

JACK LEVY, PERRY DEN BROK, THEO WUBBELS AND  
MIEKE BREKELMANS

## STUDENTS' PERCEPTIONS OF INTERPERSONAL ASPECTS OF THE LEARNING ENVIRONMENT

Received 12 February 2002; accepted (in revised form) 28 October 2002

**ABSTRACT.** This study examined variables associated with differences in students' perceptions of interpersonal teacher behavior. The perceptions of 3023 students and 74 teachers in 168 classes in seven secondary schools were used in the analyses. Investigating variance at the student, class, teacher and school levels revealed that several variables are significantly related to students' perceptions: student and teacher gender, student and teacher ethnic background, student age and grade, class size, grade level, subject taught and teacher experience. There were interaction effects between some variables, such as student ethnicity and student gender, as well as student and teacher gender. While significant, the amount of variance explained by these was low (around 10%). The outcomes generally confirmed earlier research, although some new effects were found. Perhaps the main result of the study was its verification of the complex and interactive nature of students' perceptions of the learning environment and researchers' understanding of it.

**KEY WORDS:** classroom environment, interpersonal behavior, multilevel analysis, student perceptions, teacher-student relationships

### 1. RATIONALE

This study is an outgrowth of class ecology and environment research. As such, it has roots in psychology, anthropology, sociology and linguistics (Doyle, 1979; Fraser, 1989, 1998; Green, 1983; Hamilton, 1983; Shulman, 1986; Wubbels, Créton & Holvast, 1988). It assumes that a productive and stable classroom atmosphere is at the heart of teaching effectiveness, and that the quality of the climate is dependent on the nature of teacher-student communication (Levy, Wubbels & Brekelmans, 1992). Research on interpersonal teacher behavior has found that teacher-centered behavior (in this article known as 'influence' or 'dominance') and cooperative behavior (called 'proximity') are positively related to cognitive and affective student outcomes. Such associations have been established by researchers from Australia (Evans, 1998; Goh, 1994; Henderson, 1995; Rawnsley, 1997; Scott, 2001), The Netherlands (Brekelmans, van den Eeden, Terwel & Wubbels, 1997; Den Brok, 2001; Wubbels & Brekelmans,



1998) and the USA (Gorham & Zakahi, 1990; Neuliep, 1995; Powell & Harville, 1990; Sanders & Wiseman, 1990; Wubbels & Levy, 1993). Thus, the more that students perceive their teachers to be dominant and cooperative, the more they will achieve cognitively and affectively.

While there is considerable agreement between students on the interpersonal behavior of their teachers, the above research also found clear perceptual differences within classes (e.g. Den Brok, 2001; Den Brok, Levy, Rodriguez & Wubbels, 2002; Evans, 1998; Levy, Wubbels, Brekelmans & Morganfield, 1997). Over half of the variance (roughly 60–80%) in students' perceptions is related to differences between students within classes, while the remainder is accounted for by the nature of the teacher rather than the class (Den Brok, 2001). Moreover, these within-class differences are systematic and follow a different conceptual structure than those between classes or teachers.

Differences in within-class perceptions could have several causes. First, they could be the result of differences in teacher treatment. While this would be unsurprising at the individual level, it is clear that some teachers do treat students differently depending on their students' and their own gender and/or ethnic background (e.g. Casteel, 1996; Irvine, 1985, 1986; Simpson & Erickson, 1983). Second, within-class perceptual differences could be the result of varying needs and expectations that students have with respect to the teacher. Some students, for example, could have lower self-esteem than others and therefore need a teacher who is overly supportive. These students could project this need onto their teachers, resulting in different interpretations than other students of the same behavior. Third, within-class differences could be caused by dissimilar values and norms used by students to assess their teachers. Some students could regard a teacher who repeatedly checks for understanding as helpful, for example, while others might see this as intrusive.

Finally, systematic differences could occur with respect to specific characteristics of students, teachers or classes. For example, girls could view teachers differently than boys, or teachers could pay more attention to one group than the other. Differences in students' opinions have been associated with variables such as student and teacher gender, student and teacher ethnic background,<sup>1</sup> grade level, teacher experience, subject and report card grade (Brekelmans, Wubbels & Den Brok, 2002; Den Brok et al., 2002; Levy et al., 1992, 1997; Wubbels & Brekelmans, 1998; Wubbels & Levy, 1993). In a similar vein, research conducted at universities on student evaluations of teaching (e.g. Marsh & Roche, 1997) have shown that ratings are associated with (prior) subject interest, grades, effort, difficulty of courses and class size. These studies also show that findings with

respect to grade level, subject and teacher and student gender are inconclusive. Naturally, it is difficult to compare research conducted in university classrooms with studies done in secondary settings, due to a range of environmental and design differences.

A more specific explanation of variables affecting differences in students' perceptions appears in a subsequent section of this article. Unfortunately, the research which highlighted some of these factors has limited reliability and validity due to methodological weaknesses. Most studies have used correlations or simple variance analyses to establish significant effects between variables, and examine one variable at a time. This could result in overestimation of statistical significance, because the design might ignore overlap between variables and leave it untested. Moreover, the nested structure of the data (students are sampled within classes that are sampled within teachers) was often not accounted for (exceptions were the study by Brekelmans et al., 2002; Den Brok et al., 2002; Levy et al., 1997). This also could have led to spurious correlations or loss of power (e.g. Den Brok, 2001; Hox, 1995).

The present study addressed this limitation by using multilevel (or hierarchical) analyses of data from a large sample of USA students and their teachers. As a result, we have been able to uncover effects of and interactions between student, class and teacher characteristics on students' perceptions of their teachers. The outcomes are relevant for teachers and school leaders, as they indicate which groups of students or classes need greater affirmation (e.g. Nieto, 1996). This article starts with a description of the theoretical framework and research on teacher interpersonal behavior, before proceeding to the design, results and discussion.

## 2. INTERPERSONAL TEACHER BEHAVIOR

The Model for Interpersonal Teacher Behavior is based on Timothy Leary's research on the diagnosis of personality (1957) and its application to teaching (Wubbels, Créton & Hooymayers, 1985, 1987). The Leary model has been investigated extensively and proven to be effective in describing human interaction (Foa, 1961; Lonner, 1980). While not conclusive, there is evidence that it is also cross-culturally generalizable (Brown, 1965; Dunkin & Biddle, 1974; Lonner, 1980).

The model describes interpersonal teacher behavior (also called teacher communication style) along two dimensions: Influence (DS, or Dominance – Submission) and Proximity (CO, Cooperation – Opposition). The Influence dimension represents the degree of dominance or control displayed

by the teacher, while Proximity describes the level of cooperation between teacher and students. The two dimensions can be represented in a co-ordinate system divided into eight equal sectors (see Figure 1). The sectors are labeled DC, CD, and so on, according to their position on the graph. For example, the two sectors DC and CD are both characterized by dominance and cooperation. However, the DC sector demonstrates a higher degree of dominance than cooperation. Similarly, the adjacent sector CD includes actions that are more cooperative and dominant. The sectors of the model describe eight different behavior types: Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict.

The Questionnaire on Teacher Interaction (QTI) was developed in The Netherlands in 1984 to gather data on teacher communication style (Wubbels & Levy, 1991; Wubbels et al., 1985). A recent review of the validity and reliability of over 20 studies that used the QTI during the last 17 years (Den Brok, 2001) showed that reliability coefficients of the eight scales (sectors) are generally above 0.80 (a value of 0.70 is considered sufficient)

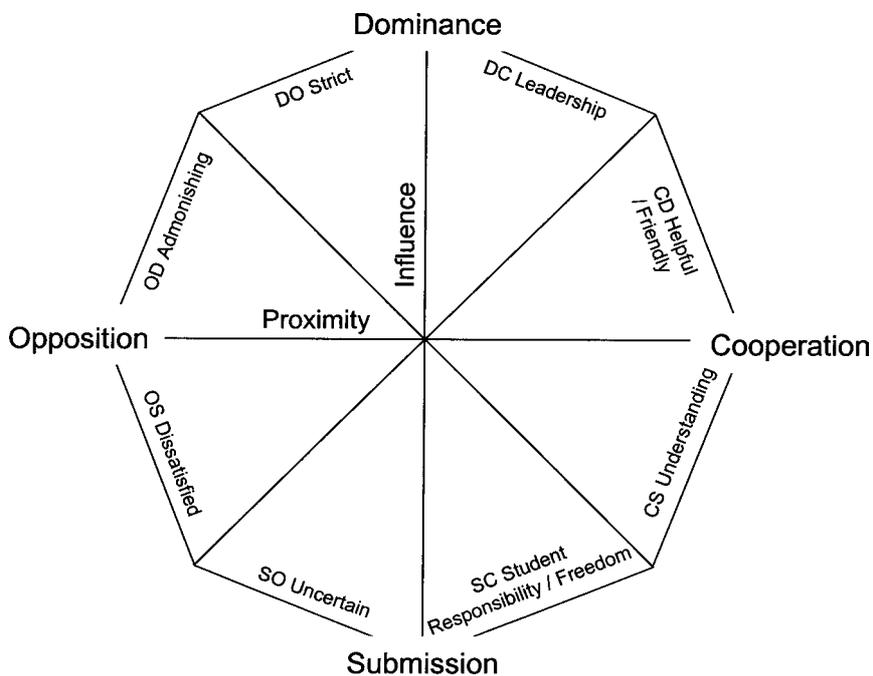


Figure 1. The Model for Interpersonal Teacher Behavior.

and scores are consistent across classes. Moreover, the QTI's circular structure is sound.

Like the model, the QTI has eight scales, from DC (Leadership) to DO (Strictness) behavior. It employs a five-point response range, from 'never/not at all' to 'always/very'. Scores are reported for each of the eight sectors and sometimes on two summarizing factors: Influence (DS) and Proximity (CO). While the DS and CO dimensions are based on all eight sectors, behaviors in the sectors closest to the DS axis – strictness, leadership, student responsibility/freedom, and uncertainty – are most relevant to the Influence score, while helpful/friendly, understanding, dissatisfied and admonishing behavior are most related to CO ratings.

### 3. VARIABLES AFFECTING DIFFERENCES IN STUDENTS' PERCEPTIONS

Studies of differences in student ratings of teacher communication style suggest a number of variables that are important: student and teacher gender, student and teacher ethnic background, grade level, experience, subject taught, report card grade and class size. A brief overview follows.

#### 3.1. *Student Variables*

##### 3.1.1. *Gender*

Research on gender-related perceptions found that females at both the primary and secondary levels viewed their teachers as more dominant (e.g. teacher centered) and cooperative than males (e.g. Goh & Fraser, 1995; Levy et al., 1992; Wubbels & Levy, 1993). Despite these consistent patterns, as well as research which demonstrates that females often receive less attention and reinforcement from some teachers (e.g. Irvine, 1985, 1986; Simpson & Erickson, 1983; Woolfolk, 2001) and that some teachers have lower expectations for females (e.g. Brophy, 1985; Rosenthal, 1985), gender-related differences with respect to other elements of classroom climate or learning environments research is less conclusive (e.g. Dart et al., 1999; Ferguson & Fraser, 1998; Pianta & Nimetz, 1993; Waxman & Huang, 1998). Moreover, relationships between gender and perceptions of teacher behavior are complex, as they seem to interact with a number of other variables, such as curricular and subject preference (e.g. Baker & Leary, 1995; Jones & Kirk, 1990; Jones & Wheatley, 1990; Kahle, Parker, Rennie & Riley, 1993), cognitive processes and approaches to learning (e.g. Belenky, Clincy, Goldberger & Tarule, 1986; Carr & Jessup, 1997; Eggen & Kauchak, 1999; Fennema & Carpenter, 1998; Fennema et

al., 1996; Gallagher & DeLisi, 1994) and culturally-related gender role definitions (e.g. Marcus, Gross & Seefeldt, 1991; Park, 1997; Timm, 1999). For example, it has been found that females are interested in more humanitarian applications of science than males, choose social science subjects (e.g. history, geography, economy, religion, etc.) at a greater rate, and use different problem-solving strategies (Fennema & Carpenter, 1998; Fennema et al., 1996). It has also been found that gender differences are not as prominent in one culture or ethnic group than another (Hofstede, 1991).

### 3.1.2. *Ethnicity*

There is a clear relationship between student ethnicity and their perceptions of teacher communication patterns. Using self-designated ethnic group membership as an explanatory variable, investigators found that Asian-American students perceived less dominance and proximity than students from African-American, Hispanic or Caucasian backgrounds<sup>2</sup> (Den Brok, Levy, Wubbels & Rodriguez, in press; Levy, Wubbels & Brekelmans, 1996). In a similar vein, Hispanic students felt that their teachers were more dominant and cooperative than other ethnic groups (Den Brok et al., 2002; Levy et al., 1996). Primary home language was also found to be a significant variable in explaining the range of students' views. For example, it was found that those speaking English at home perceived less dominance than students speaking other languages (Levy et al., 1997), while those speaking Spanish perceived the most cooperation (Den Brok et al., in press). Finally, acculturation was found to be of importance: students who have lived longer in the country of interest noticed less dominance than those who had just arrived (Evans & Fisher, 2000, for Australia; Den Brok et al., in press, for the USA). Like gender, ethnicity is an extremely complex variable, and many explanations have been provided for its associations with students' views of their learning environment. Research suggests that culture-related differences in perception could well be the result of differences in treatment with respect to ethnic background (e.g. Banks & Banks, 1995; Casteel, 1996; Gollnick & Chinn, 1997; Irvine, 1985, 1986; Nieto, 1996), and that its influence interacts with a number of other variables, such as curricular and instructional preferences (Banks & Banks, 1995), acculturation level (Lafromboise, Coleman & Gerton, 1993; Pomales & Williams, 1989; Ponce & Atkinson, 1989), gender roles (see above), and societal approach to individualism/collectivism and power distance (Bellah, Madsen, Sullivan, Swidler & Tipton, 1985; Hofstede, 1991; Kim, Sharkey & Singelis, 1994).

### 3.1.3. *Age*

Students' age occasionally has been found to be significantly related to their perceptions of teachers. Levy and colleagues (1997) found that older students noted more teacher dominance than their younger peers, though no effect was found with respect to proximity. In another study (Levy et al., 1992), however, student age was unrelated to either influence or proximity.

### 3.1.4. *Achievement*

Research investigating the association between students' achievement and their perceptions of teacher behavior is also inconclusive, showing significant but weak effects when report card grade is used as an indicator. Levy et al. (1992) found that report card grades were positively related to influence and proximity, but the same researchers were not able to replicate this finding in a later study (Levy et al., 1997). Research using cognitive test scores and treating students' perceptions as the independent rather than the dependent variable did find consistent and positive relationships between achievement and influence and proximity (see Rationale section).

## 3.2. *Teacher and Class Variables*

A number of class and teacher variables seem to be related to students' perceptions of teacher communication. These include grade level, teacher experience, and teacher ethnicity.

### 3.2.1. *Grade Level*

Students in higher grade levels reported greater influence and proximity than their younger peers (Ferguson & Fraser, 1998; Levy et al., 1992).

### 3.2.2. *Teacher Experience*

The more experience that a teacher had, the greater the perception of dominance, leadership and strictness (Levy et al., 1992). While experience was found to be positively related to views on influence, those for proximity – including helpful/friendly or understanding behaviors – remained constant. In other words, students' didn't perceive any increase in cooperative behavior according to teacher experience (Brekelmans, Holvast & van Tartwijk, 1992; Brekelmans et al., 2002; Somers, Brekelmans & Wubbels, 1997; Wubbels & Brekelmans, 1998; Wubbels & Levy, 1993).

### 3.2.3. *Teacher Ethnicity*

In a number of investigations, teacher ethnic background was found to be related to students' views on teacher communication. Asian and Asian-American teachers were perceived as less dominant and cooperative than teachers from other ethnic groups (Den Brok et al., 2002; Den Brok et al., in press; Levy et al., 1996), while Hispanic teachers were perceived as more dominant and cooperative than their colleagues from other ethnicities (Den Brok et al., 2002; Levy et al., 1996).

## 4. RESEARCH QUESTIONS

As mentioned in the Rationale, while research has tied a number of variables to student perceptions, many studies did not account for the nested structure of the data and results were often inconclusive or even contradictory. Moreover, interactions between variables often went untested and those variables that were included only explained small amounts of variance. We attempted to improve upon this through an exploratory study which employed multilevel analyses, investigated interactions between variables, and included the variables described above. Thus, the following research questions were investigated:

1. To what extent do schools, teachers, and classes contribute to differences in students' perceptions of their teachers' interpersonal behavior?
2. (a) Which student, teacher and class variables explain differences in students' perceptions of their teachers' interpersonal behavior?  
(b) How are these variables related to students' perceptions and what is their relative strength?  
(c) How much variance in students' perceptions can be explained by all significant variables combined?

## 5. RESEARCH DESIGN

### 5.1. *Sample*

Between November 1999 and March 2000, QTI data were gathered from 3023 students and 74 teachers in 168 classes in seven secondary schools (five high schools, two middle schools) in the Washington DC metropolitan area. Teachers volunteered and selected up to five classes in Grades

7–12 for participation. Slightly more than half (51.8%) of the students were female. They ranged in age from 11–18 years, with most being 12, 16 or 17 years (each category contained over 16% of the students). There was great ethnic diversity in the sample: nearly 40% were not born in the USA. Students came from Latin America (16.8%), Korea (1.3%), Vietnam (4.2%), Japan or China (0.8%), Southeast-Asia (2.7%), the Middle East (3.5%) or other countries (11.5%). Only half (50.7%) primarily spoke English at home, with Spanish (26.4%) and Vietnamese (5.3%) being the second and third most frequent home languages. While diverse in origin, over half of the students had been living in the USA for more than five years.

Students and teachers were presented with five ethnic categories from which to choose: Asian-American, Hispanic, African American, White and Other.<sup>2</sup> The participants identified themselves as follows: Hispanic (33.5% of the students; 9.2% of the teachers), Asian-American (21.9% of the students; 1.5% of the teachers), African American (14.2% of the students; 18.2% of the teachers) and White (22.9% of the students; 71.2% of the teachers), with the rest indicating Other. While there were significant numbers of students who indicated that they were Hispanic or Asian-American, most were born in the USA. This implies that, despite their diversity, a large segment of the student sample (including those with a non-English language background) had been socialized into USA society to a significant degree. Class size ranged between six and 37 students.

Most of the teachers (63%) in our sample were younger than 30 years, while only a small number (16.7%) was older than 40 years. About half had less than five years of experience, 14% between five and ten years, 12.9% between 11 and 15 years, and 21.5% had more than 15 years of experience. Many (25.8%) taught English or modern languages (17.5%), while somewhat smaller numbers taught mathematics and science (each 13%) and social studies (11.3%). Most of the teachers (68.1%) were female.

## 5.2. Instrumentation

While each class completed the QTI, the researchers were present to answer questions and provide support if necessary. Within a day or two after administration, each teacher received a report on the class perceptions. Table I contains typical items for the QTI scales.

While the QTI has been repeatedly judged to be an acceptable instrument for use in teacher research and professional development, it is nearly 20 years old. It was therefore important that we determined whether the

TABLE I  
Typical Items for the Scales of the QTI

Scale (sector)	Typical item
DC – Leadership	This teacher acts confidently.
CD – Helpful/friendly	This teacher is friendly.
CS – Understanding	This teacher is patient.
SC – Student responsibility/freedom	We can influence this teacher
SO – Uncertain	This teacher is hesitant.
OS – Dissatisfied	This teacher is suspicious.
OD – Admonishing	This teacher gets angry quickly.
DO – Strict	This teacher is strict.

instrument still reflected acceptable reliability and validity. We conducted reliability and factor analyses for the eight scales. While there were some minor irregularities, the results reported in the Appendix verified that the QTI was indeed acceptable for use in the study.

In addition to students' perceptions of general teacher interpersonal behavior, several other student, teacher and class variables were investigated (see Table II for an overview of these variables). Students' ethnic background was measured by three indicators in addition to the self-identification mentioned above. They specified their country/region of birth, home language (language used greater than half the time) and length of residence in the USA. The language and ethnic membership data were recoded into sets of dummy variables for the multilevel analyses. The student ethnicity data were also used to create a number of class-related ethnicity variables. For each class, the percentage of African-American, Asian-American, Hispanic, White and Other students was determined and used as a variable. An 'ethnic makeup' variable was created by counting the number of ethnic groups present in the class. Teachers were also asked to identify themselves by ethnicity, and these data were used at the teacher level.

Apart from ethnicity, students were asked to provide information regarding their gender, their last report card grade and their age. At the class level, the following variables were created: class size (number of students), grade level, percentage of male students and subject taught. 'Subject taught' was also divided into a number of dummy variables. In addition to ethnicity, data on teacher gender and experience were collected. No information was gathered with respect to the school.

### 5.3. Analyses

Multilevel analyses were conducted on each of the eight sectors. Because of slight irregularities with respect to the circular ordering of the scales

TABLE II  
Variables Used in the Multilevel Analyses

Level	Variable	Short description
Student	Gender	Dummy variable, with boys indicated by a '1'.
	Self-defined ethnicity	Students indicate to which ethnic group they feel that they belong. Represented by 5 dummy variables (a '1' indicating a category 'hit'): African-American, Asian-American, Hispanic-American, White/Caucasian and other.
	Country of birth	Dummy variable, with born in the USA indicated by a '1'.
	Language spoken at home	Students indicate which language is spoken with their parents. Represented by 5 dummy variables (a '1' indicating a category 'hit'): English, Spanish, Asian languages, Middle Eastern languages and other languages.
	Length of stay	Students indicate the number of years for which they have been living in the USA.
	Report card grade	Students indicate the score on the last report card grade that they received.
	Age	Students indicate their age in years.
Class	Class size	The number of students in the class.
	Grade level	The grade level of the class (from 7 to 12).
	Subject taught	Subject taught by the teacher. Represented by 5 dummy variables (a '1' indicating a category 'hit'): natural sciences (science, chemistry, biology and mathematics), social sciences (history, geography and economics), languages (English, French, German and Spanish), special education and other subjects.
	Percentage of students from ethnic groups	The percentage of students belonging to one of the ethnic groups. Represented by 5 variables: percentage of African-American, Asian-American, Hispanic-American, White and other students.
	Number of ethnic groups	Number of different ethnic groups present in class (range between 1 and 5).
Teacher	Gender	Dummy variable, with males indicated by a '1'.
	Self-defined ethnicity	Teachers indicate to which ethnic group they feel that they belong. Represented by 5 dummy variables (a '1' indicating a category 'hit'): African-American, Asian-American, Hispanic-American, White/Caucasian and other.
	Experience	Number of years for which the teacher had been teaching.

(see the Appendix), it was decided not to use the summarizing DS and CO dimension scores in the analyses. Models with four levels (student, class,

teacher and school) were used for analyses of the student perceptions. Standard estimation procedures in multilevel analyses programs, such as Iterative Generalized Least Squares (IGLS), often produce biased estimates of coefficients and variance distribution, especially when small numbers of units are available at the higher levels (Luyten & De Jong, 1998). Because of the small number of schools and teachers involved in this study, it was decided to use the Restricted Iterative Generalized Least Squares (RIGLS) method, which is suitable for small numbers of units at the highest levels (Goldstein, 1995).

The models were tested in a number of steps. First, an empty model (with no independent variables) was tested in order to obtain raw percentages of variance in the sector scores at the student, class, teacher and school level. Next, a model with student variables including gender, age, report card grade, language spoken at home, country of birth, number of years in the USA and ethnicity was tested. The following class variables were then added to the model: size, ethnic makeup (the number of ethnic groups present in the class), gender makeup (the percentage of male students), percentages of students from the different ethnic groups and grade level. In the next step, teacher-level variables were entered: gender, age, experience and ethnicity. Finally, interactions between variables, especially between the gender and ethnicity indicators, were tested, both within and across levels. The results of the analyses were compared with those of earlier studies. We also determined effect sizes, in order to compare the relative importance of variables, as well as percentages of variance explained by all the significant variables combined.

To enhance interpretation, associations between the explanatory variables were established by means of correlational and cross-tabular analyses. Relevant associations are described in the Discussion section. Additionally, regular analyses of variance (ANOVA) with only one explanatory variable at a time were conducted to obtain an estimate of the 'raw' or 'uncorrected' coefficients and amounts of variance. If relevant, these are also mentioned in the Discussion section. It should be noted that the different scales of the QTI are correlated with each other, because they are ordered in a (semi) circular structure.

## 6. RESULTS

### 6.1. *Variance Distribution in Students' Perceptions*

In agreement with earlier research (Den Brok, 2001; Den Brok et al., 2002; Evans, 1998), most (approximately 70%) of the variance in students' per-

ceptions in this study was located at the student level, while about 10–15% was explained by class and teacher factors. Less than 10% of the variance was accounted for at the school level (see Tables IIIa–III d).

The variance at the student level ranges between 69.0% (Leadership) and 77.3% (Uncertain), at the class level between 6.9% (Leadership) and 12.5% (Helpful/Friendly, Student Responsibility/Freedom and Dissatisfied), and at the teacher level between 10.7% (Understanding) and 17.6% (Strict).

Surprisingly, we also found a small amount of variance at the school level (6.9% for Leadership, and 7.1% for Understanding). This could indicate the presence of a 'school pedagogy', though this result would have to be investigated further. In earlier studies, differences between schools were not examined, or the school was not included as a separate level in the analyses. None of the other scales displayed significant variance at the school level. Moreover, variance distribution at the different levels hardly changed after explanatory variables had been added to the models.

## 6.2. *Significant Variables in Students' Perceptions of Interpersonal Teacher Behavior*

### 6.2.1. *Student Variables*

As can be seen in Tables IIIa–III d, student gender was related to almost all of the scales of the QTI. The coefficients indicate that females viewed their teachers as more helpful/friendly and understanding, while males thought that they were more uncertain, dissatisfied, admonishing and strict. Males also perceived more leadership behavior than females.

The effect size for gender was weak when compared with other variables in the leadership, helpful/friendly and understanding sectors. However, it was moderate – about one fifth of a standard deviation – for the uncertain, dissatisfied, admonishing and strict sectors. An effect size of this nature can occasionally mean considerable differences, because a standard deviation in proximity, for example, could account for as much as a one year gain in motivation or achievement (Den Brok, 2001). Moreover, the findings are in line with those of earlier studies (Levy et al., 1992; Wong & Fraser, 1996).

The relationship between gender and students' perceptions of their teachers is complex, however, as several significant interactions with other variables were found. In terms of gender and ethnicity, African-American males perceived less leadership and helpful/friendly behavior than males and females from all other ethnic backgrounds. These interaction effects can be regarded as strong: they equaled over one third of a standard dev-

TABLE IIIa

Multilevel Analysis on the DC and CD sectors (Standard Errors Between Brackets)

Variable	DC (Leadership)		CD (Helpful/friendly)	
	Coefficient	Effect size	Coefficient	Effect size
Student-level:				
Gender (male = 1)	0.004 (0.005)*	0.040	-0.018 (0.006)	-0.178
Age	-	-	-	-
Grade	-0.026 (0.003)	-0.263	-0.025 (0.003)	-0.248
Asian	-	-	-	-
Black	0.027 (0.010)	0.273	0.020 (0.011)	0.198
Gender × Black (Black male = 1)	-0.040 (0.013)	-0.404	-0.038 (0.013)	0.376
Gender × Asian (Asian male = 1)	-	-	-	-
Latin-American country	0.032 (0.010)	0.323	-	-
Middle Eastern country	0.031 (0.010)	0.313	-	-
Asian language	-	-	-0.028 (0.014)	-0.277
Number of years in USA	-0.004 (0.002)	-0.040	-	-
Class-level:				
Class size	-0.003 (0.001)	-0.030	-0.004 (0.001)	-0.040
Grade level	-	-	0.011 (0.004)	0.109
Exact subjects	-0.045 (0.019)	-0.455	-	-
Social subjects	-	-	-	-
Percentage Asian students	0.073 (0.031)	0.737	-	-
Teacher-level:				
Gender (male = 1)	-	-	-0.035 (0.020)	-0.347
Student × teacher gender (both male = 1)	-	-	0.045 (0.012)	0.446
Experience	-	-	-	-
Hispanic	-	-	-	-
Variance distribution (percent):				
Student	69.0		71.9	
Class	6.9		12.5	
Teacher	17.2		15.6	
School	6.9		0.0	
Likelihood empty model	-2937.375		-2573.195	
Likelihood final model	-3072.682		-2684.346	
<i>df</i> -difference	10		9	
% of (total) variance explained	10.3		3.1	

Note. \*Nonsignificant (at  $\alpha = 0.025$ ).

For each of the ethnic variables, dummies were created, with the ethnic group mentioned coded as 1, the other groups coded as 0. The same applies to language spoken at home (Asian), country of birth (Latin-American and Middle East) and subject (exact and social).

TABLE IIIb

Variable	CS (Understanding)		SC (Student responsibility/ freedom)	
	Coefficient	Effect size	Coefficient	Effect size
Student-level:				
Gender (male = 1)	-0.017 (0.006)	-0.183	-	-
Age	-	-	-	-
Grade	-0.025 (0.003)	-0.267	-0.007 (0.002)	-0.097
Asian	-	-	-0.019 (0.005)	-0.264
Black	-	-	-	-
Gender × Black (Black male = 1)	-	-	-	-
Gender × Asian (Asian male = 1)	-	-	-	-
Latin-American country	-	-	-	-
Middle Eastern country	-	-	-	-
Asian language	-	-	-	-
Number of years in USA	-	-	0.002 (0.001)	0.028
Class-level:				
Class size	-0.003 (0.001)	-0.032	-	-
Grade level	-	-	-	-
Exact subjects	-0.051 (0.019)	-0.548	-	-
Social subjects	-	-	-	-
Percentage Asian students	0.070 (0.031)	0.753	-	-
Teacher-level:				
Gender (male = 1)	-0.012 (0.019)*	0.129	-	-
Student × teacher gender (both male = 1)	0.034 (0.011)	0.366	-	-
Experience	-	-	-	-
Hispanic	-0.038 (0.017)	-0.409	-	-
Variance distribution (percent):				
Student	71.4		75.0	
Class	10.7		12.5	
Teacher	10.7		12.5	
School	7.1		0	
Likelihood empty model	-2976.258		-4408.945	
Likelihood final model	-3099.258		-4438.525	
<i>df</i> -difference	8		3	
% of (total) variance explained	10.7		0.0	

Note.\*Nonsignificant (at  $\alpha = 0.025$ ).

For each of the ethnic variables, dummies were created, with the ethnic group mentioned coded as 1, the other groups coded as 0. The same applies to language spoken at home (Asian), country of birth (Latin-American and Middle East) and subject (exact and social).

TABLE IIIc

Multilevel Analysis on the SO and OS Sectors (Standard Errors Between Brackets)

Variable	SO (Uncertain)		OS (Dissatisfied)	
	Coefficient	Effect size	Coefficient	Effect size
Student-level:				
Gender (male = 1)	0.031 (0.004)	0.413	0.024 (0.005)	0.289
Age	–	–	–	–
Grade	0.009 (0.002)	0.120	0.019 (0.003)	0.229
Asian	–	–	–	–
Black	0.018 (0.006)	0.240	–	–
Gender × Black (Black male = 1)	–	–	–	–
Gender × Asian (Asian male = 1)	–	–	–	–
Latin-American country	–	–	–	–
Middle Eastern country	–	–	–	–
Asian language	–	–	–	–
Number of years in USA	0.004 (0.001)	0.053	–	–
Class-level:				
Class size	–	–	0.002 (0.001)	0.024
Grade level	–0.010 (0.003)	–0.133	–	–
Exact subjects	–	–	–	–
Social subjects	–0.038 (0.019)	–0.507	–	–
Percentage Asian students	–	–	–	–
Teacher-level:				
Gender (male = 1)	–	–	–	–
Student × teacher gender (both male = 1)	–	–	–	–
Experience	–	–	–	–
Hispanic	–	–	–	–
Variance distribution (percent):				
Student	77.3		75.0	
Class	9.1		12.5	
Teacher	13.6		12.5	
School	0.0		0.0	
Likelihood empty model	–3565.767		–3210.485	
Likelihood final model	–3662.742		–3301.033	
<i>df</i> -difference	6		3	
% of (total) variance explained	9.1		0.0	

Note. \*Nonsignificant (at  $\alpha = 0.025$ ).

For each of the ethnic variables, dummies were created, with the ethnic group mentioned coded as 1, the other groups coded as 0. The same applies to language spoken at home (Asian), country of birth (Latin-American and Middle East) and subject (exact and social).

TABLE IIIId

Multilevel Analysis on the OD and DO Sectors (Standard Errors Between Brackets)

Variable	OD (Admonishing)		DO (Strict)	
	Coefficient	Effect size	Coefficient	Effect size
Student-level:				
Gender (male = 1)	0.015 (0.005)	0.169	0.019 (0.005)	0.253
Age	–	–	0.008 (0.002)	0.107
Grade	0.020 (0.003)	0.225	0.013 (0.002)	0.173
Asian	–	–	0.018 (0.007)	0.240
Black	–	–	–	–
Gender × Black (Black male = 1)	–	–	–	–
Gender × Asian (Asian male = 1)	–	–	–0.017 (0.008)	–0.227
Latin-American country	–	–	–	–
Middle Eastern country	–	–	–	–
Asian language	–	–	–	–
Number of years in USA	0.003 (0.001)	0.039	0.003 (0.001)	0.040
Class-level:				
Class size	0.002 (0.001)	0.022	0.003 (0.001)	0.040
Grade level	–	–	–	–
Exact subjects	–	–	–	–
Social subjects	–	–	–	–
Percentage Asian students	–	–	–	–
Teacher-level:				
Gender (male = 1)	–	–	–	–
Student × teacher gender (both male = 1)	–	–	–	–
Experience	0.009 (0.004)	0.101	0.010 (0.003)	0.133
Hispanic	–	–	–	–
Variance distribution (percent):				
Student	76.0		70.6	
Class	12.0		11.8	
Teacher	12.0		17.6	
School	0.0		0.0	
Likelihood empty model	–3132.354		–4432.851	
Likelihood final model	–3214.378		–4543.046	
<i>df</i> -difference	5		8	
% of (total) variance explained	4.0		0.0	

Note. \*Nonsignificant (at  $\alpha = 0.025$ ).

For each of the ethnic variables, dummies were created, with the ethnic group mentioned coded as 1, the other groups coded as 0. The same applies to language spoken at home (Asian), country of birth (Latin-American and Middle East) and subject (exact and social).

iation and were larger than the effects for most other variables. In addition, Asian-American males perceived less strictness than all other ethnic groups.

Several ethnic background variables were also significantly related with the scales. African-American students thought that their teachers demonstrated greater leadership and were more helpful and friendly, though they also detected more uncertain behavior than other students. The moderate effect size – up to one fourth of a standard deviation – was largely unexpected, because earlier studies had shown no differences between African-American students and their peers.

In comparison with their peers, Asian-American students felt that their teachers provided them with significantly less responsibility and freedom and were stricter. This was also unexpected, because it contradicted earlier findings that Asians perceive less dominance and more submissive behavior (Den Brok et al., 2002, in press; Levy et al., 1996). As was described above, students' ethnicity also interacted with gender.

In addition to group membership, other indicators of ethnic background displayed significant effects. Students born in Latin American or Middle Eastern countries thought that their teachers demonstrated more leadership than their peers, which is in keeping with earlier research (Den Brok et al., in press; Levy et al., 1996). Students speaking an Asian language at home saw less helpful/friendly behavior than students speaking other languages. While associations with home language were not found for Asians in earlier research, the results nonetheless align with studies showing that Asian students perceive less proximity than other groups (Den Brok et al., in press; Levy et al., 1996). Effect sizes for the country and language variables were strong – about one third of a standard deviation.

As expected, the high degree of socialization into American society seemed to influence students' perceptions, because the number of years for which they had lived in the USA was significantly related to their ratings. As their residency period in the USA increased, students generally felt that their teachers diminished in leadership yet still provided them with a greater amount of responsibility and freedom. They also thought, however, that teachers were more uncertain, admonishing and strict than students who had lived here a shorter time. While the effect size for this variable appears weak, its time-related nature could increase the importance in some instances. For example, a student who has lived for more than ten years in the USA perceives a quarter to one-third of a standard deviation more responsibility/freedom, uncertain, admonishing and strict behaviors than does one who just arrived. The results concur with those of earlier research (Den Brok et al., in press; Evans & Fisher, 2000), show-

ing that students perceive less dominance and more submissiveness the longer they reside in the country.

Two other student variables were related to their perceptions: age and academic achievement as measured by report card grade. Older students felt that their teachers were stricter than did their younger classmates. In terms of QTI sectors, higher grades were significantly associated with less leadership, helpful/friendly, understanding and student responsibility/freedom, and with more uncertain, dissatisfied, admonishing and strict behavior. The effect size for this variable was weak, however, and was not greater than one-fifth of a standard deviation. The results add to the mixed findings with respect to this variable in earlier research: while contradictory patterns were found in one study (Levy et al., 1992), they were not corroborated in others, and the effects were weak. However, the associations contradict expectations, as one might think that students who do well in class would think that their teachers are accomplished leaders and communicators, rather than the opposite.

#### 6.2.2. *Class Variables*

The ethnic makeup of the class did not seem to influence students' perceptions. One exception, however, was the percentage of Asian-American students in class: the higher was this proportion, the more leadership, helpful/friendly and understanding behavior was perceived. The effect of this variable was strong – nearly half of a standard deviation. In those cases for which its effect occurred, it was the largest of all variables.

Apart from the percentage of Asian-American students, a number of other class variables also showed significant associations with students' perceptions. Unremarkably, class size was negatively associated with proximity-related scales. Thus, the larger the class size, the more that the students thought that their teachers were dissatisfied, admonishing and strict, and displayed less leadership, helpful/friendly and understanding behavior.

In terms of grade level, students in the higher grades felt that their teachers were more helpful and friendly, and less uncertain than students in the lower levels. However, the effects of this variable were weak – about one-tenth of a standard deviation. This is in keeping with the inconsistent showing of this variable in prior research. Two separate studies (Levy et al., 1992, 1997) reached different conclusions – in the first study, grade level was significant but, in the second study, it was not.

The specific subject of the class was also significantly related to student perceptions. Students in mathematics/natural science classes thought that their teachers exhibited less leadership and understanding behavior, while students in the social sciences felt that their teachers were more

uncertain. The effects of subject are strong – about half a standard deviation – and earlier studies also showed differences between subjects (Den Brok, 2001; Wubbels & Levy, 1993), although no clear patterns were found.

### 6.2.3. *Teacher Variables*

Teacher ethnicity was also related to students' perceptions. Hispanic teachers were seen as less understanding than teachers with other backgrounds. Like the ethnic makeup of the class, this effect was strong – almost half of a standard deviation. Yet, it contradicted earlier findings (Den Brok et al., 2002). Overall, these results demonstrate that teacher ethnic background clearly influences students' views of teacher communication style, but the relationship is complex.

Teacher experience and gender were significantly related to students' ratings. Veteran teachers were seen as more admonishing and strict than their less experienced colleagues. This is in agreement with earlier results that demonstrate that experienced teachers are perceived as more teacher-centered (dominant) than their beginning colleagues (Brekelmans et al., 1992, 2002; Somers et al., 1997; Wubbels & Brekelmans, 1998; Wubbels & Levy, 1993). However, the effect size is small – only one-tenth of a standard deviation.

### 6.2.4. *Cross-Level Interactions*

Only one cross-level interaction was found: student gender interacted with teacher gender. Boys who were taught by a male teacher perceived more helpful/friendly and understanding behavior than did girls with male or female teachers.

## 6.3. *Amount of Variance Explained by Variables Significant in the Analyses*

When taken as a whole, none of the student, class and teacher variables accounted for much of the variance in student perceptions. In some cases, such as for the influence domain and the Student Responsibility/Freedom, Dissatisfied and Strict scales, no variance at all was explained. The overall amount of variance explained by the variables ranged from 3.1% (Helpful/Friendly) to 10.7% (Understanding). Thus, these findings are comparable to other studies (Den Brok et al., 2002, in press) in their suggestion that many other factors (such as motivation and intelligence) could be relevant in clarifying the nature of students' perceptions. In general, then, the results suggest that systematic differences in students' perceptions due to teacher, student or class characteristics are limited.

## 7. DISCUSSION

### 7.1. *The Complicated Nature of Student Perceptions*

While the study revealed a number of significant influences on students' perceptions – student and teacher ethnic background, student and teacher gender, report card grade, age, class size, grade level, subject taught and teacher experience – none were overwhelming in their effect. This study, however, determined 'additive' consequences of each of the variables, because we analyzed the effects of a variable while keeping all others constant. This is different from previous research that usually investigated the effects of single variables, ignoring interactions with or indirect influences by other factors.

A number of significant interactions between variables were found. This reinforced the notion that student cognition and perceptions are the result of a complicated mix of factors, each of which needs to be studied carefully. As mentioned, this was an exploratory study and even the indication of small, yet significant, results in students' perceptions of the learning environment are worthy of more careful investigation.

A number of noteworthy findings emerged. For example, the perceptions of African-American students significantly differed from their peers. In particular, African-American males inferred significantly less leadership and helpful/friendly teacher behavior than other groups. This is in keeping with the literature which states that African-American males often get treated less favorably than other students and have the least positive view of their teachers (Irvine, 1985, 1986; Simpson & Erickson, 1983). It remains unclear, however, if such differential treatment occurred in this study. This was the first time that a study using the QTI found a difference in the ratings of African-American males and other groups. The result might have occurred because the current sample was more diverse than those in previous studies, and this certainly warrants further investigation in the future. The study also pointed at the importance of the teacher level, as compared to the class level: differences in student perceptions between teachers are more prominent than differences between the classes of the teachers themselves.

Although many earlier findings were corroborated, some surprising results were found. As noted, the fact that Asian-American students felt that their teachers were stricter and provided them with less responsibility or freedom (a pattern which strengthened as the proportion of Asian-Americans in class rose) did not agree with previous research involving use of the QTI. This result could be explained in different ways. First, as

suggested before, the method of analysis differs from previous studies. When we performed the same type of analysis as conducted in earlier research – a standard analysis of variance with ethnic background as the only variable – the results were in agreement. White students perceived even more strictness and less responsibility/freedom than the Asian-American students did, and Hispanic students also perceived lower amounts of responsibility/freedom than the Asian-Americans.

Second, this result could have been caused by the specific makeup of the current sample which, compared to earlier studies, contained more Asian-American students. Moreover, the percentage of Asian-Americans differed more from class to class than other groups. To confuse the issue further, these findings are in line with those of an Australian study by Evans and Fisher (2000). We are therefore left with inconclusive outcomes regarding the effect of Asian-American ethnic background, and greater respect for the complexity of the relationship between ethnicity, culture and student perceptions.

We were also surprised by the perceptions of Hispanic teachers as being less understanding than their peers, because earlier studies indicated the opposite. Interestingly, regular analyses of variance with teacher ethnicity as the only variable (as done in the past) hardly showed differences in perceptions of students between their Hispanic, White and Other teachers. Only the Asian teachers were rated higher on understanding. Again, these findings highlight the influence of our method of analysis. Apparently, other variables, such as teacher gender, experience, age and others co-determine the (raw) effect of teacher ethnicity on the students' perceptions. Thus, this ethnicity-related finding could have been contaminated by other variables such as gender or experience. Cross-tabular analyses showed that Hispanic teachers were significantly more experienced than their Asian or African-American counterparts ( $\chi^2 = 89.56$  with  $df = 16$ ,  $p = 0.00$ ). It remains unclear if and to what degree experience could have influenced the outcomes; nevertheless, some subtle association seems likely.

The results for student achievement, as measured via report card grade, were also puzzling. Students who did well in class saw much less teacher influence and cooperation than their lower-achieving peers. While this outcome contradicted our expectations, it was nonetheless in agreement with previous research (Levy et al., 1996, 1997). Again, these effects could have been contaminated by subtle interactions with other variables. For example, it was found that males had lower grades than females ( $\chi^2 = 30.18$  with  $df = 4$ ,  $p = 0.00$ ) and that younger students ( $\chi^2 = 96.85$  with  $df = 32$ ,  $p = 0.00$ ) did better than their older peers. Because older and female stu-

dents displayed higher ratings on influence and proximity related scales, it seems likely that these variables were influential, despite the fact that their interactions did not turn out to be significant.

Finally, the interaction between student and teacher gender is noteworthy. The fact that male students thought that their male teachers were more helpful, friendly and understanding than their female teachers – a result which was not reflected in female student ratings of female teachers – warrants further study.

As mentioned, the outcome differences between this study and previous work in this domain could have been caused by the particular types of analyses used. Instead of simple correlations and variance analyses conducted at either the student or the class level data, this study used multilevel variance analysis techniques. Additionally, four – instead of two – levels were distinguished and interactions between variables were investigated, including cross-level interactions. While the former types of analyses could provide a first and rough indication regarding the effects of certain variables, the latter types of analyses provide estimates that show the unique and additive effects of variables and account better for the nested structure of the data.

## *7.2. Limitations*

Some general remarks can be made regarding the limitations of this study. First of all, we only investigated student perceptions and only focused on interpersonal behavior. Thus, it remains unclear how the findings would relate to teacher and observer perceptions, or how they might apply to other aspects of teaching that are relevant to student learning. Future research could focus on these factors, and might also be conducted with K–6 and university populations.

Second, as noted in the Research Design section, there is a slight concern with respect to the validity of the QTI in this study. While scale reliabilities across classes were high, factor analyses showed a minor dislocation of some of the sectors in the interpersonal circle, and statistically significant correlations between the two dimensions were found. For this reason, we did not use dimension scores in the analyses. Unfortunately, the exact consequences of these irregularities on the scale scores themselves remain unknown. It is possible that variance estimates and effects of variables could have been smaller than would have been the case in the 'ideal' factorial situation. Also, patterns of association between background variables and perception scores could have been less similar across certain scales than the results indicate, because factor analyses showed that

students perceived less 'distinction' between certain scales (e.g. CS and CD; or SO, OS and OD) than hypothesized. Therefore, caution in interpreting the outcomes is warranted.

Further validation of the QTI is also needed. This might involve interviews with students to uncover changed, alternative and culturally-sensitive meanings of items; testing additional sets of items, particularly for the Understanding, Responsibility/Freedom, Uncertain and Admonishing scales; and developing reliability and validity data with other diverse samples.

Third, while the ratio between the student and class level units was satisfactory, ratios between the higher-level units (classes, teachers and schools) were far from optimal. This could have had some effect on the estimation of variance and coefficients, especially for these higher levels, despite the use of the RIGLS estimation method. In future research, it could be relevant to conduct separate analyses on subsections of this sample in order to test the stability of outcomes or the effect of omitting certain levels, as well as research using larger numbers of schools and teachers.

Fourth, in terms of ethnicity, the current sample contained a lower proportion of White students and teachers, and higher percentages of Asian-Americans, African-Americans and Hispanics than in earlier studies. Because of this higher within-class and between-class diversity, certain ethnicity-related differences in student perceptions could have changed compared to earlier research. On the other hand, like earlier samples, the students in this study were socialized into American society to a large degree.

Fifth, associations were found between a number of the student-level and teacher-level explanatory variables. Earlier, we mentioned the significant interactions between student gender and report card grade, student age and report card grade, and teacher ethnic membership and experience. As might be expected, strong associations were found between students' ethnic membership, the language spoken at home and the country of birth. While most of the Asian-Americans spoke an Asian language at home, most White students spoke English and most Hispanics spoke Spanish. Analyses showed that not all ethnic groups were equally acculturated: whereas most White and Hispanic students had lived in the USA for a long time (more than ten years), African-American and Asian-American students lived there for shorter periods ( $\chi^2 = 528.19$  with  $df = 20$ ,  $p = 0.00$ ). There is no clear explanation of this result for African-Americans. In terms of student achievement, Asian-American and White students reported higher report card grades than African-Americans, while Hispanics' grades were mixed ( $\chi^2 = 89.56$  with  $df = 16$ ,  $p = 0.00$ ). Finally, male teachers had less

experience than their female colleagues ( $\chi^2 = 22.92$  with  $df = 6$ ,  $p = 0.00$ ). It seems very possible that the interactions between these independent variables affected the magnitude of some of the effects found. Therefore, while some variables were not significant, they still could have had an indirect influence. More qualitative methods of research, including interviews with students and classroom observation, and also different kinds of quantitative analyses, like path analysis, could help uncover some of these subtleties in future research.

Sixth, the percentages of variance explained in this study were low. This could have been caused by the fact that we could not investigate some critical variables such as student motivation, student needs and beliefs with respect to communication and learning, intelligence or socioeconomic background. Future research that includes these variables could detect new associations, resulting in higher levels of explained variance.

Seventh and last, while analyses were conducted to detect the influence of a number of independent variables on students' perceptions (the dependent variable), some of the associations, in fact, could reverse these roles. For example, while a low report card grade could have influenced a student to see the teacher as dissatisfied, the perceptions of dissatisfaction also could have led to poor achievement by the student. Thus, some of the associations probably represent circular perceptual processes, which is in keeping with prior research on communication systems (Watzlawick, Beavin & Jackson, 1967).

The outcomes of this study have several implications, two of which are discussed here. First, because of the link between student perceptions and student outcomes, and because of the differences in perceptions as a result of background variables of students, we feel that it is important for teachers to become aware of these differences and to incorporate this intelligence in their instructional repertoire. This background knowledge could assist teachers in properly affirming the diversity in their classrooms and could contribute to the development of culturally-responsive strategies. Second, it could be relevant for researchers to check carefully for variables that covariate with other factors. If a study is to report on teaching from a class perspective, these class aggregates of variables could be inadequate, especially if the sample is heterogeneous in nature and certain interactions or overlaps between factors exist.

In closing, perhaps the main outcome of this study is its verification of the complexity of the interactive nature of the learning environment and our understanding of it. It points to the need for researchers to take incremental, yet comprehensive steps, to unravel its mysteries.

## APPENDIX

## RELIABILITY AND VALIDITY ANALYSES FOR THE QTI

Table IV lists the reliabilities (Cronbach's alpha and Multilevel Lambda<sup>3</sup>) for each of the eight scales.

As can be seen, all scales displayed alpha coefficients of over 0.80 at the class level, while a value of 0.70 or higher is considered to be acceptable for research purposes (Nunnally, 1967). Moreover, scales were measured consistently across classes (lambda > 0.85).

A factor analysis was also performed to determine the instrument's loyalty to the Leary model (Maximum Likelihood method, rotation 'by hand'; see Den Brok, 2001). The expected two factors (influence and proximity) emerged with an eigenvalue larger than one, explaining 77% of the variance. Figure 2 shows a graphical display of the factor loadings after rotation.

As can be seen, scale scores roughly followed a two-dimensional, circular structure. However, a few irregularities surfaced. Four scales were situated too high on the influence dimension: Understanding (CS), Student Responsibility/Freedom (SC), Uncertain (SO) and Dissatisfied (OS). As a consequence, the CS scale was closer to CD (Helpful/Friendly) than desired. Similarly, the distances between the SO and OS and OD (Admonishing) scales were quite small. These irregularities might have been caused by the strong presence of very young (Grade levels 7 and 8) and special education students. Although they were assisted by the researchers, the questionnaire was mostly developed for Grades 9–12, and these students might have had difficulties in answering or distinguishing between some of the items.

TABLE IV

QTI Scale Reliabilities (Cronbach's Alpha at Student and Class Level) and Consistencies Across Classes (Multilevel Lambda)

Scale	Alpha reliability		Lambda
	Student	Class	
DC – Leadership	0.82	0.94	0.90
CD – Helpful/friendly	0.87	0.94	0.89
CS – Understanding	0.83	0.94	0.89
SC – Student responsibility/freedom	0.67	0.83	0.87
SO – Uncertain	0.76	0.88	0.86
OS – Dissatisfied	0.83	0.91	0.87
OD – Admonishing	0.79	0.88	0.86
DO – Strict	0.68	0.81	0.89

Finally, ideal dimension scores (DS and CO) were computed, using predetermined factor loadings,<sup>4</sup> and these were correlated with the factor scores as displayed in Figure 2. Correlations between these 'empirical' and 'theoretical' dimension scores were high (0.85 and 0.99 for DS and CO, respectively), indicating that the circular structure behind the QTI was approximated. Nevertheless, the dislocation of some of the scales in the influence dimension is clearly reflected in the lower correlation for DS. Correlations between the two dimensions of influence and proximity were also significant (0.56 for the 'empirical' dimension scores, 0.28 for the 'theoretical' dimension scores), which is in contradiction with the model, because two independent dimensions are expected. However, because the validity of the QTI has been strongly supported in many other studies using the American QTI (e.g. Den Brok, 2001; Wubbels & Levy, 1993), and because reliability and consistency were high, it was decided to proceed with the eight scale scores for further analyses.

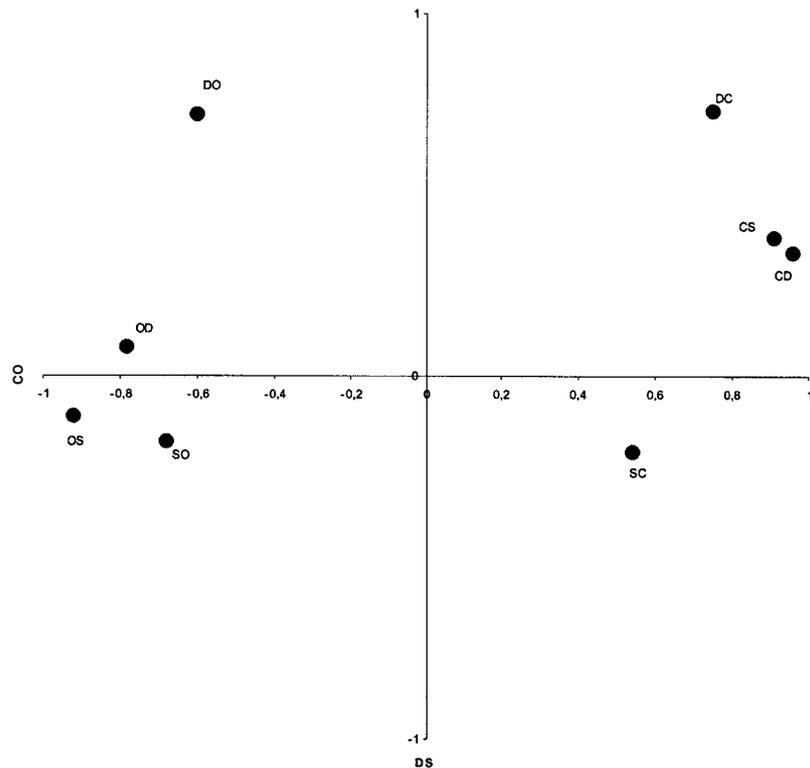


Figure 2. Graphical representation of the factor loadings for the scales of the QTI.

## NOTES

1. In this study, the terms 'culture' and 'ethnicity' are both used. Following Nieto (1996, p. 390), we define culture as "the ever-changing values, traditions, social and political relationships, and worldview created and shared by a group of people bound together by a combination of factors (which can include a common history, geographic location, language, social class, and/or religion), and how these are transformed by those who share them". In this context, ethnicity refers to linguistic and national origin. It is seen as one of the indicators that binds people and is regarded as a subset of the broader term culture.
2. The terms 'Hispanic', 'Latino', 'Hispanic-American', 'Asian', 'Asian-American', 'Black', 'African-American' and 'White' are used in this article in this common-sense meaning. It is recognized that these designations can be misleading, because a tremendous amount of diversity exists within each category. When reporting on the cultural membership of the teachers and students involved in this study, the categories have been selected by the subjects (self-defined), and they generally refer to place of birth and primary language spoken at home. White and African-American students were born in the USA and speak English; Latinos or Hispanics were born in Latin America and speak Spanish; and Asians were born in Asia and speak an Asian language. The general nature of these designations is a limitation of the study.
3. Multilevel Lambda =  $n_j \times \rho_j / (1 + [n_j - 1]\rho_j)$ , where  $n_j$  reflects average class size and  $\rho_j$  the intra-class correlation coefficient (Snijders & Bosker, 1999).
4. Dimension scores (following the ideal circumplex model) were computed as follows: Influence =  $(0.92 \times DC) + (0.38 \times CD) - (0.38 \times CS) - (0.92 \times SC) - (0.92 \times SO) - (0.38 \times OS) + (0.38 \times OD) + (0.92 \times DO)$ ; Proximity =  $(0.38 \times DC) + (0.92 \times CD) + (0.92 \times CS) + (0.38 \times SC) - (0.38 \times SO) - (0.92 \times OS) - (0.92 \times OD) - (0.38 \times DO)$ . These scores range between about -3 and +3.

## REFERENCES

- Baker, D., & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching*, 32, 3-27.
- Banks, J. A., & Banks, C. A. (1995). *Handbook of research on multicultural education*. New York: Macmillan.
- Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing*. New York: Basic Books.
- Bellah, R. N., Madsen, R., Sullivan, W. M., Swidler, A., & Tipton, S. (1985). *Habits of the heart: Individualism and commitment in American life*. New York: Harper & Row.
- Brekelmans, M., Holvast, A., & Tartwijk, J. van. (1992). Changes in teacher communication styles during the professional career. *The Journal of Classroom Interaction*, 27, 13-22.
- Brekelmans, M., van den Eeden, P., Terwel, J., & Wubbels, Th. (1997). Student characteristics and learning environment interactions in mathematics and physics education: A resource perspective. *International Journal of Educational Research*, 27, 283-292.
- Brekelmans, M., Wubbels, T., & Den Brok, P. (2002). Teacher experience and the teacher-student relationship. In S. C. Goh & M. S. Khine (Eds.), *Studies in educational learning environments: An international perspective* (pp. 73-99). Singapore: World Scientific.

- Brophy, J. E. (1985). Teacher-student interaction. In J. B. Dusek (Ed.), *Teacher expectations* (pp. 303–328). Hillsdale, NJ: Lawrence Erlbaum.
- Brown, R. (1965). *Social psychology*. London: Collier-Macmillan.
- Carr, M., & Jessup, D. L. (1997). Gender differences in first grade mathematics strategy use: Social and metacognitive influences. *Journal of Educational Psychology, 98*, 318–328.
- Casteel, C. A. (1996). Teacher-student interactions and race in integrated classrooms. *Journal of Educational Research, 92*, 115–121.
- Dart, B., Burnett, P., Boulton-Lewis, G., Campbell, J., Smith, D., & McCrindle, A. (1999). Classroom learning environments and students' approaches to learning. *Learning Environments Research, 2*, 137–156.
- Den Brok, P. (2001). *Teaching and student outcomes: A study on teachers' thoughts and actions from an interpersonal and a learning activities perspective*. Utrecht, The Netherlands: W.C.C.
- Den Brok, P. J., Levy, J., Rodriguez, R., & Wubbels, Th. (2002). Perceptions of Asian-American and Hispanic-American teachers and their students on interpersonal communication style. *Teaching and Teacher Education, 18*, 447–467.
- Den Brok, P. J., Levy, J., Wubbels, Th., & Rodriguez, M. (in press). Cultural influences on students' perceptions of videotaped lessons. *International Journal of Intercultural Relations*.
- Doyle, W. (1979). Classroom effects. *Theory into Practice, 18*, 138–144.
- Dunkin, M. J., & Biddle, B. J. (1974). *The study of teaching*. New York: Rinehart & Winston.
- Eggen, P., & Kauchak, D. (1999). *Educational psychology* (4th ed). Columbus, OH: Merrill.
- Evans, H. M. (1998). *A study of students' cultural background and teacher-student interpersonal behavior in secondary Science classrooms in Australia*. Unpublished doctoral dissertation, Curtin University of Technology, Science and Mathematics Education Centre, Perth, Australia.
- Evans, H., & Fisher, D. (2000). Cultural differences in students' perceptions of science teachers' interpersonal behaviour. *Australian Science Teachers Journal, 46*(2), 9–18.
- Fennema, E., & Carpenter, T. (1998). New perspectives on gender differences in mathematics: An introduction. *Educational Researcher, 27*(5), 4–16.
- Fennema, E., Carpenter, T. P., Franke, M. L., Levi, L., Jacobs, V. R., & Empson, S. B. (1996). A longitudinal study of learning to use children's thinking in mathematics instruction. *Journal for Research in Mathematics Education, 27*(4), 403–434.
- Ferguson, P. D., & Fraser, B. J. (1998). Changes in learning environment during the transition from primary to secondary school. *Learning Environments Research, 1*, 369–383.
- Foa, U. (1961). Convergences in the analysis of the structure of interpersonal behavior. *Psychological Review, 68*, 341–353.
- Fraser, B. J. (1989). Research syntheses on school and instructional effectiveness. *International Journal of Educational Research, 13*, 707–719.
- Fraser, B. J. (1998). Science learning environments: Assessment, effects and determinants. In B. J. Fraser & K. G. Tobin (Eds.), *International handbook of science education* (pp. 527–564). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Gallagher, A. M., & DeLisi, R. (1994). Gender differences in scholastic aptitude tests – Mathematics problem solving among high-ability students. *Journal of Educational Psychology, 86*, 204–211.

- Goh, S. C. (1994). *Interpersonal teacher behaviour, classroom climate and student outcomes in primary mathematics classes in Singapore*. Unpublished doctoral dissertation, Curtin University of Technology, Science and Mathematics Education Centre, Perth, Australia.
- Goh, S. C., & Fraser, B. J. (1995, April). *Learning environment and student outcomes in primary mathematics classrooms in Singapore*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.
- Goldstein, H. (1995). *Multilevel statistical models*. London: Edward Arnold.
- Gollnick, D., & Chinn, P. C. (1997). *Multicultural education in a pluralistic society* (5th ed.). New York: Merrill.
- Gorham, J., & Zakahi, W. R. (1990). A comparison of teacher and student perceptions of immediacy and learning: Monitoring process and product. *Communication Education*, 39, 354–368.
- Green, J. (1983). Teaching and learning: A linguistic perspective. *Elementary School Journal*, 83, 353–391.
- Hamilton, S. (1983). The social side of schooling: Ecological studies of classrooms and schools. *Elementary School Journal*, 83, 313–334.
- Henderson, D. G. (1995). *A study of the classroom and laboratory environments and student attitude and achievement in senior secondary Biology classes*. Unpublished doctoral dissertation, Curtin University of Technology, Science and Mathematics Education Centre, Perth, Australia.
- Hofstede, G. (1991). *Cultures and organizations: Software of the mind*. London: McGraw-Hill.
- Hox, J. J. (1995). *Applied multilevel analysis*. Amsterdam: TT Publicaties.
- Irvine, J. J. (1985). Teacher communication patterns as related to the race and sex of the student. *Journal of Educational Research*, 78, 338–345.
- Irvine, J. J. (1986). Teacher-student interactions: Effects of student race, sex and age level. *Journal of Educational Psychology*, 78, 14–21.
- Jones, A. T., & Kirk, C. M. (1990). Gender differences in students' interests in applications of school physics. *Physics Education*, 25, 308–313.
- Jones, A. T., & Wheatley, J. (1990). Gender differences in teacher-student interactions in science classrooms. *Journal of Research in Science Teaching*, 27, 861–874.
- Kahle, J. B., Parker, L. H., Rennie, L. J., & Riley, D. (1993). Gender differences in science education: Building a model. *Educational Psychologist*, 28, 379–404.
- Kim, M.-S., Sharkey, W., & Singelis, T. (1994). The relationship between individuals' self-construals and perceived importance of interactive constraints. *International Journal of Intercultural Relations*, 18(1), 117–140.
- Lafromboise, T., Coleman, H. L. K., & Gerton, J. (1993). The psychological impact of biculturalism: Evidence and theory. *Psychological Bulletin*, 114, 395–412.
- Leary, T. (1957). *An interpersonal diagnosis of personality*. New York: Ronald Press Company.
- Levy, J., Wubbels, T., & Brekelmans, M. (1992). Student and teacher characteristics and perceptions of teacher communication style. *Journal of Classroom Interaction*, 27, 23–39.
- Levy, J., Wubbels, Th., & Brekelmans, M. (1996, April). *Cultural factors in students' and teachers' perceptions of the learning environment*. Paper presented at the annual meeting of the American Educational Research Association, New York.
- Levy, J., Wubbels, T., Brekelmans, M., & Morganfield, B. (1997). Language and cultural factors in students' perceptions of teacher communication style. *International Journal of Intercultural Relations*, 21(4), 29–56.

- Lonner, W. J. (1980). The search for psychological universals. In H. C. Triandis & W. W. Lambert (Eds.), *Handbook of cross-cultural psychology* (Vol. 1, pp. 143–204). Boston: Allyn & Bacon.
- Luyten, H., & De Jong, R. (1998). Parallel classes: Differences and similarities, teacher effects and school effects in secondary schools. *School Effectiveness and School Improvement*, 9, 437–473.
- Marcus, G., Gross, S., & Seefeldt, C. (1991). Black and White students' perceptions of teacher treatment. *Journal of Educational Research*, 84, 363–367.
- Marsh, H. W., & Roche, L. A. (1997). Making students' evaluations of teaching effectiveness effective. *American Psychologist*, 52, 1187–1197.
- Neuliep, J. W. (1995). A comparison of teacher immediacy in African-American and Euro-American college classrooms. *Communication Education*, 44, 267–280.
- Nieto, S. (1996). *Affirming diversity: The sociopolitical context of multicultural education* (2nd ed.). New York: Longman.
- Nunnally, N. N. (1967). *Psychometric theory*. New York: McGraw Hill.
- Park, C. C. (1997, March). A comparative study of learning style preferences: Asian-American and Anglo students in secondary schools. Paper presented at the annual meeting of the American Educational Research Association, Chicago.
- Pianta, R., & Nimetz, S. L. (1993). The student-teacher relationship scale: Results of a pilot study (Research Reports). Harrisonburg, VA: James Madison University. (ERIC Document Reproduction Service No. Ed. 308961)
- Pomales, J., & Williams, V. (1989). Effects of acculturation and counseling style on Hispanic students' perceptions of counselor. *Journal of Counseling Psychology*, 36, 79–83.
- Ponce, F. Q., & Atkinson, D. R. (1989). Mexican-American acculturation, counselor ethnicity, counseling style, and perceived counselor credibility. *Journal of Counseling Psychology*, 36, 203–208.
- Powell, R. G., & Harville, B. (1990). The effects of teacher immediacy and clarity on instructional outcomes: An intercultural assessment. *Communication Education*, 39, 369–379.
- Rawnsley, D. G. (1997). *Associations between classroom learning environments, teacher interpersonal behaviour and student outcomes in secondary mathematics classrooms*. Unpublished doctoral dissertation, Curtin University of Technology, Perth, Australia.
- Rosenthal, R. (1985). From unconscious experimenter bias to teacher expectancy effects. In J. B. Dusek (Ed.), *Teacher expectancies* (pp. 37–66). Hillsdale, NJ: Lawrence Erlbaum.
- Sanders, J. A., & Wiseman, R. L. (1990). The effects of verbal and nonverbal teacher immediacy on perceived cognitive, affective and behavioral learning in the multicultural classroom. *Communication Education*, 39, 341–353.
- Scott, R. H. (2001). *Students' perceptions of science teachers' behaviour in Brunei Darussalam*. Unpublished doctoral dissertation, Curtin University of Technology, Science and Mathematics Education Centre, Perth, Australia.
- Shulman, L. (1986). Paradigms and research programs in the study of teaching: A contemporary perspective. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 3–36). New York: Macmillan.
- Simpson, A. W., & Erickson, M. T. (1983). Teachers' verbal and nonverbal communication patterns as a function of teacher race, student gender and student race. *American Educational Research Journal*, 20(2), 183–198.
- Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. London: Sage Publications.

- Somers, T., Brekelmans, M., & Wubbels, Th. (1997, August). *Development of student teachers on the teacher-pupil relationship in the classroom*. Paper presented at the bi-annual meeting of the European Association of Research on Learning and Instruction, Athens, Greece.
- Timm, J. T. (1999). The relationship between culture and cognitive style: A review of the evidence and some reflections for the classroom. *Educational Researcher*, 28(3), 36–44.
- Watzlawick, P., Beavin, J. H., & Jackson, D. (1967). *The pragmatics of human communication*. New York: Norton.
- Waxman, H. C., & Huang, S. L. (1998). Classroom learning environments in urban elementary, middle and high schools. *Learning Environments Research*, 1, 95–113.
- Woolfolk, A. (2001). *Educational psychology* (8th ed.). Boston: Allyn & Bacon.
- Wong, A. F. L., & Fraser, B. J. (1996, November). *Gender differences in perceptions of chemistry laboratory environments in Singapore*. Paper presented at the Joint Conference of the Singapore Educational Research Association and the Australian Association for Research in Education, Singapore.
- Wubbels, T., & Brekelmans, M. (1998). The teacher factor in the social climate of the classroom. In B. J. Fraser & K. G. Tobin (Eds.), *International handbook of science education* (pp. 565–580). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Wubbels, T., Créton, H., & Holvast, A. (1988). Undesirable classroom situations. *Interchange*, 19(2), 25–40.
- Wubbels, T., Créton, H. A., & Hooymayers, H. P. (1985, March). *Discipline problems of beginning teachers: Interactional behaviour mapped out*. Paper presented at the annual meeting of the American Educational Research Association, Chicago. (ERIC Document Reproduction Service No. Ed. 260040)
- Wubbels, T., Créton, H. A., & Hooymayers, H. P. (1987). A school-based teacher induction programme. *European Journal of Teacher Education*, 10, 81–94.
- Wubbels, T., & Levy, J. (1991). A comparison of interpersonal behavior of Dutch and American teachers. *International Journal of Intercultural Relations*, 15, 1–18.
- Wubbels, T., & Levy, J. (Eds.). (1993). *Do you know what you look like?: Interpersonal relationships in education*. London: Falmer Press.

JACK LEVY

*Graduate School of Education  
George Mason University  
4400 University Drive, MS 4B3  
Fairfax, VA 22030-4444, USA  
E-mail: jlevy@gmu.edu*

THEO WUBBELS

*Institute of Educational Studies  
Utrecht University  
P.O. Box 80140,  
3508 TC Utrecht  
The Netherlands  
E-mail: t.wubbels@fss.uu.nl*

PERRY DEN BROK AND MIEKE BREKELMANS

*IVLOS Institute of Education  
Utrecht University  
P.O. Box 80127, 3508 TC Utrecht  
The Netherlands  
E-mail: p.denbrok@ivlos.uu.nl; m.brekelmans@ivlos.uu.nl*

(Correspondence to: Jack Levy. E-mail: jlevy@gmu.edu)