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ABSTRACT

The purpose of this study was to determine associations between science and mathematics students' perceptions of their classroom learning environments, the cultural backgrounds and gender of students, and their attitudinal and achievement outcomes. The subjects were 3,994 students from 182 secondary school science and mathematics classes in 35 coeducational schools in Western Australia and Tasmania. The students completed a survey including the Questionnaire on Teacher Interaction (QTI), an attitude to class scale, and questions relating to cultural background. Statistical analyses have confirmed the reliability and validity of the QTI for secondary school science and mathematics students. Generally, the dimensions of the QTI were found to be significantly associated with student attitude scores. In particular, students' attitude scores were higher in classrooms in which students perceived greater leadership, helping/friendly, and understanding behaviors in their teachers. Females perceived their teachers in a more positive way than did males, and students from an Asian background tended to perceive their teachers more positively than those from the other cultural groups used in the study. (Contains 24 references). (Author/SPM)

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GENDER AND CULTURAL DIFFERENCES IN TEACHER-STUDENT INTERPERSONAL BEHAVIOR

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Abstract

The purpose of this study was to determine associations between science and mathematics students' perceptions of their classroom learning environments, the cultural backgrounds and gender of students, and their attitudinal and achievement outcomes. A sample of 3994 students from 182 secondary school science and mathematics classes in 35 schools completed a survey including the Questionnaire on Teacher Interaction (QTI), an attitude to class scale and questions relating to cultural background. The sample was chosen carefully so as to be representative, though only coeducational classes were used in order to permit an unconfounded test of gender differences. Achievement on internal school benchmark assessment tests were used as student cognitive outcome measures. Statistical analyses have confirmed the reliability and validity of the QTI for secondary school science and mathematics students. Generally, the dimensions of the QTI were found to be significantly associated with student attitude scores. In particular, students' attitude scores were higher in classrooms in which students perceived greater leadership, helping/friendly, and understanding behaviors in their teachers. Females perceived their teachers in a more positive way than did males and students from an Asian background tended to perceive their teachers more positively than those from the other cultural groups used in the study.

Many students come from communities with widely differing cultural practices and at times the teaching and learning strategies adopted in science and mathematics classrooms can be perceived as being in conflict with the natural learning strategies of the learner. Since teachers can use practices that may inadvertently conflict with students' previous learning patterns, home environment, mores and values, there is an increasing need for teachers to be sensitive to the important cultural milieu into which their teaching is placed (Thaman, 1993). Teachers tend to find it difficult to understand the 'nature, causes and consequences of cultural conflicts in minority populations' (Delgado-Gaiten & Trueba, 1991, p. 24). As schools are becoming increasingly diverse in their scope and clientele, any examination of the interaction of culturally sensitive factors of students' learning environments with learning processes, assumes critical importance. While there are a number of research studies in science and to a lesser extent mathematics classes in existence concerning culture and education generally (Atwater, 1993, 1996; Cobern, in press; Maddock, 1981),

comparatively little research examines the interaction that occurs between students' culturally sensitive learning environment and their learning. It is timely and relevant to examine how this aspect of students' learning environments enhances or inhibits their learning within a secondary school science classroom. Furthermore, there is an awareness that Australian classrooms are becoming increasingly multicultural and that the way in which people communicate and perceive communication is culturally influenced (Giles & Franklyn-Stokes, 1989; Segall et al., 1990). This study investigates differences in the way in which teachers interact with students from different cultures.

At no other time in history has there been such an awareness around the world of the importance of ensuring that girls receive an equitable education. In Australia, the *National Action Plan for the Education of Girls 1993-97* (Australian Education Council and Curriculum Corporation, 1993) highlights this concern. Of all school subjects, probably the greatest inequity between the sexes in enrollments, achievement and attitudes occurs for science (Parker, Rennie & Fraser, 1996; Young & Fraser, in press). This study enhances our understanding of differences between boys and girls by examining the nature of the interpersonal behavior between teachers and their students.

Teacher-Student Interpersonal Behavior

In the past three decades, international research efforts involving the conceptualization, assessment, and investigation of perceptions of aspects of the classroom environment have firmly established classroom environment as a thriving field of study (see reviews by Fraser 1994; Fraser & Walberg, 1991). For example, recent classroom environment research has focused on constructivist classroom environments (Taylor, Dawson & Fraser, 1995), computer-assisted instruction classrooms (Teh & Fraser, 1994) and teacher interpersonal behavior in the classroom (Wubbels, Levy, Creton & Hooymayers, 1993).

In The Netherlands, Wubbels, Creton and Holvast (1988) investigated teacher behavior in classrooms from a systems perspective, adapting a theory on communication processes developed by Watzlawick, Beavin and Jackson (1967). Within the systems perspective on communication, it is assumed that the behaviors of participants influence each other mutually. The behavior of the teacher is influenced by the behavior of the students and in turn influences student behavior. Circular communication processes develop which not only consist of behavior, but determine behavior as well.

With the systems perspective in mind, Wubbels, Créton and Hooymayers (1985) developed the *Questionnaire on Teacher Interaction (QTI)*. Based on the circumplex model proposed by Leary (1957), its eight scales are symmetrically arrayed around orthogonal axes representing an Influence dimension (Dominance, D - Submission, S) and a Proximity dimension (Cooperation, C - Opposition, O). Wubbels, Créton and Hooymayers (1985) believed that all teacher interactional behaviors can be plotted in this system of coordinates. The quadrants resulting from these axes were subdivided onto equal sized octants as illustrated in Figure 1.

The sectors were labeled DC, CD, etc. according to their position in the coordinate system, the letters coding the relative influence of the axes. For example, sectors DC and CD are both characterized by Dominance and Cooperation, but in DC Dominance predominates over Cooperation, whereas in CD, Cooperation is more evident. The closer that the sectors are to each other, the more closely they resemble each other and the more they represent similar teacher behaviors.

Figure 1 shows typical behaviors in each sector, as well as the names of the behaviors (e.g., leadership behavior, helping/friendly behavior, understanding behavior) given to each sector. The QTI contains eight scales based on the eight parts of the model. A typical item in the OD scale is "This teacher gets angry unexpectedly".

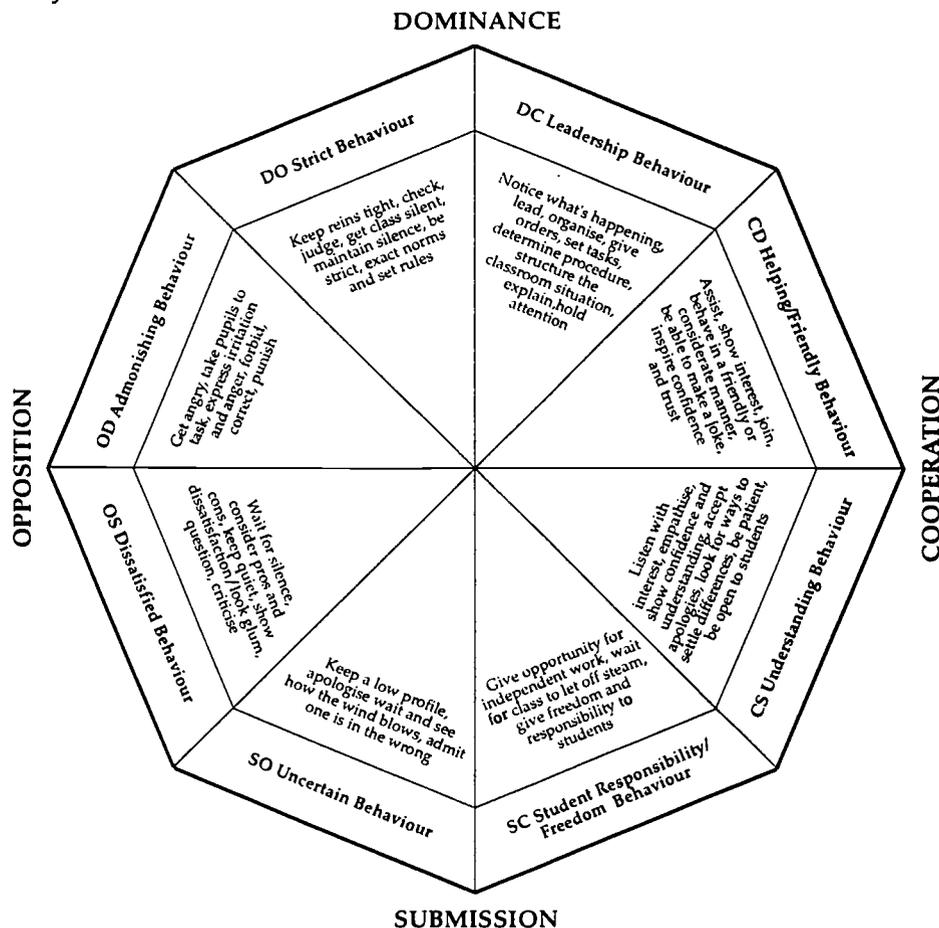


Figure 1. *The model of interpersonal teacher behavior*

The Australian version of the QTI (Wubbels, 1993; Fisher, Henderson and Fraser 1995) has 48 items, six for every sector of the model of interpersonal teacher behavior. The items are assigned to the eight scales named Leadership (DC), Helping/Friendly (CD), Understanding (CS), Student Responsibility and Freedom (SC), Uncertain (SO), Dissatisfaction (OS), Admonishing (OD), and Strict (DO) behavior. The instrument can be used as either a teacher self-report measure or as a measure of student perceptions (using the class as a unit of analysis) of teacher interpersonal behavior. Each item in the QTI is scored on a 5-point Likert

scale. Examples of items are "This teacher acts confidently" (DC) and "This teacher thinks we cheat" (OS). Aggregated class data are used to produce eight scale scores which together form a profile for the teacher. For ease of comprehension and comparison, the results can be represented visually in a characteristic "cob-web-like" figure where sectors are shaded according to the scale scores.

Initial validation information for the Australian version of the QTI has been reported by Wubbels (1993) who concluded that the QTI can be used as a valid and reliable measure of perceptions of classroom interaction.

Using the QTI

An Australian version of the QTI was used in a pilot study involving upper secondary science classes in Western Australia and Tasmania (Fisher, Fraser & Wubbels, 1993; Fisher, Fraser, Wubbels & Brekelmans, 1993). This pilot study strongly supported the validity and potential usefulness of the QTI within the Australian context, and suggested the desirability of conducting further and more comprehensive research involving the QTI.

The QTI has been shown to be a valid and reliable instrument when used in The Netherlands (Wubbels & Levy, 1993). When the 64-item USA version of the QTI was used with 1,606 students and 66 teachers in the USA, the cross-cultural validity and usefulness of the QTI were confirmed. Using the Cronbach alpha coefficient, Wubbels and Levy (1991) reported acceptable internal consistency reliabilities for the QTI scales ranging from 0.76 to 0.84 for student responses and from 0.74 to 0.84 for teacher responses.

Wubbels (1993) used the QTI with a sample of 792 students and 46 teachers in Western Australia and Tasmania. The results of this study were similar to previous Dutch and American research in that, generally, teachers did not reach their ideal and differed from the best teachers as perceived by students. It is noteworthy that the best teachers, according to students, are stronger leaders, more friendly and understanding, and less uncertain, dissatisfied and admonishing than teachers on average.

When teachers described their perceptions of their own behaviours, they tended to see it a little more favourably than did their students. On average, the teachers' perceptions were between the students' perceptions of actual behaviour and the teachers' ideal behaviour. An interpretation of this is that teachers think that they behave closer to their ideal than their students think that they do.

Another use of the QTI in The Netherlands involved investigation of relationships between perceptions on the QTI scales and student learning outcomes (Wubbels, Brekelmans & Hooymayers, 1991). Regarding students' cognitive outcomes, the more that teachers demonstrated strict, leadership and helpful/friendly behaviour, then the higher were cognitive outcomes scores. Conversely, student responsibility and freedom, uncertain and dissatisfied behaviours were related negatively to achievement.

Variations in the students' attitudes toward the subject and the lessons have been characterised on the basis of the proximity dimension: the more cooperative the behaviour displayed, the higher the affective outcome scores (Wubbels, Brekelmans & Hooymayers, 1991). That is, student responsibility and freedom, understanding, helping/friendly and leadership behaviours were related positively to student attitudes. Uncertain, dissatisfied, admonishing and strict behaviours were related negatively to student attitudes. Overall, previous studies have indicated that interpersonal teacher behaviour is an important aspect of the learning environment and that it is related strongly to student outcomes.

Levy, Créton and Wubbels (1993) analysed data from studies in The Netherlands, the USA and Australia involving students being asked to use the QTI to rate their best and worst teachers. Students rated their best teachers as being strong leaders and as friendly and understanding. The characteristics of the worst teachers were that they were more admonishing and dissatisfied.

One recent Australian study (Fisher, Rickards & Fraser, 1996) found that after having completed the QTI and having had time to read the QTI report supplied to them, science teachers reported that the results had stimulated them to reflect on their own teaching and verbal communication in the classroom. Based upon her sector profile diagrams, one teacher concluded that she had become more aware of the students' need for clear communication and that this had subsequently become a focus for her in improving her classroom environment and her teaching (Fisher, Rickards & Fraser, 1996). Other studies of secondary science classrooms (Fisher & Rickards, 1996) and secondary mathematics classrooms (Rickards & Fisher, 1996) in Australia; and a comparative study conducted between Australian and Singaporean secondary science classrooms (Fisher, Goh, Wong & Rickards, 1996) provide further validation support for the QTI within inter-cultural and intra-cultural contexts.

Method

The main aim of the study was to investigate how teacher-student interpersonal behavior in the classroom varies with student gender and cultural background. For the purpose of the study, cultural background was determined by asking students what language is normally spoken at home and their parents' birthplace. Furthermore, following past research (e.g., Fraser & Fisher, 1982), the effect of teacher-student interpersonal behavior on student outcomes was also investigated.

Thus the objectives of this study were to provide further validation information for the QTI (in terms of reliability, scale independence, ability to differentiate between classrooms, etc.) when used with a large Australian sample of science and mathematics classes; to investigate gender difference in students' perceptions of teacher interpersonal behavior; to investigate cultural differences in students' perceptions of teacher interpersonal behavior; and to investigate whether the

nature of interpersonal teacher behavior (as perceived by students or teachers) affects student achievement and attitudes.

The sample was chosen from science and mathematics classes at the lower secondary levels. Only coeducational classes were used in order to permit an unconfounded test of gender differences. Two Australian states, Western Australia and Tasmania, were used for the data collection as having two states made it more convenient to find enough schools willing to take part in the study, and it removed any state bias that could occur if only one state was used. The total sample involved approximately 4,000 students in 185 science or mathematics classes spread approximately equally between grades 8, 9 and 10 in 42 different schools.

Each student in the sample completed a survey which provided the following information on that student's gender, cultural background, attitude to class and perception of teacher-student interpersonal behavior.

Attitude to class was assessed using a seven-item scale based on the *Test Of Science Related Attitudes* (TOSRA) (Fraser, 1981; Fisher, Henderson & Fraser, 1995). Teacher-student interpersonal behavior was assessed using the QTI and each student's performance on a school bench-mark test was provided by the classroom teacher and used as a measure of cognitive achievement. To enable meaningful comparisons, standardized scores (expressed in terms of the number of standard deviations above or below the group mean) were calculated.

Results

Validation of the Questionnaire

The large database consisting of the responses to the QTI of almost 4,000 students in 185 classes provided further cross-validation data on this instrument. Table 1 provides information for the QTI when used specifically in the present sample of science and mathematics classes. Statistics are reported for two units of analysis, namely, the individual student's score and the class mean score. As expected, reliabilities for class means were higher than those where the individual student was used as the unit of analysis. Analysis of responses to the QTI revealed that each QTI scale had acceptable internal consistency, with all scales having a Cronbach alpha coefficient of greater than 0.63, either using the individual student or the class mean as the unit of analysis. The ability of the QTI to differentiate between the perceptions of students in different classes was examined by performing a one-way ANOVA for each scale with class membership as the main effect. It was found that each QTI scale differentiated significantly ($p < .001$) between classes and that the η^2 statistic, representing the proportion of variance explained by class membership, ranged from 0.22 to 0.35 for different scales.

Table 1 shows that the alpha reliability figures for different QTI scales ranged from 0.63 to 0.88 when the individual student was used as the unit of analysis, and from 0.78 to 0.96 when the class mean was used as the unit of analysis. The

values presented in Table 1 for the present sample provide further cross-validation information supporting the internal consistency of the QTI, with either the individual student or the class mean as the unit of analysis.

Another desirable characteristic of any instrument like the QTI is that it is capable of differentiating between the perceptions of students in different classrooms. That is, students within the same class should perceive it relatively similarly, while mean within-class perceptions should vary from class to class. This characteristic was explored for each scale of the QTI using one-way ANOVA, with class membership as the main effect. It was found that each QTI scale differentiated significantly ($p < .001$) between classes and that the η^2 statistic, representing the proportion of variance explained by class membership, ranged from 0.22 to 0.35 for different scales.

Table 1
Internal Consistency (Cronbach Alpha Coefficient) and Ability to Differentiate Between Classrooms for the QTI

Scale	Unit of Analysis	Alpha Reliability	ANOVA Results (η^2)
Leadership	Individual	0.82	0.33*
	Class Mean	0.93	
Helping/ Friendly	Individual	0.88	0.35*
	Class Mean	0.96	
Understanding	Individual	0.85	0.32*
	Class Mean	0.95	
Student Resp/ Freedom	Individual	0.66	0.26*
	Class Mean	0.82	
Uncertain	Individual	0.72	0.22*
	Class Mean	0.87	
Dissatisfied	Individual	0.80	0.23*
	Class Mean	0.93	
Admonishing	Individual	0.76	0.31*
	Class Mean	0.87	
Strict	Individual	0.63	0.23*
	Class Mean	0.78	

* $p < .001$ n = 3994 students in 185 classes.

Interpersonal Behavior and Gender Differences

Gender differences in teacher-student interpersonal behavior were examined using a two-way MANOVA with the eight QTI scales as dependent variables. It should be noted that gender groups were represented almost equally in the study. Table 2 presents the scale means and standard deviations for male and female students' scores on the eight scales of the QTI. Statistically significant gender differences were apparent in students' responses to seven of the eight scales of the QTI, with females perceiving greater leadership, helping/friendly and understanding behaviors in their teachers and males perceiving their teachers as being more uncertain, dissatisfied, admonishing and strict. The magnitude of these differences is not large but the differences consistently show that females perceive their teachers in a more positive way than do males.

Table 2.

Scale Means and Standard Deviations for Male and Female Science and Mathematics Students' Scores on the Eight Scales of the QTI

Scale	Scale Mean			Standard Deviation	
	Male	Female	Difference	Male	Female
Leadership	2.75	2.80	0.05*	0.76	0.73
Helping/Friendly	2.78	2.94	0.16**	0.94	0.85
Understanding	2.79	2.92	0.13**	0.85	0.81
Student Resp/ Freedom	1.69	1.67	0.02	0.65	0.65
Uncertain	1.01	0.83	0.18**	0.75	0.67
Dissatisfied	1.20	0.95	0.25**	0.84	0.79
Admonishing	1.47	1.27	0.20**	0.86	0.81
Strict	1.85	1.78	0.07**	0.67	0.64

* $p < .05$ males n = 2026

** $p < .01$ females n = 1926

Interpersonal Behavior and Cultural Differences

Cultural background was analyzed using the fathers' place of birth and the primary language spoken at home separately as independent variables. Table 3 presents the mean and standard deviation for father's birthplace for each scale of the QTI. Statistically significant differences were apparent in students' responses to three of the eight scales of the QTI. Mean scores were highest for students from an Asian cultural background on the QTI scales of Leadership,

Helping/Friendly, Understanding and Student Responsibility/Freedom. This suggests that students from an Asian background perceive their teachers more positively than those from the other cultural groups used in this analysis.

Table 3

Scale Means for each Scale of the QTI for Fathers' Birthplace.

Scale	Mean Scores							F Value
	Europe	SE Asia	Asia	Oceania	Africa	North America	South. America	
Leadership	2.76	2.92	2.93	2.76	2.64	2.90	2.67	1.68
Helping/Friendly	2.82	3.02	3.08	2.86	2.50	2.73	2.81	2.83**
Understanding	2.85	2.95	2.97	2.85	2.72	2.76	2.83	0.69
Student Resp/ Freedom	1.70	1.72	1.91	1.67	1.56	1.60	1.49	2.13*
Uncertain	0.90	0.87	0.86	0.94	0.94	1.11	0.80	0.72
Dissatisfied	1.10	1.07	1.01	1.07	1.33	0.97	1.17	1.00
Admonishing	1.37	1.29	1.35	1.37	1.45	1.35	1.58	0.45
Strict	1.80	1.86	1.74	1.82	1.94	1.69	1.83	0.69

* $p < .05$

n = 3994

** $p < .01$

*** $p < .001$

When primary language spoken at home was used as the cultural variable, it was found that children from homes where Asian based languages were dominant had statistically significant higher mean scores on the scales of Leadership, Helping/Friendly, Understanding and Student Responsibility and Freedom. Again students from an Asian background perceived their teachers' interpersonal behavior more positively than students from other cultures.

Table 4
Mean Scores for each Scale of the QTI for Different Primary Language Spoken at Home

Scale	Mean scores			F Value
	English	Other European	Asian	
Leadership	2.77	2.59	2.92	4.38*
Helping/Friendly	2.86	2.64	2.99	3.66*
Understanding	2.85	2.70	2.98	2.49
Student Resp/Freedom	1.68	1.75	1.89	4.08
Uncertain	0.92	1.04	0.99	1.62
Dissatisfied	1.07	1.22	1.18	2.02
Admonishing	1.37	1.48	1.34	0.86
Strict	1.81	1.85	1.82	0.13

* $p < .05$ $n = 3589$

Associations between Interpersonal Teacher Behavior and Student Outcomes and Attitudes to Science and Mathematics

Table 5 reports the results for associations between students' perceptions of teacher-student interpersonal behavior and students' attitudinal and cognitive outcomes when the data were analyzed using both simple and multiple correlations. Whereas the simple correlation (r) describes the bivariate association between an outcome and a QTI scale, the standardized regression weight (β) characterizes the association between an outcome and a particular QTI scale when all other QTI dimensions are controlled.

An examination of the simple correlation (r) figures in Table 5 indicates that there were 14 significant relationships ($p < .05$), out of 16 possible, between the scales of the QTI and student outcome variables; this is 15 times that expected by chance alone.

The more conservative beta weights reveal 6 out of 16 significant relationships ($p < .05$), which is 6 times that expected by chance alone. These associations were positive for the scales of Leadership, Helping/Friendly and Understanding for both attitude to class and student achievement. The scales of Uncertain, Dissatisfied, Admonishing and Strict displayed negative associations for both attitude to class and student achievement. The scale reporting student responsibility and freedom behavior in the classroom had a positive association with attitude to class but a negative association with cognitive achievement.

Table 5
Associations Between QTI Scales and Students Attitudinal Outcomes in Terms of Simple Correlations (r) and Standardized Regression Coefficients (β)

Scale	Attitude to class		Achievement score	
	r	β	r	β
Leadership	0.54**	0.20**	0.14**	0.04
Helping/ Friendly	0.62**	0.28	0.14**	0.02
Understanding	0.57**	0.05*	0.14**	0.00
Student Resp/ Freedom	0.16**	0.01	-0.01	-0.03
Uncertain	-0.34**	-0.01	-0.11**	0.01
Dissatisfied	-0.51**	-0.07**	-0.19**	-0.15**
Admonishing	-0.48**	-0.05*	-0.13**	0.00
Strict	-0.41**	-0.20**	-0.10**	-0.02
Multiple R Correlation		0.67**		0.20**

* $p < .05$ $n = 2960$

** $p < .01$

This suggests that students enjoy the class more if they are given responsibility and freedom but if they are not their cognitive achievement is increased. The more conservative multiple regression indicated that it was the Dissatisfied scale that was negatively associated with cognitive achievement and that associations were strongest between students' perceptions of teacher interpersonal behavior and attitudinal outcomes.

Conclusions

Past learning environment studies have shown the importance of perceptions of interpersonal behavior in determining student learning outcomes. This study provides a distinctive contribution to this line of learning environment research in that it investigated associations between gender, cultural background, attitude to science and mathematics, student achievement and interpersonal elements in learning environments, through the application of the Leary model.

The study has confirmed the QTI as a valid, reliable and economical instrument for use in providing teachers with information about their relationships with students in their own classes. Teachers could find the QTI to be a valuable source of information, particularly for comparisons between their own and their students' perceptions.

It seems clear from the results of this study that there are gender and cultural differences in the student perceptions of teacher-student interpersonal behavior. Specifically, this study found gender differences that consistently showed that females perceive their teachers in a more positive way than do males. It should be noted that gender was represented almost equally in the study sample.

Cultural background was analyzed using the fathers' place of birth and the primary language spoken at home separately as independent variables. For father's birthplace, statistically significant gender differences were apparent in students' responses to three of the eight scales of the QTI. Mean scores were highest for students from an Asian cultural background on the QTI scales of Leadership, Helping/Friendly, Understanding and Student Responsibility/Freedom. This suggests that students from an Asian background perceive their teachers more positively than those from the other cultural groups identified in this analysis.

When primary language spoken at home was used as the cultural variable, it was found that children from homes where Asian based languages were dominant had statistically significant higher mean scores on the scales of Leadership, Helping/Friendly, Understanding and Student Responsibility and Freedom. Again students from an Asian background perceived their teachers' interpersonal behavior more positively than students from other cultures.

The cultural differences in teacher-student interpersonal behavior showed that students from an Asian background tended to perceive their teachers more positively than those from the other cultural groups used in this study. This was found to be consistent for both cultural background indicator variables used in the study, namely, the father's birthplace and the primary language spoken at home.

Generally, the dimensions of the QTI, representing students' perceptions of their teachers' interpersonal behavior, were found to be significantly associated with student attitude scores. In particular, the study showed that there was a positive correlation between student attitude and the teachers' leadership, helping/friendly and understanding behaviors. Students had a more positive attitude to their class when their teacher exhibited more of these behaviors and less admonishing, dissatisfied, uncertain and strict behaviors.

Correlations between cognitive achievement and interpersonal behavior were not as strong, but there were positive associations with cooperative behaviors and negative associations with oppositional behaviors. If teachers want to promote favorable student attitudes to their class, they should ensure the presence of these interpersonal behaviors.

This research is of practical significance in that it has drawn a link between student attitudes, student achievement and the nature of the teacher-student behavior in the classroom. The study could be of significance for teacher educators and policy makers in that it provides a way of improving student

outcomes by changing the nature of interpersonal relationships between students and teachers in classrooms.

The extensive data base that has been created from this study will allow the application of more sophisticated multi-level statistical analysis during 1997. Further research could seek to conduct observations and in-depth interviews with students and teachers in order to explain why males and female students differ in their perceptions or why students from different cultural backgrounds perceive the same classroom environment differently.

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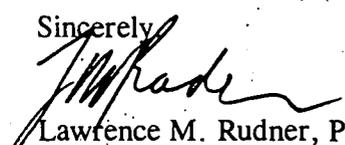
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