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ABSTRACT

The purpose of this study was to develop and use both a totally role-specific measure of pupil/teacher compatibility and a measure of students' perception of compatibility to predict students' science attitudes and self-concepts in science. A sample of seven ninth-grade science teachers and the 334 students in their 16 classes was administered a set of attitude, interpersonal compatibility, and self-concept instruments. Among the findings of the study were: the regression equations consisting of 18 compatibility variables, sex, and six coded teacher variables accounted for a significant amount of variation in both self-concept in science and science attitude; girls had lower attitudes toward science than boys; students who perceived a greater originator control compatibility between themselves and their teachers tended to have higher self-concepts in science; and students with greater role-specific reciprocal control compatibility tended to have higher self-concepts in science. (Author/MH)

STUDENTS' SCIENCE ATTITUDES AND SELF-CONCEPTS IN SCIENCE AS A FUNCTION OF ROLE SPECIFIC PUPIL/TEACHER INTERPERSONAL COMPATIBILITY

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Science teaching has become more discovery or inquiry oriented. As a result, teachers tend to interact more frequently with individual students. With the increased interaction, pupil/science teacher interpersonal compatibility most likely contributes significantly to the development of students' science attitudes. A study described at the 1974 NARST convention, however, revealed that when measures of general interpersonal tendencies (FIRO-B) were used to determine pupil/teacher interpersonal compatibility, no correlation was found to exist between compatibility and students' science related attitudes. Perhaps no compatibility-attitude correlation was found because the measures of general interpersonal tendencies did not adequately measure teachers' specific interpersonal tendencies toward students or students' specific interpersonal tendencies toward teachers. A follow-up study (1975 NARST) revealed that when the role-specific interpersonal tendencies of teachers (i.e., FIRO-BT--measures of teachers' interpersonal tendencies toward students) and the general interpersonal tendencies of students (i.e., FIRO-B--measures of students' interpersonal tendencies toward people in general) were used to determine pupil/science teacher compatibility, compatibility was found to be significantly and positively correlated with students' science related attitudes.

With only one measure of role-specific interpersonal tendencies (i.e., the teachers'), interpersonal compatibility proved to be a better predictor of students' attitudes. Perhaps by using role-specific tendencies of students as well as role-specific interpersonal tendencies of teachers, pupil/teacher compatibility will become even a better predictor of students' science related attitudes. The primary purpose of this study was to develop a measure of

the role-specific interpersonal tendencies of students (FIRO-BS), determine pupil/science teacher compatibility from measures of the role-specific interpersonal tendencies of both students (FIRO-BS) and teachers (FIRO-BT), and then investigate the extent to which role-specific pupil/teacher compatibility predicts students' attitude toward science and their self-concept in science. In addition, since the role-specific pupil/teacher compatibility, as defined in this study, was determined from measures of interpersonal tendencies rather than from actual interpersonal behaviors, an instrument, SPOIC, was developed and used to measure students' perceptions of the actual classroom pupil/teacher interpersonal compatibility. To derive pupil/science teacher compatibility scores, formulas developed by Schutz (1966) were applied to the role-specific interpersonal tendencies of students and teachers as well as the teacher and student interpersonal tendencies perceived by the student. These compatibility scores were used in multiple regression equations to predict students' attitude toward science (SAS) and their self-concept in science (SCSSD). As hypothesized above, greater correlations between interpersonal compatibility and students' science related attitudes were expected using the measures which more accurately index pupil/teacher interactions in the classroom.

CONCEPTUAL DEVELOPMENT OF THE STUDY

FIRO Theory

The Fundamental Interpersonal Relations Orientation Theory or FIRO Theory (Schutz, 1966) has been used extensively in interpersonal behavior research. Schutz maintains that there exist three basic domains of interpersonal behavior, namely, inclusion, control and affection behavior.

Inclusion behavior (I) is the need to establish and maintain a satisfactory relationship with people with respect to association and interaction. In an interpersonal encounter, this domain is the first to be entered as

two people evaluate each other and then determine the extent to which they will include each other. Next, the control domain is entered. Control behavior (C) is the need to establish and maintain a satisfactory relationship with people with respect to power and authority. Affection (A) is the last domain to be entered for it takes more time to develop a relationship based on love and affection.

The nature of an interpersonal encounter between two people depends not only on the amount of behavior each person tends to express to the other, but also on that which each person tends to want or desire from the other. For each person there is a set of expressed behaviors (expressed inclusion, e^I; expressed control, e^C; expressed affection, e^A) and a set of wanted or desired behaviors (wanted inclusion, w^I; wanted control, w^C; wanted affection, w^A). Figure 1 provides statements that characterize each of the six "expressed" or "wanted" behaviors.

	Expressed Behavior	Wanted Behavior
Inclusion	e^I I make efforts to include other people in my activities and to get them to include me in theirs. I try to belong, to join social groups, to be with people as much as possible.	w^I I want other people to include me in their activities and to invite me to belong, even if I do not make an effort to be included.
Control	e^C I try to exert control and influence over things. I take charge of things and tell other people what to do.	w^C I want others to control and influence me. I want other people to tell me what to do.
Affection	e^A I make efforts to become close to people. I express friendly and affectionate feelings and try to be personal and intimate.	w^A I want others to express friendly and affectionate feelings toward me and to try to become close to me.

Fig. 1 Names, Symbols and Descriptions of FIRO-B Categories (Schutz, 1967).

FIRO Compatibility Theory

The amount of "expression" for various people may range from small (e) to large (E). Similarly, the amount of "want" may range from small (w) to large (W). All pairwise combinations of large and small "wants" and "expresses" appear in the column and row headings of Figure 2. Each "wants-expresses" combination represents a particular kind of person. Considering the affection domain, for example, a person with a wE designation would want or desire very little affection (small w) from others but would seek to express (large E) much affection toward others. The matrix in Figure 2 shows the different kinds of people listed across the top and down the sides. The cells of the matrix represent two-people interactions. For example, the upper left cell of the matrix represents the association of two people with the same "wants-expresses" designation (WE). Similarly, the upper right cell represents the association of people with designations WE and we.

By considering these "wants-expresses" designations, it becomes possible to determine the extent to which two people are likely to be compatible. Three types of interpersonal compatibility can be measured. Interchange compatibility (xK) refers to how much two people agree on the total amount of interpersonal exchange (both expressed and wanted) that should take place. Two people who have strong tendencies to express and want (WE-WE) are compatible since they both desire a great deal of "give and take". People who have relatively weak tendencies to express and want (we and we) are likewise compatible since they both desire minimum "give and take". Interchange incompatibility arises when one person desires a very lively interchange (WE) and the other person desires a minimum interchange (we). The matrix in Figure 2 shows the level of interchange compatibility (high, medium, and low) for the various combinations of people types.

FIGURE 2, PAGE 5 WAS REMOVED FROM THIS DOCUMENT PRIOR TO BEING SUBMITTED TO THE ERIC DOCUMENT REPRODUCTION SERVICE DUE TO COPYRIGHT RESTRICTIONS

Originator compatibility (oK) refers to the extent to which there is agreement as to who should originate or initiate an interpersonal exchange. High originator compatibility occurs when two people agree that both should strongly initiate (WE-WE), when people agree that neither should strongly initiate (we-we), when both people initiate for different reasons (We-wE), and when one strongly initiates and the other does not (WE-we). Originator incompatibility arises when people originate for the same reasons (i.e., both compete to express, wE-wE, or both have the same wants or desires, We-We).

Reciprocal compatibility (rK) refers to the extent to which the expressed behavior of one individual is equal to the wanted behavior of the other, and vice versa. As the matrix in Figure 2 shows, there is high reciprocal compatibility when little is expressed by one person and little is wanted by the other and when much is expressed by one person and when much is wanted by the other (WE-WE, We-wE, we-we). Reciprocal incompatibility exists when little is expressed by one person and much is wanted by the other and when much is expressed by one person and little is wanted by the other (We-we, wE-wE, We-We).

Illustrations as shown in Figures 3 and 4, will be used to further illustrate these compatibility types. The control domain will be used in the following examples. Figure 3 shows a case in which the control needs of both teacher and student are satisfied. The teacher shows a high need to control but a low need to be controlled (wE) and the student displays a high need to be controlled but a low need to control (We). The matrix in Figure 2 shows this type of relationship (wE-We) results in a high degree of interchange, originator and reciprocal compatibility. High interchange compatibility exists because there is a considerable agreement on the total amount of "give and take"; the teacher's overwhelming need to control is

FIGURES 3 AND 4, PAGES 7 AND 8 WERE REMOVED FROM THIS DOCUMENT PRIOR TO BEING SUBMITTED TO THE ERIC DOCUMENT REPRODUCTION SERVICE DUE TO COPYRIGHT RESTRICTIONS

complemented by the student's need to be controlled. High originator compatibility would result because there is complete agreement as to who should originate and who should receive control behavior. Also, high reciprocal compatibility results since the student's need to be controlled is matched by the teacher's want to control and the student's lack of desire to control is likewise matched by the teacher's unwillingness to be controlled.

Figure 4 shows a situation in which originator and reciprocal compatibility are low but interchange compatibility is high. Neither the teacher nor the student want to be controlled and each competes to control the other (wE-wE). Originator incompatibility exists because there is a great deal of disagreement as to who should originate and who should receive control behavior. Similarly, reciprocal incompatibility results because neither teacher nor student satisfy each other's expressed and desired behaviors. But high interchange compatibility exists since they do agree on the total amount of "give and take", even though it is not complementary.

The matrix in Figure 2 has been primarily used for illustrative purposes. Whereas extremes in "wants" and "expresses" (small and large) were shown, the FIRO instrumentation used in this study identifies a full range of tendencies to "want" and "express" and therefore makes possible a full range of compatibility scores.

Compatibility Research

Interpersonal compatibility sutdies utilizing FIRO Theory have been conducted not only with respect to pupil/teacher interactions (Hutcherson, 1963; Collins, 1970) but also with respect to pupil/tutor interactions (Schultz, 1969), intern/supervisor interactions (Snyder, 1969), student teacher/supervisor interactions (DiTosto, 1968; Brabble, 1969; Nelson and Hutcherson, 1970),

counselor/counselee interactions (Sapolsky, 1965; Paravonian, 1966; Arndt, 1969; Mendelsohn and Rankin, 1969) and group interactions (Estadt, 1964; Schutz, 1966; Shalinsky, 1967; Edwards, 1968; Riley, 1970).

Hutcherson (1963) found social studies achievement to be positively correlated with compatibility in the control domain, but negatively correlated with compatibility in the inclusion and affection domains. Collins' (1970) results revealed that interpersonal compatibility dimensions had no significant effect on either mathematics or social studies achievement. Schultz (1969) found no significant relationships between interpersonal compatibility and arithmetic achievement and self-concept of arithmetic ability.

In most of the previous compatibility studies the effect of compatibility on achievement has been investigated and found to be insignificant. Perhaps, compatibility, which seems more closely associated with the affective than the cognitive domain, has more impact on affective domain elements (self concept, attitude, etc.) than on cognitive domain elements (achievement, problem solving, etc.). Assuming this to be the case, in this study compatibility was expected to make a significant impact on the affective dependent variables of attitude toward science (Science Attitude Scale-SAS) and self-concept in science (Self-Concept in Science Semantic Differential - SCSSD).

Role Specific Behavior Tendencies

The lack of a substantial trend of significant relationships between compatibility measures and selected dependent variables may be accounted for, in part, by the discrepancies that may exist between people's general behavioral tendencies (as measured by the FIRO-B) and the behaviors that arise in the fulfillment of specific roles. For example, a teacher's FIRO-B score may indicate that he generally does not seek to control others. How-

ever, in his role as teacher, he may in fact exert a great deal of control over students. Compatibility measures determined by the FIRO-B scores would not, in this teacher's case, be good indicators of the actual interpersonal exchanges occuring in the classroom and hence, would not likely be highly associated with a variable hypothesized to be affected by compatibility. Perhaps a better index of the actual interpersonal exchanges would be determined by behavioral tendencies measured relative to the specific roles. In a previous study (Vargo and Schafer, 1975), the FIRO-B instrument was transformed into the FIRO-BT (Teacher), which measures teachers' interpersonal tendencies toward students. To develop the FIRO-BT, FIRO-B statements such as, "I let other people strongly influence my actions" and "I like people to invite me to things", were transformed to role specific statements such as, "I let students strongly influence my actions" and "I like students to invite me to things". The results showed that pupil/teacher compatibility scores derived from teachers' role specific interpersonal tendencies were more highly related to students' science attitudes than those scores derived from teachers' general interpersonal tendencies. Note that in that study, no attempt was made to measure the students' role specific interpersonal tendencies. The present study, however, used role specific tendencies of both students and teachers. To acquire a measure of students' role specific tendencies, the FIRO-B was transformed into the FIRO-BS (Student). This time, statements such as, "I let people strongly influence my actions", were changed to statements such as, "I let teachers strongly influence my actions". Assuming that compatibility does have an impact on affective domain elements, the prediction in this study is that pupil/teacher role specific interpersonal compatibility as determined from FIRO-BT and FIRO-BS data, will be a better predictor of pupil's science related attitudes than general compatibility.

The FIRO-BS and FIRO-BT, although measures of role specific tendencies are general in the sense that students indicate interpersonal tendencies toward teachers in general and teachers indicate interpersonal tendencies toward students in general. To obtain measures of compatibility between specific students and their particular science teacher (not teachers in general) an instrument called the Students' Perceptions of Interpersonal Compatibility (SPOIC) was developed. The SPOIC consisted of twelve items, six of which measured students' perceptions of their own interpersonal behavior (one item for each of $e^I, w^I, e^C, w^C, e^A, w^A$). For example, the item

> How often do you want to control the conversation when you're talking with your science teacher about school?
>
> | 1 | 2 | 3 | 4 | 5 |
> |---|---|---|---|---|
> | Never | Rarely | Sometimes | Usually | Always |

was considered to measure a students' perception of his or her expressed control (e^C) behavior when dealing specifically with his or her science teacher. The remaining six items measured students' perceptions of their teachers' interpersonal behaviors (one item for each of $e^I, w^I, e^C, w^C, e^A, w^A$). For example, the item

> How often do you think your science teacher wants to approach you to talk about school?
>
1	2	3	4	5
Never	Rarely	Sometimes	Usually	Always

was considered to measure a students' perception of his or her teacher's wanted inclusion (w^I) behavior when dealing specifically with students. Thus, twelve scores were produced: six representing students' perceptions of their own expressed-wanted designations for inclusion, control, and affection, and six representing students' perceptions of their own particular science teacher's expressed-wanted designations for inclusion, control, and

affection. From the twelve perceived interpersonal behaviors, nine compatibility scores were generated using the formulas developed by Schutz (1966). These compatibility scores are similar to those compatibility scores calfrom FIRO-BS and FIRO-BT because they provide measures of how well teachers and students "get along". They differ from those calculated from the FIRO-BS and FIRO-BT because they are derived solely from students' perceptions and because they refer to interpersonal tendencies between students and their particular science teachers (not teachers in general).

METHOD

Sample

The sample consisted of seven different ninth grade science teachers, all using the discovery-oriented New York State Earth Science Syllabus, and the 334 students in their sixteen classes. One teacher and his students were from a junior high school within metropolitan Syracuse. The remaining students and teachers were from schools in Syracuse-area suburban communities.

Instrumentation

The previously described FIRO-BT and FIRO-BS were administered to the teachers and students, respectively. The Students' Perceptions of Interpersonal Compatibility (SPOIC), the Science Attitude Scale (SAS), and the Self Concept in Science Semantic Differential (SCSSD) were also administered to the students.

The SAS was adapted from the Mathematics Attitude Scale (Aiken, 1972) and consisted of twenty statements to which students responded by indicating strong agreement, agreement, indecision, disagreement, or strong disagreement. Test-retest reliability for the SAS has been found to be 0.93.

The SCSSD, which was adapted from an instrument developed by Schwartz and Tangri (1965), consisted of sixteen bipolar adjective-pairs (e.g., good-bad, common-exceptional, happy-sad) with a seven point scale separating the

adjectives in each pair. The students indicated how they felt about themselves as science students (self-concept in science) by marking the scales in response to the phrase, "While in science class I am . . . ." Test-retest reliability for the SCSSD has been found to be 0.93.

RESULTS AND DISCUSSION

The data were analyzed using BMD 02R Stepwise Multiple Regression procedures. Eighteen compatibility variables, sex, and six dummy-coded teacher variables (Draper and Smith, 1966) were used as predictors of science attitude (SAS) and self-concept in science (SCSSD). Nine of the eighteen compatibility scores were calculated from role specific FIRO tendency scores and the other nine were calculated from SPOIC tendency scores. Each set of nine was comprised of three different kinds of compatibility scores (reciprocal, originator, and interchange) for each of the three domains (inclusion, control, and affection).

Tables 1 and 2 show that predictor variables together accounted for a significant amount of variation in both self-concept in science (R^2 = .26) and attitude toward science (R^2 = .24). Given significant R^2's,

Table 1

Analysis of Variance for the Regression Equation Predicting Self-Concept in Science (SCSSD)

	Df	SS	MS	F
Regression	22	16171.0	735.0	5.14*
Residual	311	44528.3	143.2	

*$F=5.14 > F_{.05}(22,311)=1.61$

Table 2

Analysis of Variance for the Regression Equation Predicting Attitude Toward Science (SAS)

	Df	SS	MS	F
Regression	22	17875.2	812.5	4.34*
Residual	311	58254.0	187.3	

$F=4.34 > F_{.05}(22,311)=1.61$

the question can be asked: How do these R^2's, which are calculated from role specific tendencies, compare with the R^2's observed in previous studies? Table 3 shows the R's and R^2's for the present (1976) and two previous studies, Vargo (1974) and Vargo and Schafer (1975). The 1974 study used non-specific compatibility scores to predict self-concept and attitude, the 1975 study used only partially role specific compatibility scores (role specific for teachers, not for students). The same self-concept and attitude instruments were used in all the studies. To make the R^2's in Table 3 comparable, the unique contribution of previous science grades (a variable not included in the present study) was removed from the R^2's reported in the 1974 and 1975 studies.

Although differences observed in Table 3 may have resulted from sampling differences, role specific compatibilities (1976 Study) seem to predict self-concept in science (SCSSD) and science attitude (SAS) better than non-specific compatibilities (1974 Study). Note, however, that role specific compatibilities do not seem to increase the predictability of science attitude (SAS) over that predicted by the partially role specific compatibilities (1975 Study). Without rendering the results conclusive, the interpersonal tendencies expressed through roles, which likely are more indicative of

actual behaviors, seem to be more highly associated with students' self-concepts in science and science attitudes than are the general measures of interpersonal tendencies.

Table 3

R's and R^2's for Three Studies Predicting Science Attitude and Self Concepts from Compatibility Measures

	1974 Study Non-Specific Compatibility		1975 Study Partially Role Specific Compatibility		1976 Study Role Specific Compatibility	
	R	R^2	R	R^2	R	R^2
Self-Concept in Science (SCSSD)	.37	.14	.37	.14	.52	.26
Science Attitude (SAS)	.45	.21	.50	.25	.49	.24

Variables' Unique Contributions to the Prediction of Science Attitudes and Self-Concept in Science

Since the regression equations that predicted self-concept in science and attitude toward science both yielded significant R^2's, it is now appropriate to determine which predictor variables contributed uniquely to those predictions. In other words, does any particular variable add significantly to the prediction after all other variables have been considered in the prediction equation. Regarding this type of analysis, Kerlinger and Pedhazur (1973) state that:

> Calculating R^2's in this manner and using the F test to evaluate the significance of increments to prediction, as it were, is a powerful method of analysis. It enables us to determine the relative efficacies of different variables in the regression equation, at least as far as statistical significance is concerned. [p. 71]

Tables 4 and 5 show the predictor variables' unique contributions to the regression equations, i.e., their "relative efficacies" in uniquely increasing the prediction of self-concept in science and attitude toward science. With respect to the prediction of self-concept in science, a dummy-coded teacher effect (Teacher 5), student-perceived originator control compatibility and reciprocal control compatibility each contributed uniquely (Table 4). Table 5 shows that the prediction of attitude toward science was increased significantly when teachers and sex were each added last to the regression equation.

Table 6, which shows the correlations (r) between the dependent variables and the unique predictors, aids in the further interpretation of the unique contribution. The coded teacher effect (Teacher 5) was significantly and negatively correlated

Table 4

Variables' Unique Contributions to the Prediction of Self-Concept in Science

Predictor Variable	Unique Contribution to R^2	F - Ratio
Teacher 1	0.003	1.40
Teacher 2	0.001	0.35
Teacher 3	0	0
Teacher 4	0.008	3.42
Teacher 5	0.034	14.12*
Teacher 6	0.006	2.61
Sex	0.007	2.87
SPOIC Compatibility		
Inclusion		
ciprocal	0	0
Originator	0	0
Interchange	0.002	0.64
Control		
Reciprocal	0	0
Originator	0.017	6.91*
Interchange	0.004	1.65
Affection		
Reciprocal	0.002	0.83
Originator	0.008	3.40
Interchange	0.008	3.28
FIRO Compatibility		
Inclusion		
Reciprocal	0.003	1.13
Originator	0.004	1.49
Interchange	0	0
Control		
Reciprocal	0.013	5.62*
Originator	0	0
Interchange	0	0
Affection		
Reciprocal	0	0
Originator	0.005	2.08
Interchange	0.005	2.08

*$F_{OBS} > F_{.05}(1,311) = 3.87$

Table 5

Variables' Unique Contributions to the Prediction of Attitude Toward Science

Predictor Variable	Unique Contribution to R^2	F - Ratio
Teacher 1	0	0.02
Teacher 2	0.006	2.48
Teacher 3	0.000	0
Teacher 4	0.001	0.28
Teacher 5	0.01	4.57*
Teacher 6	0.001	0.24
Sex	0.05	20.74*
SPOIC Compatibility		
Inclusion		
Reciprocal	0	0
Originator	0	0
Interchange	0.002	0.87
Control		
Reciprocal	0	0
Originator	0.005	1.83
Interchange	0.003	1.35
Affection		
Reciprocal	0	0
Originator	0.005	1.83
Interchange	0	0
FIRO Compatibility		
Inclusion		
Reciprocal	0.000	0
Originator	0.002	0.83
Interchange	0.001	0.20
Control		
Reciprocal	0.001	0.19
Originator	0.001	0.37
Interchange	0.004	1.62
Affection		
Reciprocal	0	0
Originator	0.002	0.98
Interchange	0.002	0.89

*$F_{OBS} > F_{.05}(1,311) = 3.87$

(α = 0.01) with both self-concept in science (r=-.22) and attitude toward science (r=-.20). Thus, the students associated with Teacher 5 had less positive attitudes toward science and self-concepts in science than did those students associated with the other teachers. The effect, therefore, of Teacher 5 resulted in a unique contribution to the predication of both dependent variables, but that effect was manifested in negative attitudes.

Table 6 also reveals a significant positive correlation between sex and attitude toward science (r=0.25). Since male students were coded as one's and female students as zero's, and considering the positive direction of the correlation, it can be concluded that male students were associated with more positive attitude's toward science than were female students. This finding is consistent with the results of previous studies (Vargo, 1974, Vargo and Schafer, 1975).

Two compatibility variables, student perceived originator control compatibilit and reciprocal control compatibility, also yielded significant positive correlation with self-concept in science (0.28 and 0.12 respectively). Therefore, those studen who perceive a disagreement as to who shall express and receive control behavior (i.e., high originator control incompatibility), tend to have lower self-concepts in science. A glance back at Figure 2 shows that low originator compatibility can occur when both teacher and student compete to express but neither want to receive (wE-wE) or when both would prefer to receive rather than express (We-We). Assuming that competition to express control is more prevalent in classrooms than the competition to be controlled, the correlation between student perceived originator

Table 6
Correlations Between Dependent Variables and Unique Predictors

Variables Correlated	Correlation Coefficient (r)
Self-Concept in Science/Teacher 5	-0.22**
Self-Concept in Science/Student-Perceived Originator Compatibility	0.28**
Self-Concept in Science/Reciprocal Control Compatibility	0.12*
Attitude Toward Science/Teacher 5	-0.20**
Attitude Toward Science/Sex	0.25

* r significant at α = .05
**r significant at α = .01

control compatibility and self-concept suggests that when students perceive the existence of competition to express control and then perhaps realize the futility of their efforts to control, their perceived ability to excel (self-concept) in the subject most closely associated with that teacher decreases.

With respect to reciprocal control compatibility, the greater the discrepancy between expressed and wanted tendencies (high reciprocal control incompatibility) for both teachers and students, the greater is the association with low self-concepts in science. On the other hand, more positive self-concepts are associated with high reciprocal control compatibility. Thus, it seems likely that the growth of more positive self-concepts in science is related to both teacher and student complementing each other's expressed and wanted control behavior.

One additional point requires amplification. In this study, the only compatibility variables that contributed uniquely to the prediction of a dependent variable involved the control domain. This finding is consistent with previous studies (Hutcherson, 1963, Vargo and Schafer, 1975) in that originator control compatibility is significantly and positively correlated with a student outcome variable, whether it be achievement or attitude. It seems reasonable to conclude that in teaching and learning situations, discrepancies in the expressed and wanted control behavior of students and teachers must be reckoned with if suitable learning environments are to be maintained.

Students' Perceived Compatibility (SPOIC) versus Role Specific FIRO Compatibility

Role specific FIRO compatibility was determined from students' interpersonal tendencies toward teachers in general and from teachers' interpersonal tendencies toward students in general. SPOIC compatibility, on the other hand, was determined solely from the students' perceptions of their own and a particular teacher's interpersonal tendencies. The SPOIC was then the more specific measure of pupil/teacher compatibility. Not only did it measure compatibility between each particular student and his or her teacher but it measured that compatibility as perceived by the student. Assuming that more specific measures yield greater association with other variables when associations exist, the SPOIC compatibility/ measure (student

and teacher specific) was expected to be a better predictor of self-concept and science attitude than the role specific. FIRO compatibility measure. The R's and R^2's in Table 7 seemingly confirm that expectation. For both self-concept (SCSSD) and science attitude (SAS), SPOIC yielded higher correlations than the role specific. FIRO.

Table 7

R's and R^2's for Predicting Self-Concept in Science and Science Attitude from Role Specific FIRO and SPOIC Compatibility

	Role Specific FIRO		SPOIC	
	R	R^2	R	R^2
Science Attitude (SAS)	.26	.07*	.31	.10*
Self Concept in Science (SCSSD)	.29	.08*	.37	.14*

*$F_{ob} > F_{.05}(7,326) = 2.04$

SUMMARY AND CONCLUSIONS

In previous studies either general interpersonal compatibility or partially role specific compatibility was used to predict students' science attitudes and self-concepts in science. The purpose of this study was to develop and use both a totally role specific measure of pupil/teacher compatibility and a measure of students' perception of compatibility to predict students' science attitudes and self-concepts in science. The major hypothesis was that the new, more specific measures would improve the prediction of students' science attitudes and self-concepts in science.

The major findings of the study were:

1. The regression equations consisting of nine SPOIC and nine role specific FIRO compatibility variables, sex, and six coded teacher variables accounted for a significant amount of variation in both self-concept in science and science attitude (Tables 1 + 2).

2. A comparison of the results of this study and the results of previous studies suggested that more specific measures of pupil/teacher interpersonal compatibility increase the predictability of students' self-concept in science and science attitudes (Table 3).

3. Coded teacher variable 5, students perceived originator control compatibility, and role specific reciprocal control compatibility contributed uniquely to increasing the prediction of students' self-concept in science (Table 4). Coded teacher variable 5 and sex uniquely contributed to increasing the prediction of students' science attitudes (Table 5).

4. Correlations between the unique prediction and the dependent variables (Table 6) indicated that:

    a) Girls had lower attitudes toward science than boys.
    b) Students who perceived a greater originator control compatibility between themselves and their teachers tended to have higher self-concepts in science.
    c) Students with greater role specific reciprocal control compatibility tended to have higher self-concepts in science.

d) Students of one teacher (coded teacher 5) revealed lower self-concepts in science and lower science attitudes than students of other teachers.

5. Although both the totally role specific pupil/teacher compatibility (FIRO) and the student perceived compatibility (SPOIC) predicted self-concept and attitude, the more specific student perceived compatibility seemed to be the slightly better predictor of the two.

In revealing the significance of pupil/teacher compatibility in predicting tudents' science attitudes and self concepts in science and in revealing the importnce of control compatibility, this study has provided the bases for continued research. Ultimately, it may be found that training teachers to become aware of their wn and their students' interpersonal tendencies (escpecially with respect to control) ill indeed produce significant changes in science related outcomes for both the ffective and the cognitive domains.

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REFERENCES

Aiken, L. R. Research on attitudes toward mathematics. The Arithmetic Teacher, March, 1972, 229-34.

Arndt, G. M. An investigation of the influence of interpersonal compatibility on counselor and counselee perceptions of the initial interviews. Unpublished doctoral dissertation, the University of Rochester, 1969.

Brabble, E. W. Student teacher-supervising teacher compatibility and its relation to success in student-teaching. Unpublished doctoral dissertation, The Pennsylvania State University, 1969.

Collins, M. A. An investigation of the influence of interpersonal compatibility on pupil achievement and teacher and pupil perceptions of the relationship. Unpublished doctoral dissertation, The University of Rochester, 1970.

DiTosto, E. The factors of interpersonal relations in compatibility to productivity of student teacher-supervisor dyads. Unpublished doctoral dissertation, West Virginia University, 1968.

Draper, N. R. & Smith, H. Applied regression analysis. New York: Wiley, 1966.

Edwards, W. P. Interpersonal relations orientation compatibility as related to outcome variables in group psychotherapy. Unpublished doctoral dissertation , Ohio University, 1968.

Estadt, B.K. Interpersonal compatibility and intra-group choices. Unpublished doctoral dissertation, The Catholic University of America, 1964.

Hayes, W. L. Statistics for the social sciences. (2nd ed.) New York: Holt, Rinehart and Winston, Inc., 1973.

Hutcherson, D. E. Relationships among teacher-pupil compatibility, social studies grades, and selected-factors. Unpublished doctoral dissertation, The University of California at Berkeley, 1963.

Kerlinger, F. N. & Pedhazur, E. J. Multiple regression in behavioral research. New York: Holt, Rinehart and Winston, 1973.

Mendelsohn, G. A. & Rankin, N. O. Client-counselor compatibility and the outcome of counseling. Journal of Abnormal Psychology, 1969, 74 (2), 157-63.

Nelson, J. A., & Hutcherson, D. E. A pilot study of the relationships of student-teaching grades to FIRO compatibility among the student teacher, supervising teacher, and university supervisor. Journal of Teacher Education, 1970, 21 (1), 44-46.

Paravonian, S. D. The effects of counselor-client compatibility on the client's evaluation of the effectiveness of the counseling relationship. Unpublished doctoral dissertation, Purdue University, 1966.

Riley, R. An investigation of the influence of group compatibility on group cohesiveness and change in self-concept in a T-group setting. Unpublished doctoral dissertation, The University of Rochester, 1970.

Sapolsky, A. Relationship between patient-doctor compatibility, mut ception, and outcome of treatment. Journal of Abnormal Psychol 1965, 70, 70-76.

Schultz, E. W. A study concerning the influence of two facilitative and interpersonal compatibility on selected educational outcome tutorial program. Unpublished doctoral dissertation, Syracuse 1969.

Schutz, W. C. The interpersonal underworld. Palo Alto, Calif.: Sc and Behavior Books, Inc., 1966.

Schutz, W. C. The FIRO scales. Palo Alto, Calif.: Consulting Psyc Press, Inc., 1967.

Schwartz, M., & Tangri, S. A note on self-concept as an insulator a delinquency. American Sociological Review, 1965, 30, 922-26.

Snyder, H. A. The relationship of selected interpersonal and profes characteristics of administrative interns and their supervisors satisfaction of the internship experience. Unpublished doctora tion, University of Minnesota, 1969.

Vargo, R. A. Pupil/science teacher interpersonal compatibility and attitudes. Paper presented at the annual meeting of the Nation Association for Research in Science Teaching, Chicago, April 19

Vargo, R. A., & Schafer, L. E. Role specific pupil/science teacher compatibility and science attitudes. Paper presented at the an of the National Association for Research in Science Teaching, L March, 1975.