1.1429	25.7551
SQ anxiety	x_2^2	679.4146	624.2091
SQ int	$x_1x_2^2$	-100.3275	871.0932

The $\underline{x}$ variables in Table 2 are the means of each variable and are used only when predicting from the mean. All variables are taken from the full

model (2).

TABLE 3

DESCRIPTIVE STATISTICS, INDIRECT AND DIRECT STYLES

Style	Variable	Mean	SD	Cases
Indirect	Achievement	66.7613	13.6139	155
	Anxiety	19.9871	11.0271	155
Direct	Achievement	65.1172	16.5051	128
	Anxiety	26.7656	11.8192	128

Testing the Assumptions. The two assumptions as related previously were normality and homoscedasticity (homogeneity of variance). As reported earlier, the lack of these points does not necessarily detract from the study. In order to be consistent with tradition the assumptions are tested. Table 4 provides the kurtosis and skewness of the two continuous variables.

TABLE 4

NORMALITY (N=283)

Variable	Kurtosis	Skewness
Achievement	.053	-.51**
Anxiety	-.787	.247*

*significant at the .05 level.
**significant at the .01 level.

With the scores being significant at the .05 or .01 level, the sample employed in this study is clearly not normal. This, however, according to Norris and Hjelm (1961) and Kirk (1968) does not detract from the analysis of this study because of the robust nature of the F distribution and the larger number of subjects employed in the study.

The second assumption, homoscedasticity, is tested using Cochran's C (Kirk, 1968, p. 62). Using Cochran's C, C is determined to be .595. The critical value for C with df = 282 and 2 with the level of significance at .05 is .5313. The C obtained is higher but substantially higher than the critical C. The sample in this study lacks homogeneity of variance, as determined by Cochran's C, but according to Kirk (1968) and Hayes (1963), the lack of homogeneity of variance does not affect the robust nature of the F distribution especially if the number of subjects within a study is large.

Statistical Analysis

The Quadratic Trend. The predictors employed in this study are as follows:

Achievement - the student's achievement score on the IPS test,

Style - the student's perception of teacher style as measured by Tuckman's SPOTS,

Anxiety - the student's general anxiety level as measured by Cattell's IPAT Anxiety Scale,

Int - the interaction of style and anxiety,

SQ anxiety - the quadratic term of the variable anxiety,

SQ int - the quadratic term of the interaction of style and anxiety,

A quadratic trend is determined by comparing the $R_{(1)}^2$ with the $R_{(2)}^2$. If the quadratic model $R_{(2)}^2$ is larger than the linear model $R_{(1)}^2$ then there is a quadratic trend. Tables 5 and 6 are multiple regression summary tables for both model (1) and model (2), respectively.

TABLE 5

MODEL (1) MULTIPLE REGRESSION, LINEAR

Variable	Multiple R	R^2 incremental	b
Style	.05538	.00307	19.85614
Anxiety	.06144	.00378	- .01660708
Int	.58936	.34375	- .8144284
Constant			63.02204

TABLE 6

MODEL (2) MULTIPLE REGRESSION, QUADRATIC

Variable	Multiple R	R^2 incremental	b
Int	.20759	.04309	-1.997221
Style	.58923	.34719	30.42003
Anxiety	.58936	.34735	.9910946
SQ anxiety	.62355	.38881	- .0202521
SQ int	.64559	.41678	.02485374
Constant			53.76288

The linear $R_{(1)}^2$ is .34375, from Table 1, and the quadratic $R_{(2)}^2$, from Table 2 is .41678. In order to test the significance of the

difference in regression an F ratio is produced. The null hypothesis is denoted as H_{o_1} and is: H_{o_1} : b_3 , b_5 = 0 . Using formula (1) from Chapter III with $df_{(1)}$ being (5-3) and $df_{(2)}$ being (283-5-1). The critical value for F, with $df_{(1),(2)}$ = 2, 277 and the level of significance set at .05, is 3.05.

$$F = \frac{(.41678 - .34735)/ (5-3)}{(1 - .41678) / 277}$$

$$F = 16.488$$

The obtained F ratio is clearly larger than the critical F ratio, and therefore the quadratic trend is significant. This means that there is a significant curvilinear relationship. Model (2) becomes the model used in this study to denote predicted achievement. The separate regression lines are taken from the full model (2). Thus, either one or both of the individual regression lines, models (4) through (7) are curvilinear.

The Significance of the Quadratic Interaction. This test is very similar to the prior test as it is also an F ratio. The test partials out the quadratic interaction term, SQ int, and tests for its significance. Table 7 establishes the summary table for the regression without the predictor for the quadratic interaction $R_{(3)}^2$.

TABLE 7

MODEL (3)

MULTIPLE REGRESSION WITHOUT SQint

Variable	Multiple R	R^2 incremental	b
Style	.05538	.00307	20.02985
Anxiety	.06144	.00378	.9510946
SQ anxiety	.19375	.03754	-.01976951
Int	.62355	.38881	-.08239697
Constant			54.17947

Formula (2) is used to determine the F ratio. The $df_{(1)}$ is (5-4) while $df_{(2)}$ is (283-5-1). The critical value for F with $df_{(1),(2)}$ = 1, 277 and with the level of significance set at .05 is 3.87. The null hypothesis is, $H_{o_1} : b_5 = 0$.

$$F = \frac{(.41671 - .38881) / (5-4)}{(1 - .41678) / 277}$$

$$F = 13.284$$

The obtained F value is significant and therefore there is a significant curvilinear interaction.

The Regression Equations

The Full Regression Model. The full regression model (2) can now be written in equation form. The b weights for each of the predictors are given in Table 6 while the means of the predictors are given in Table 1.

Numerically, model (2) can be written

$$Y' = 53.762 + 30.42\ (.084) + .991\ (22.989) - .0203\ (679.415)^2 - 1.997\ (-1.143) + .025\ (-109.328)$$

$$Y' = 65.44 \quad .$$

As would be expected the predicted achievement score Y' is the same as the mean achievement score from Table 1.

The Direct and Indirect Teacher Style Regression Equations. Each equation is taken in its quadratic form and each is then tested for its quadratic significance. Even though the full model (2) is significantly curvilinear it does not necessarily follow that both individual regression lines are curvilinear. The indirect teacher style regression equation is given by model (4), while the direct teacher style regression equation is given by model (8). The numbers used in the models are obtained from Tables 8 and 9

TABLE 8

MODELS(4), (5)
SUMMARY TABLE FOR INDIRECT STYLE

Variable	Multiple R	R^2incremental	b
Anxiety	.68764	.47285	-1.370480
SQ anxiety	.69286	.48006	- .01122138
Constant			88.31475

TABLE 9

MODELS (6), (7)

SUMMARY TABLE FOR DIRECT STYLE, QUADRATIC

Variable	Multiple R	R^2 incremental	b
Anxiety	.53686	.28822	2.545131
SQ anxiety	.59281	.35142	- .03746876
Constant		23.03097	

The Quadratic Significance Test. The formula for the F ratio test for each individual regression line is denoted as Formula (3). The null hypothesis is, H_{o_3} : $b_2 = 0$ for the indirect teacher. The $df_{(1)}$ is (2-1) and $df_{(2)}$ is (155-2-1). The significance level is set at .05. The critical F value is 3.91.

$$F = \frac{(.480 - .473) \ / \ (2-1)}{(1 - .480) \ / \ (155-2-1)}$$

$$F = 2.92$$

The obtained F ratio is below the critical F value and therefore the null hypothesis is not rejected. The regression line is assumed to be linear for the indirect teacher style. Thus model (4) is the model used for the indirect teacher style.

Formula (4) is used to test the significance of the quadratic form of the direct teacher style. This tests models (6) and (7). The null hypothesis is, H_{o_4} : $b_2 = 0$. The $df_{(1)}$ is (2-1) and $df_{(2)}$ is (128-2-1). The level of significance is set at .05. The critical value of F is 3.92.

$$F = \frac{(.351 - .288)/ (2-1)}{(1 - .351) / (128-2-1)}$$

$$F = 12.13$$

The obtained F ratio is much higher than the critical F value and therefore the null hypothesis is rejected. The regression line for the direct style is considered to be curvilinear and model (7) is used for the direct teacher style.

The summary table for the indirect teaching style, linear model (4) is given in Table 10.

TABLE 10

MODEL (4):
SUMMARY TABLE FOR INDIRECT STYLE, LINEAR

Variable	Multiple R	R^2incremental	b
Anxiety	.68764	.47285	-1.370480
Constant			83.73

The numerical values, in equation form, for model (4) are

$$Y_I' = 83.73 - 1.37x,$$

The numerical values, in equation form, for model (7) are

$$Y_D' = 29.03 + 2.545 \quad x - .037x^2.$$

A Graphical Representation of the Regression Lines. The points plotted on the graph are depicted in Table 11.

TABLE 11

POINTS FOR GRAPHICAL REPRESENTATION

Anxiety (the x-axis)	Indirect Y_I'	Direct Y_D'
5	70.88	40.83
10	70.03	50.78
15	63.18	58.88
20	56.35	65.13
25	49.48	69.53
30	42.63	72.08
35	35.78	72.78
40	28.93	71.63
45	22.08	68.63

The point of intersection is obtained through the use of formula (7) since one line is curvilinear and the other is linear. Because of the quadratic term there are two possible points of interaction.

$$X = \frac{-(2.545 + 1.37) \pm \sqrt{(2.545 - 1.37)^2 - 4(-.037)(29.03 - 8373)}}{2\,(-.037)}$$

$X = 89.26$ or $X = 16.554$

As 89.26 is beyond the range of the anxiety scores, the point 16.554 is accepted as the point of intersection. Figure 3 clearly depicts ordinal interaction.

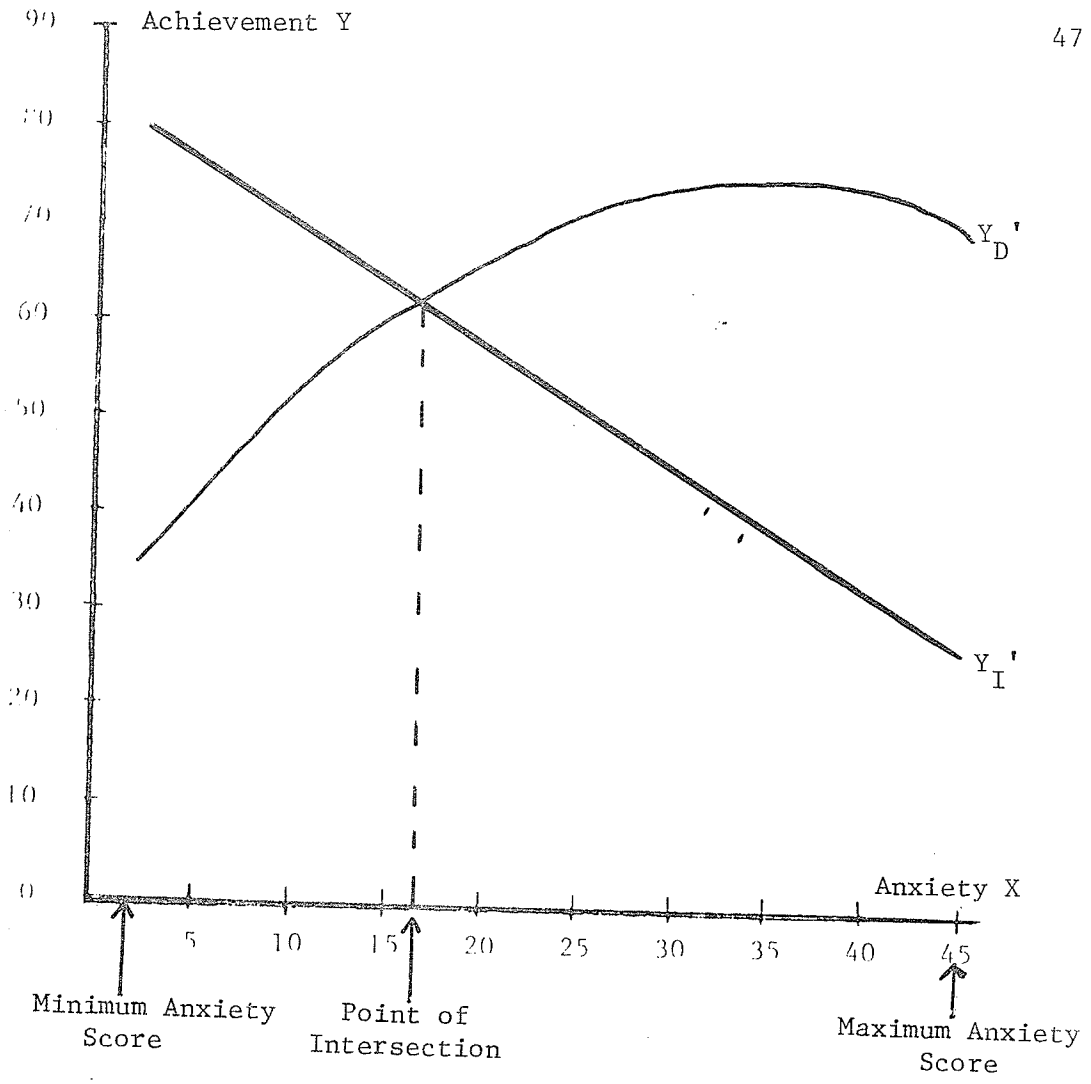

Figure 3. The interaction between anxiety and style on achievement.

Confidence Regions. The establishment of confidence regions show graphically the areas where anxiety scores in the two styles differ significantly in their effect upon achievement. In order to arrive at these regions, new regression lines are produced by using formulae (8) and (9). This will produce the new models (8) and (11). The information used in the formulae are taken from Tables 12 and 13.

TABLE 12

ANALYSIS OF VARIANCE (Indirect Style)

	df	Sum of Squares	Mean Squares	n
Regression	1	13496.22	13496.22	155
Residual	154	15045.95	98.34	

TABLE 13

ANALYSIS OF VARIANCE (Direct Style)

	df	Sum of Squares	Mean Square	n
Regression	2	12158.22	6079.112	128
Residual	126	22439.018	179.512	

The $\underline{F}$ critical value for the indirect style, with $\underline{df}$ = 1,154 and the level of significance = .05, is 3.91.

$$W_I = \pm \sqrt{3.91\ (98.34)\ (\frac{1}{155})}$$

$$W_I = \pm\ 1.57$$

The numerical equation for model (8) is the same as model (4) except that the constant $\underline{W_I}$ is added on. The numerical equation for model (8) is

$$Y_I' = 83.73 - 1.37x \pm 1.57.$$

The $\underline{F}$ critical value for the direct style, with $\underline{df}$ = 2,126 and

the level of significance set at .05, is 3.92.

$$W_D = \pm \sqrt{3.92\ (179.512)\ (\frac{1}{128})}$$

$$W_D = \pm 2.34$$

The numerical equation for model (11) is the same as model (7) except that the constant $\underline{W}$ is added on. The numerical equation for model (11) is

$$Y_D' = 29.03 + 2.545x - .037x^2 \pm 2.34$$

The four regression lines using the constant $\underline{W}$ are now plotted on the graph. These lines represent the confidence limits around the indirect and direct style regression lines. Table 14 depicts the graphical points for the two new regression lines around Y_I'. Table 15 depicts the graphical points for the two new regression lines around Y_D'.

TABLE 14

GRAPHICAL POINTS FOR INDIRECT CONFIDENCE RECIONS

Anxiety (the x-axis)	Y_{I_1}'	Y_{I_2}'
5	78.45	75.31
10	71.6	68.46
20	57.9	54.76
30	44.2	41.06
40	30.5	27.36
45	23.65	20.51

TABLE 15

GRAPHICAL POINTS FOR THE DIRECT CONFIDENCE REGIONS

Anxiety (the x-axis)	Y_{D_1}'	Y_{D_2}'
5	43.17	38.49
10	53.12	48.44
20	67.47	62.79
30	74.42	69.74
40	73.97	69.29
45	70.97	66.29

In order to establish the significance regions, the points of intersection for the regression lines of the confidence intervals are determined. The formula used is formula (7). The two points necessary to establish significance regions are determined by the intersection of the lines Y_{I_1}' and Y_{D_2}', and the lines Y_{I_2}' and Y_{D_1}'. For the point of intersection of Y_{I_1}' and Y_{D_2}',

$$X = \frac{-(2.545 + 1.37) \pm \sqrt{(2.545 + 1.37)^2 - 4(-.037)(26.69 - 85.3)}}{2\ (-.037)}$$

$X = 87.77$ and 18.04.

Since 87.77 lies outside the range of the anxiety scores, 18.04 is accepted as the point of intersection.

For the point of intersection between Y_{I_2}' and Y_{D_1}',

$$X = \frac{-(2.545 + 1.37) \pm \sqrt{(2.545 + 1.37)^2 - 4(-.037)(31.37 - 82.16)}}{2(-.037)}$$

$X = 90.676$ and $X = 15.14$.

Since 90.676 lies beyond the range of the anxiety scores, 15.14 is accepted as the point of intersection.

Thus all students, whose anxiety scores range between 15.14 and 18.04, are close enough to each other in their achievement scores so that it is insignificant as to how they perceive their teacher's style. However, it is significant as to how the students perceive their teacher for those whose anxiety scores are below 15.14 and 18.04.

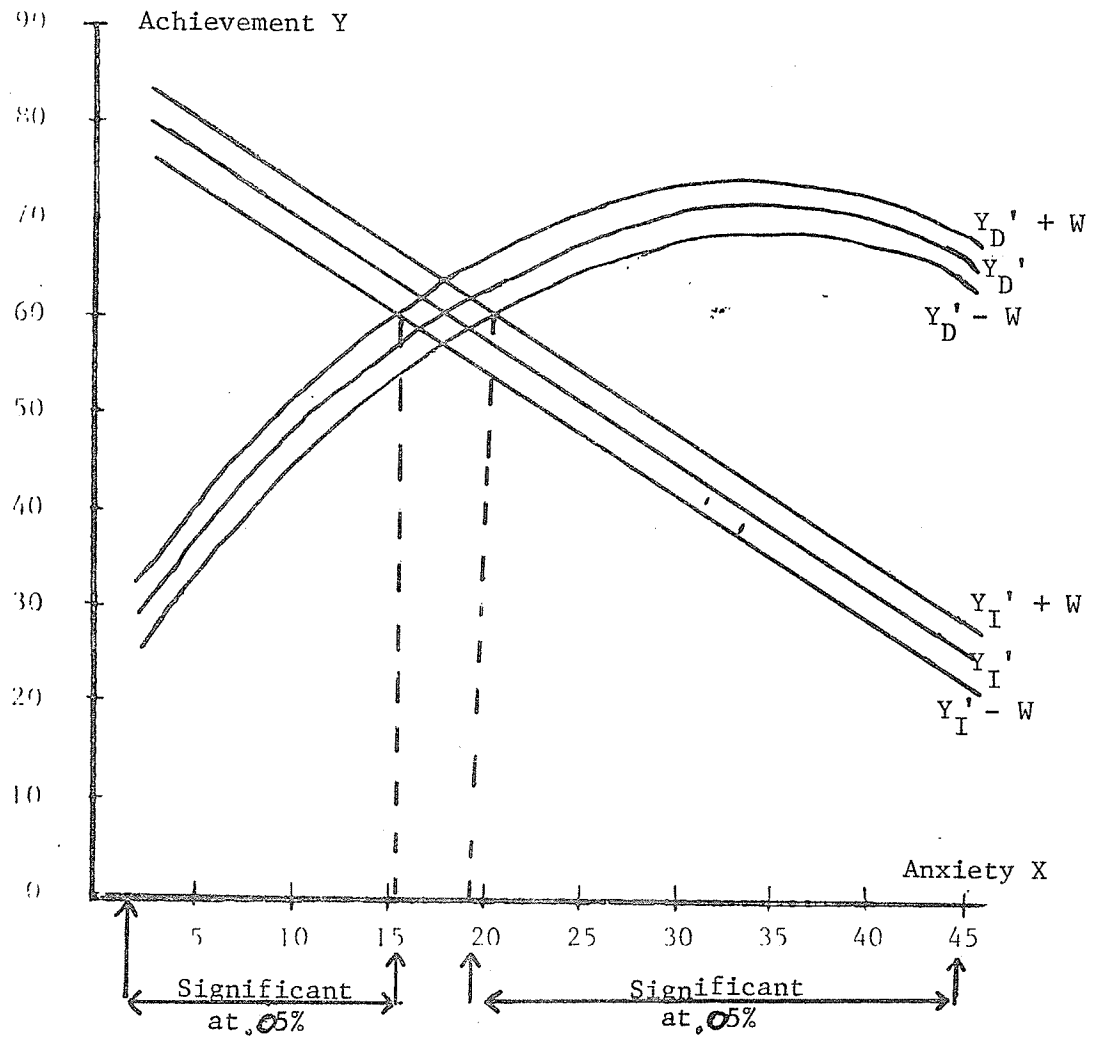

Figure 4. The regions of significance of the interaction between anxiety and style

Between Teacher Differences. Because there were nine different teachers employed in this study, and because not all classes achieved similar achievement scores, some differences can be expected between teachers. Tables 16 and 17 depict the descriptive statistics and regression weights for the nine teachers. Table 16 provides the statistics for a teacher perceived as indirect while Table 17 provides the same information for a teacher who is perceived to be direct. The statistics concerning the teacher perceived as indirect are provided in linear form, while the statistics concerning the teacher perceived as direct are given in quadratic form with the quadratic regression weight.

TABLE 16

TEACHER DIFFERENCES, INDIRECT STYLE

Teacher	n	$\bar{Y}$	$\bar{X}$	SD	Constant	b	MS_{res}
1	13	61.54	19.77	14.30	76.205	-.742	187.742
2	11	64.27	23.18	10.40	91.139	-1.159	23.711
3	25	65.88	22.72	11.97	77.625	.517	137.263
4	25	69.96	19.60	12.10	84.589	-.746	75.394
5	12	57.33	27.00	11.58	79.90	-.836	110.093
6	18	70.83	17.11	11.33	91.955	-1.234	63.684
7	26	67.50	18.31	8.40	84.703	-.939	60.150
8	17	67.94	18.00	7.83	91.458	-1.307	67.112
9	8	71.50	14.25	7.36	74.917	-.239	204.029
Total	155	596.76	179.937				
Mean		66.307	19.993				

TABLE 17

TEACHER DIFFERENCES, DIRECT STYLE

Teacher	n	$\bar{Y}$	$\bar{X}$	SD	Constant	b_1	b_2	HS_{res}
1	10	71.0	28.70	9.64	52.121	.658	.082	218.775
2	17	70.64	27.47	11.46	29.226	1.508	-.024	62.421
3	23	56.87	24.304	13.985	45.460	.469	-.084	219.447
4	20	64.85	25.60	13.28	41.779	.901	-.022	136.503
5	15	66.8	23.66	13.860	55.879	.461	-.049	270.75
6	12	61.75	27.66	11.42	43.218	.669	-.103	204.053
7	16	66.56	32.06	8.004	42.124	.762	-.137	268.69
8	11	68.09	26.64	10.023	53.418	.550	.096	133.564
9	4	65.50	27.00	9.019	21.680	1.623	.101	23.156
Total	128	592.06	243.084					
Mean		65.78	27.0					

Tables 16 and 17 show that there are differences between teachers. The average achievement scores range between 57 and 71 for both indirect and direct teachers. Anxiety scores are also quite different. The average anxiety score for those who perceived their teacher as indirect is 19.993 while the average anxiety score for those who perceived their teacher as direct is 27.0. It could be that the teacher, realizing the higher level of the student applies a more direct style towards that student.

Tables 16 and 17 also depict the possible interactions within the teacher's own classes. Teacher 1, when perceived as indirect, has a b

weight of -.742. This number depicts the slope of the regression line. The minus sign shows the regression line to be dropping. For the same teacher, when perceived as direct, the $\underline{b}_1$ regression weight is .658. The positive value denotes an upward rise. For teacher 1 there is an interaction between student perception of teacher style and his anxiety level on achievement. This interaction repeats itself for each of the nine teachers, although the slopes of the $\underline{b}$ regression weights do differ a little. All slopes for the indirect style are negative, while all slopes for the direct style are positive.

When each class was analyzed separately it was found that there were insufficient subjects from each style, to give results that could be used. Therefore differences within and between teachers are reported rather than differences within and between classes.

Summary

The statistical analysis clearly shows that the main hypothesis, H_1, that there is an interaction between student perception of his teacher's style and the student's anxiety level on achievement, is accepted. The graphical representation of this interaction depicts a disordinal interaction. The second hypothesis, H_2, that the regression line depicting the prediction equation for the full model is curvilinear, is also accepted. The third hypothesis, H_3, that the indirect style regression line is curvilinear is rejected; while H_4, that the direct style regression line is curvilinear, is accepted. Significance regions were established and were quite pronounced. There were differences

between teachers, but for each teacher an interaction existed as depicted by the slope of each regression line. The anxiety level for those students who perceived their teacher as indirect was lower than the anxiety level for those who perceived their teacher as direct. The average achievement score for each style was nearly the same with the indirect style students scoring a little higher than the direct style students.

CHAPTER V

DISCUSSION AND IMPLICATIONS

Introduction

Chapter V is a review of the results of the study. It discusses these results in view of past literature and demonstrates the relevance of these results in the schools of today. There is also a short discussion concerning the implications of this study for future research.

Results

Of the four hypotheses made, three were accepted and one was rejected. The major hypothesis, that there is an interaction effect of student perception of teacher style and student anxiety on achievement, was accepted. This means that a student who perceives his teacher's style as indirect will score significantly different from a student who perceives his teacher as direct depending upon his anxiety level. The three remaining hypotheses dealt with the nature of this interaction. The results show that the best prediction of achievement scores is made only when the quadratic term is included within the regression model and, therefore, the best-fit regression line is curvilinear. Further, the best predicted achievement score for a student who perceived his teacher as indirect is made without the quadratic term and, therefore, the best-fit regression line for the indirect model is linear. Finally, the best predicted score for the student who perceived his teacher as direct is made with the quadratic term included and therefore the regression line for the direct model is curvilinear.

Confidence limits (95%) were established as were regions of significance. This showed that there were significant differences for those students whose anxiety scores ranged between 2.00 and 15.14, and 18.04 and 45.00. There was no significant difference for those students whose anxiety scores ranged between 15.14 and 18.04. The number of students whose anxiety scores lay between the numbers 15.14 and 18.04 are 36. From a total sample of 283 subjects, 247 had scores that were significantly different as determined by their anxiety level and their perception of their teacher's style.

Discussion and Comparison. Some researchers studying anxiety level and its influence on achievement have obtained a curvilinear relationship. Two of these researchers, Lea Fein Gold, (1963) and Spence and Spence (1966) found that anxiety level aided achievement but only at moderate levels. As the level of anxiety increased, the achievement dropped. The present study has also obtained a similar curvilinear relationship between anxiety and achievement.

In studying the interaction of student anxiety level and teacher style Grimes and Allinsmith (1961), using blocked analysis of variance, determined that a high anxious student achieved better results in a structured setting than a high anxious student in a non-structured setting. This study has obtained similar results, but, by the use of regression analysis, has been able to show a curvilinear relationship for the direct group. Achievement, in the direct group, improves only to a point where anxiety becomes too strong and achievement drops. The point obtained where achievement begins to descend is a score of 37 on the IPAT Anxiety Questionnaire.

Cronbach and Snow (1977) using Grimes and Allinsmith's (1961) data obtained an ordinal interaction between anxiety, and teacher style on achievement. Peterson (1974) obtained a disordinal interaction between trait anxiety and teacher style. Peterson did not report a curvilinear relationship. This might have been influenced by the relatively low number of subjects employed in his study. Peterson used only 92 subjects. Another study which did not report a curvilinear relationship between anxiety and teacher style was carried out by Dowaliby and Schumer (1973). Their study obtained a disordinal interaction between teacher style and student perception of teacher style. Their study was carried out on first year university students.

One of the findings of this study, that the average anxiety score for students perceiving their teacher as direct, is higher than the average anxiety score for students who perceive their teacher as indirect. It could be that the teacher, realizing the higher anxiety level of the students, applied a more direct style towards those particular students. This is similar to the findings of Hummel-Rossi and Merrifield (1977).

A major premise in this study is that students within the same class do perceive their teachers differently. Although the original sample used in the study consisted of 644 students and the final sample used in the study was 283 students, none of the nine teachers were eliminated from the study. In each case there were enough students who perceived their teacher differently so that all teachers remained. Therefore students within the same class do perceive their teacher's style differently, some as direct and others as indirect. This makes it necessary to query the student concerning

the style of the teacher. The SPOTS scale was chosen for this study on the basis of this premise and also on the premise that the student is a valid judge of his teacher's style. The findings, stated earlier, which corroborated Hummel-Rossi and Merrifield, tend to demonstrate the accuracy of the students' judgements.

Implications for Further Research. The design of this study follows an ex post facto design and therefore the results and their implications for use in the schools must be understood in light of the design. It cannot be assumed that one group of students will definitely achieve superior results within a particular style. Using the sampling procedures in this study it can be stated that there is a group who did achieve better results in a particular style. The use of the sampling procedure and the ex post facto design makes it difficult to state that this same result will occur all the time. In order to establish causality a rigid experimental approach with proper random selection of the subjects must be employed. This study does show that there was a disordinal interaction between student anxiety and his perception of teacher style and that an experimental design should be established to validate the results and to allow the schools to make proper use of these results.

The findings of the present study indicate that further research is necessary to specify added variables that interact with teacher style and affect achievement. Student personological variables may have a strong effect upon achievement as a first order interaction. Cronbach and Snow (1977) state that interactions of a second, third, or fourth order might also occur. These possible interactions might include such variables as ability, sex, socio-economic level, race, and place of

residence by treatment interaction.

The multiple correlation for the present study employing all the variables from the full model (2) was .68. With the addition of the above predictors the correlation might move closer to 1.00. That is the goal of ATI research: To locate and test for possible interactions; and, thus, to approach a multiple correlation of 1.00. As Cronbach and Snow (1977) stated, "The long range requirement is for understanding of the factors that cause a student to respond to one instructional plan rather than another" (p. 524).

Implications for Practise. Prior to using the information obtained from this study, a school must be aware that the design of this research cannot show a direct causal relationship. If a school was able to obtain anxiety level scores of their students, and ran a check on student perception of his teacher's style, then using the findings of this study the school might choose to regroup students according to the style of the teacher. The school might also request that a teacher employ different styles within the same class in order to meet the individual needs of the students. Assignments might be organized differently depending upon the anxiety level of the student. An assignment for a high anxious child might be more structured and quite formal. The same assignment for a low anxious child might have little formal structure with the possibility for the student to employ his own creativity within the overall framework of the assignment. Social relations between the teacher and student might also be different with the teacher maintaining a formal structured style with a high anxious student while being more open and

less structured for a low anxious student. In this case the teacher is not requested to be a psychiatrist or psychologist in providing therapy to the high anxious student in order to alleviate his anxiety. The teacher makes use of the anxiety level of the student in order to determine his style of teaching so as to maximize student achievement.

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APPENDIX 1

IPAT SAMPLES

The following are sample questions adapted from the IPAT Anxiety Questionnaire.

		True	In Between	False
1.	Often I get angry with people too quickly.	___	___	___

		Often	Sometimes	Never
2.	As a child I was afraid of the dark.	___	___	___

		Some-times	Rarely	Never
3.	In discussion with some people, I get so annoyed that I can hardly trust myself to speak.	___	___	___

APPENDIX 2

SPOTS SAMPLES

The following are sample questions adapted from the SPOTS rating scale.

1. When the teacher asks a question, the student is

1 2 3	4 5 6	7 8 9
Expected to respond immediately	Given some time to answer	Given ample time to assess the problem

2. The teacher

1 2 3	4 5 6	7 8 9
Often lectures for a full class period	Spends about one half of the time talking	Seldom lectures, encourages group discussions

3. In our class pupils work together in a group or on a committee

1 2 3	4 5 6	7 8 9
Never	Sometimes	A great deal

APPENDIX 3

IPS TEST SAMPLES

The following are sample questions adapted from the IPS Chapter Test 6-8, Form B.

1. The spacing between molecules in a gas is about 10 times what it is in a liquid. From this you could predict the ratio of density of liquid oxygen to density of gaseous oxygen to be about

   (A) 1000 (B) 100 (C) 10 (D) 1/10 (E) 1/1000

2. When a solid substance (S) is heated strongly, it disappears completely and a liquid (L) and a gas (G) are produced. Which of the substances could be an element?

   (A) Only G
   (B) Only L
   (C) Both S and G
   (D) Both S and L
   (E) Both G and L

3. The ratio of the mass of iron to the mass of oxygen in a certain pure substance composed only of iron and oxygen is 7/2; for a second pure substance also composed only of iron and oxygen, the ratio is 7/3. Which of the characteristics listed must be the same for both these substances?

   (A) Density
   (B) Melting point
   (C) Boiling point
   (D) Solubility in sulfuric acid
   (E) None of the above