# Factors affecting Australian students' perceptions of their science teachers' interpersonal behaviour

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Abstract

This study investigates which student, teacher and class characteristics are associated with students' perceptions of their science teachers' interpersonal behaviour. Using the *Questionnaire on Teacher Interaction* (QTI), two important dimensions of teacher interpersonal behaviour were investigated: influence (dominance vs. submission) and proximity (cooperation vs. opposition). Earlier work with the QTI in the USA and The Netherlands has shown that, in those countries, several factors affect students' perceptions of their teachers. These factors include student and teacher gender, student and teacher ethnic background, student age, teacher experience, class size, student achievement and subject. It has been found that each of these variables has a distinctive effect, but also that they interact with each other when determining students' perceptions. For the present study, an analysis was performed on a large Australian QTI data set of secondary science teachers and their students. QTI dimension scores were examined against factors such as: gender, class size and subject. To investigate separate and combined effects of variables, a hierarchical analysis of variance (distinguishing between the school, class and student level) was conducted. This paper reports for the first time on the effect sizes and variance explained by these variables with respect to the Australian context.

Key-words:

interpersonal behaviour, secondary education, student perceptions, multilevel analysis

Rationale

A great deal of research has shown that students' perceptions of their teacher's interpersonal behaviour is an important factor in explaining their cognitive and affective outcomes (Brekelmans, Wubbels, & den Brok, 2002; den Brok, 2001; Henderson, 1995; Rickards, 1998; Wubbels & Levy, 1993). Also, teacher-student interpersonal behaviour is seen as an important factor related to order in the classroom and is a major concern for both beginning and experienced teachers (Veenman, 1984). Researchers have mapped teacher-student interpersonal behaviour with the *Questionnaire on Teacher Interaction* (QTI) (Fisher, Fraser, & Wubbels, 1993; Wubbels, Creton, & Hooymayers, 1985, 1987). In studies using the QTI, teacher-student communication style is usually reported in terms of two dimensions, *influence* (who controls communication, teacher or students?) and *proximity* (do teacher and students cooperate or are they opposites?), or in terms of eight sectors of behaviour (leadership, helpful/friendly, understanding, responsibility/freedom, uncertain, dissatisfied, admonishing and strict) (e.g., Leary, 1957; Wubbels, et al., 1985; 1987).

Additionally, research in the USA (den Brok, Levy, Rodriguez, & Wubbels, 2002; den Brok, Levy, Wubbels, & Rodriguez, 2003; Levy, den Brok, Wubbels, & Brekelmans, 2003; Levy, Wubbels & Brekelmans, 1992; Wubbels & Levy, 1993) and in Australia (Fisher, Fraser, & Rickards, 1997; Henderson, 1995; Rawnsley & Fisher, 1997; Rickards, 1998; Rickards & Fisher, 1997; 2000; Waldrip & Fisher, 1999) has shown that several student, class and teacher characteristics are related to students' perception of their teacher. Among these associated characteristics are student and

teacher gender, student and teacher ethnic background, socio-economic status, attitude and achievement, age, teacher experience and subject taught.

While there has been a line of research (in Australia) investigating the relationship between student, teacher and class characteristics and students' perceptions of their science teacher's interpersonal behaviour, this research has not used multilevel analysis to a great extent. Multilevel analysis adjusts for the fact that data have not been sampled randomly and allows effects of multiple levels of the learning environment to exert an influence on the outcomes of any study. It has been shown that non-randomly sampled data may lead to *artificially increased* associations, since respondents (in classes) share similar experiences, history and stimuli (Hox, 1995; Muthen, 1994). Using regular analysis of variance – which has been the case in many previous studies using the QTI in or outside Australia -  thus leads to an over-estimation of possible effects (e.g., Hox, 1995).

Also, in most cases only one variable at a time has been investigated in relation to perception scores, so effects have not been corrected for the presence (and effects) of other, (partially) overlapping variables. This may also have resulted in over-estimation of effects or even in establishing reversed relationships. In addition, no interactions between variables have been investigated.

Finally, if variables are related to student perception scores, then *sector or scale scores* are used, rather than *dimension scores* (Levy, et al., 2003). While useful for feedback, sector scores have the disadvantage of being associated with each other, whilst dimension scores are independent. Moreover, sector scores are not always reliable or valid (den Brok, 2001).

This is the first study using multilevel analysis and QTI dimension scores with Australian Science teachers' data. Also, since the data set (described in Rickards,

1998; Fisher & Rickards, 2000) is rather large (nearly 4,000 students and 191 teachers), in some respect this study also represents a benchmark for Australian teacher-student interpersonal behaviour in Science. It is hoped that the results from this dataset will provide other researchers with a valuable source of comparative benchmarking and validation data.

## Teacher-Student Interpersonal Behaviour

To be able to describe the perceptions students have of teacher-student interpersonal behaviour in their classrooms, Wubbels, Créton, and Hooymayers (1985, see Wubbels & Levy, 1993) developed a model for interpersonal behaviour. They applied a general model for interpersonal relationships designed by Leary (1957) to the specific context of education. The Leary model, as it has become known, has been extensively investigated in clinical psychology and psychotherapeutic settings (Strack, 1996). It has proven to be a rather complete model to describe interpersonal relationships (e.g., Foa, 1961; Lonner, 1980). In the Leary model, two dimensions are important. Leary called them the Dominance-Submission axis and the Hostility-Affection axis. While the two dimensions have occasionally been given other names, - Brown (1965) used Status and Solidarity, Dunkin and Biddle (1974) Warmth and Directivity - they have generally been accepted as universal descriptors of human interaction. The two dimensions have also been easily transferred to education. Slater (1962) used them to describe pedagogical relationships, and Dunkin and Biddle (1974) demonstrated their importance in teachers' efforts to influence classroom events.

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Adapting the Leary Model to the context of education, Wubbels et al. (1985) used the two dimensions, which they called Influence (Dominance-Submission) and Proximity (Opposition-Cooperation) to structure the perception of eight behaviour segments: leadership, helpful/friendly behaviour, understanding behaviour, giving students freedom, uncertain, dissatisfied, admonishing and strict behaviour. Figure 1 presents a graphic representation of the Model for Interpersonal Teacher Behaviour developed by Wubbels et al. (1985).

The Model for interpersonal Teacher Behaviour (see Figure 1), as well as the Leary model, are special models because of their statistical properties and are theoretically linked to a particular branch of models named *circumplex models* (e.g., Blackburn & Renwick, 1996; Fabrigar, Visser, & Browne, 1997; Gaines, Panter, Lyde, Steers, Rusbult, Cox, & Wexler, 1997; Gurtman & Pincus, 2000). Circumplex models assume that the eight interpersonal sectors can be represented by two, independent dimensions (e,g., Influence and Proximity), are ordered with equal distances to each other in a circular structure, and maintain equal distances to the middle of the circle.

Insert Figure 1 about here.

The sections are labelled DC, CD, etc. according to their position in the coordinate system described in Figure 1. For example, the two sectors leadership and helpful/friendly are both characterised by Dominance and Cooperation. In the DC sector, the Dominance aspect prevails over the Cooperation aspect. A teacher displaying DC behaviour might be seen by students as enthusiastic, a good leader, and the like. The adjacent CD sector includes behaviours of a more cooperative and

less dominant type; the teacher might be described as helpful, friendly.

Variables Affecting Students' Perceptions of Their Teacher's Communication Style

Studies on differences in student ratings of teacher communication style suggest a number of variables that are important in explaining these differences: student and teacher gender, student and teacher ethnic background, grade level, experience, report card grade and class size.

Research on gender-related perceptions found that *females* at both the primary and secondary levels viewed their teachers as more dominant and more positive (e.g., teacher centred) and cooperative than do males (e.g., Goh & Fraser, 1995; Rickards & Fisher, 1997; Levy et al., 1992, 2003; Rickards, 1998; Waldrip & Fisher, 1999; Wubbels & Levy, 1993). Despite these consistent patterns, 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).

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, in USA samples, Asian-American students perceived less dominance and proximity than students from African-American, Hispanic-American or Caucasian backgrounds (den Brok, et al., 2002, 2003; Levy, et al., 2003; Levy, Wubbels, & Brekelmans, 1996). In a similar vein, Hispanic-American students felt that their teachers were more dominant and cooperative than other ethnic groups did (den Brok et al., 2002; 2003; Levy et al.,

1996). Interestingly, researchers in Australia found that Asian students perceived more influence and proximity and were described as perceiving their classes more positively than students originating from other cultural groups (Evans & Fisher, 2000; Rickards, 1998; Rickards & Fisher, 1997). Of course, apart from differences in methodology (the Australian studies used regular analyses of variance, the American studies multilevel analysis) and sample distribution, the country of interest (U.S. vs. Australia) may help to explain these surprising differences. *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, Wubbels, Brekelmans, & Morganfield, 1997), while those speaking Spanish perceived the most cooperation (den Brok et al., 2003).

In Australian studies, students speaking an Asian language at home were found to rate their teachers higher in terms of influence and proximity (Rickards & Fisher, 1997; Rickards, 1998). 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., 2003, for the USA).

*Students' age* occasionally has been found to significantly relate to their perceptions of teachers. Levy et al. (1997) found that older students noted more teacher dominance than their younger peers, though no effect was found with respect to proximity. A similar effect was found in a later, comprehensive study (Levy, et al., 2003). In still another study (Levy et al., 1992) student age was found to be unrelated to either the influence or proximity dimensions. Students in *higher grade-levels* have reported greater influence and proximity than their younger peers

(Ferguson & Fraser, 1998; Levy et al., 1992).

Research investigating the associations between *students' achievement* and their perceptions of teacher behaviour are also inconclusive, showing significant but weak effects when report card grade is used as an indicator of achievement. Having a standardized set of items for the assessment of achievement has been shown to give more comparable within sample results when compared with inter-school reported class grades (Brekelmans et al., 2001; Rickards, 1998). 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).

In a recent study, the effect was found to be reversed and was negatively related to influence and proximity (Levy, et al., 2003). 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 (Brekelmans, et al., 2002; Rawnsley & Fisher, 1997; Rickards, 1998). Similar findings applied to affective variables, such as *subject-related attitudes* (Brekelmans, et al., 2002; den Brok, 2001; Rawnsley & Fisher, 1997; Rickards, 1998), although associations usually were investigated in terms of the effect of perceptions of interpersonal behaviour on student (affective) outcomes, but not vice versa (which is the case in the present study).

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 positively relate to views on influence, those for proximity – including helpful/friendly or understanding behaviours – remained constant. In other words, students' did not 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).

In a number of investigations, *teacher ethnic background* 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, 2003; 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).

*Class size*, appeared to be negatively related to students' perceptions of teacher proximity, but was not related to their perceptions of teacher influence (Levy, et al., 2003).

Waldrip and Fisher (1999) investigated differences between students from rural areas (mining students) and students living in the Perth metropolitan area. Mining area students had a distinctly different perception of teacher-student interpersonal behaviours. Some of these aspects could be due to the generally more transient nature of mining area students. Rural students were less likely to report the more positive aspects of student-teacher interpersonal behaviours and were more likely to report the negative aspects.

Research Questions

As mentioned in the Rationale section, the present study is one of the first of its kind to employ multilevel analyses on an Australian sample of secondary school

teachers. Furthermore, it is the first Australian study to use dimension scores, rather than scale or sector scores.

The following research questions were investigated:

1. To what extent do schools, and classes contribute to differences in students' perceptions of their teachers' interpersonal behaviour?

2. Which student, class and school variables explain differences in students' perceptions of their teachers' interpersonal behaviour?

3. How are these variables related to students' perceptions and what is their relative strength?

4. How much variance in students' perceptions can be explained by all significant variables combined?

Method

*Instrumentation*

To assess interpersonal teacher behaviour, the QTI was designed according to the two-dimensional Leary model and the eight sectors. It was originally developed in the Netherlands and consisted of 77 items (Wubbels, et al., 1985), a 64-item American version was constructed in 1988 (Wubbels & Levy, 1991) and an Australian 48-item version in 1993 (Fisher, Fraser, & Wubbels, 1993). Items were formulated, based on large numbers of interviews with both teachers and students, and the construction process of the questionnaire included many rounds of careful testing (Wubbels & Levy, 1993).

The QTI has a five-point response scale, ranging from "Never/Not at all" to "Always/Very." It is scored on the basis of eight sectors or two summarising dimensions of Influence (DS) and Proximity (CO). The Dominance/Submission (DS) dimension is primarily comprised of behaviours in the sectors closest to the DS axis - Strict, Leadership, Uncertainty and Student Responsibility/Freedom. The sectors that mostly make up the Cooperation/Opposition (CO) dimension are Helpful/Friendly, Understanding, Dissatisfied and Admonishing. In Table 1 typical items are provided for each of the eight sectors of the QTI.

Insert Table 1 about here.

The QTI has acceptable reliability and validity when used in grades 7 to 12 (Rickards, 1998; Wubbels & Levy, 1993). A recent review on the validity and reliability of over 20 studies that have used the QTI during the last 17 years showed that reliability of the eight scales (sectors) is sufficient and consistent across classes (den Brok, 2001). Moreover, the review showed that the theoretical structure of the Model for Interpersonal Teacher Behaviour was represented in the items and scales of the instrument.

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 to re-examine whether the instrument still reflected acceptable reliability and validity. Therefore, in this study, reliability and discriminant validity analyses were conducted for the eight scales of the QTI. Table 2 provides reliability and percentages of variance at the class level for each of the scales of the QTI. As can be seen in Table 2, the instrument was found to be reliable and able to

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discriminate between classes.


Insert Table 2 about here.


The construct validity of the QTI was investigated in a number of ways. First, an exploratory factor analysis was conducted on the (aggregated) scale scores in order to see if two dimensions were present in the data (see den Brok, Rickards, & Fisher, 2003). This analysis indicated that two factors with an eigen value greater than one could be extracted, explaining 79 percent of the variance. Inspection of the factor loadings suggested two dimensions that could be labelled in terms of influence and proximity. Second, correlations were computed between scales at the class level. This correlation matrix was then investigated for its circular structure by computing a *Correspondence Index* (with the RANDALL-software; Tracey, 1994; Tracey & Schneider, 1995). The correspondence index indicates to what degree and with what probability a correlation matrix corresponds to a circumplex structure. If a circumplex model applies to the data, correlations should be highly positive for neighbouring scales, decreasing until they become highly negative with scales on the opposite end of the interpersonal circle (Gurtman & Pincus, 2000). CI for the correlation matrix was .72 ($p$=.0008), indicating that a circular ordering applied to the scales of the QTI for the present sample. Third, a correlation between the two dimension scores was computed. For the current sample, the correlation was .24 ($p$=.001), indicating some association between the two dimensions. Inspection of the plot of factor loadings, based on the factor analysis, suggested that the correlation could have been caused by two scales occupying different positions on the interpersonal circle than those hypothesised: Understanding (CS), had moved counter-clockwise and changed

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places with the Helpful/Friendly (CD) sector, while Dissatisfied (OS) had moved clockwise and almost overlapped with Admonishing (OD). Despite these (minor) irregularities, given the high CI and outcomes of the factor analysis (and prior validity outcomes on an even larger Australian data set including the present one, e.g. den Brok, Rickards & Fisher, 2003), the researchers conducting this study decided to use the QTI-based dimension scores.

In addition to students' perceptions of teacher interpersonal behaviour, several other student, class and school variables were investigated (see Table 3 for an overview of these variables). Students' ethnic background was measured in terms of a number of variables: language spoken at home most of the time (English or other), country of birth of the mother (Australia, Europe, Asia, South-East Asia, Oceania, Africa, Northern America and Southern America) and country of birth of the father (similar distinction). It was decided to only  use country of origin for the mother. 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 English-speaking students was determined, as well as the percentage of students with an Australian-born mother. Apart from ethnicity, students were asked to provide information regarding their gender, a recent achievement test and their attitude towards the teachers' lessons (using the TOSRA, a Test Of Science Related Attitudes; Fraser, 1981; Fisher, Henderson & Fraser, 1995, Rickards, 1998). Class-mean equivalents for these variables were also calculated, as it was assumed that the level of the class might also affect students' perceptions.

Insert Table 3 about here.

At the class level, the following variables were created: class size (number of students in class), grade level, percentage of male students, and subject taught. 'Subject taught' was divided into a number of dummy variables (indicating mathematics, science or other subjects). With respect to the school, information was gathered on the type of school (government or independent) and state (Tasmania or Western Australia).

*Sample*

The sample consisted of 3,994 students and 191 secondary school science teachers in 36 schools, located in two Australian states: Western Australia and Tasmania. Distribution of the sample was relatively equal in terms of state (2,204 students or 55.2% in Western Australia) and student gender (1,927 male students or 48.7%). The majority of the students indicated that they spoke English at home (3,793 students or 95.8%). Three out of four students (72.8%) indicated that they had an Australian-born mother, leaving 1,072 students (27.1%) with mothers born outside Australia, for the major part in Asian, South-East Asian or African countries. Most of the surveyed students were in the eighth (32.7%), ninth (28.5%) or tenth (20.3%) grade. About two-thirds of the students were in government schools (2,368 students or 59.3%).

In terms of class-composition variables, the sample was quite diverse. The average percentage of boys in the class was 50%, but classes ranged from girls-only to boys-only. Most of the classes consisted of mainly English-speaking students, with

a percentage range of English speaking students between 50 and 100. Class size ranged from 5 to 35, with an average of 24.

Achievement scores ranged between 3 and 97 percent (mean 62 percent, standard deviation 19.8%), and attitude ranged between 0 and 1 (mean attitude was .60, standard deviation .20).

*Analysis*

Multilevel analyses were conducted on the *dimension* scores of the QTI (DS and CO). The models consisted of three levels: school, class and student and 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, and school level. Next, a model with all the student variables named in Table 3 was tested. Non-significant variables were deleted from the model until a model was achieved with only significant student variables.  In the second step, class and school variables were added. Finally, interactions between variables, especially between the gender and ethnicity indicators, were tested, both within and across levels. Coefficients were estimated with the RIGLS method[1]. Effect sizes also were determined, 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 correlation and cross-tabular analyses[2].

Results

*Variance Distribution in Influence (DS) and Proximity (CO)*

Table 4 provides the sample mean scores for DS and CO, as well as the percentages of variance located at the school, class, and student level. As can be seen, on average, Australian secondary school teachers were regarded as both dominant and cooperative (note that DS and CO scores can range between –3 and +3). Also, two-thirds of the variance was located at the student level, with only minimal variance at the school level and the remainder of the variance at the class (or teacher) level. These findings are in line with studies using multilevel analyses on American data (den Brok, et al., 2002; Levy, et al., 1997, 2003) and suggest that a school can hardly be distinguished by its 'interpersonal' profile.

Insert Table 4 about here.

*Variables Explaining Students' Perceptions of Their Teachers' Interpersonal Behaviour.*

Table 5 provides an overview of the variables that had a significant impact on students' perceptions of their teachers' interpersonal behaviour. Table 5 lists both regular coefficients as well as effect sizes.

As can be seen in Table 5, the more positive the attitude of the student, the higher his or her perception of the teacher in terms of both influence and proximity. This finding resembles those of earlier studies (den Brok, 2001; Rickards & Fisher,

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1997). For gender, a negative relationship was found with both influence and proximity. This means that boys perceived their teachers as less dominant and cooperative than girls, a finding that again is in keeping with most of the prior work (Levy, et al., 2003; Rickards, 1998; Rickards & Fisher, 1997).

Insert Table 5 about here

Differences in perceptions were also reported with respect to ethnicity-related variables. Students speaking mainly English at home perceived their teachers as more dominant and more cooperative. As with gender and attitude, this finding supports earlier outcomes (den Brok, et al., 2003; Levy, et al., 1997; 2003). Also, students whose mothers were born in South-East Asian countries reported higher perceptions of influence than students whose mothers were born in Australia or any of the other countries.

For proximity, no differences were found with respect to country of origin of the mother. While earlier analyses on the same data set indicated similar findings for influence-related scales (Rickards, 1998; Rickards & Fisher, 1997), the absence of a relationship between ethnicity and proximity was different. It seems very likely that the analysis method used has contributed to this difference: apparently, when taking into account the fact that the data were not sampled randomly and when correcting the effect of ethnicity for other variables (in this case: gender, attitude and several class variables), the effect of ethnicity reduces and becomes non-significant.

At the class level, only class gender composition had an effect on proximity: the more boys in the class, the less proximity was perceived. This finding supports that of an earlier study by Levy and colleagues (2003).

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Ethnic make-up of the class also appeared to be relevant: the more English-speaking students in the class, the more dominant the teacher was perceived. This resembles outcomes at the student level. Also, the fewer students with Australian-born mothers, the more influence was perceived. Again, these findings resemble those at the student level.

Class attitude had a positive effect on both influence and proximity: students in highly motivated classes had a more favourable perception of their teacher.

Finally, only class-size had an effect on influence: the larger the class, the less dominant the teacher was perceived. Earlier studies only found an association between proximity and class size (e.g. Levy, et al., 1992; 2003). No school-level variables were found to be associated to students' perceptions. Similarly, no interaction effects were found.

*Relative Importance of Single Variables and All Variables Combined*

Looking at the effect sizes reported in Table 5, it seems that attitude was by far the most relevant variable in explaining variance in students' perceptions of their teachers' interpersonal behaviour. Its effect was twice as strong as that of most other variables. However, class composition variables such as percentage of students speaking English at home or having an Australian-born mother seemed also important. Gender and class size were less relevant. However, in the case of class size, the picture may be misleading, since the coefficient provides the growth in influence per student: if a class, for example, contains 5 more students, this has an effect that is equal in size to that of (class) attitude.

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Combined, the variables only explained a relatively small amount of variance (6.5 percent) in influence. This percentage is similar to that of earlier studies (e.g. Levy, et al., 2003) and suggests that other variables may be necessary in order to explain differences in perceptions between students and their classes. The model explained up to 11 percent of the variance at the class level, but only 7 percent of the variance at the student level.

A large amount of variance – more than half of it – was explained for proximity. This is a unique and surprising finding, as - usually - similar amounts of variance are explained in influence and proximity. The model explained nearly all variance at the class level and about 30 percent of the variance at the class level. This is a very satisfying finding and adds value to this study as a source of validation for other studies.

## Discussion

The present study was the first of its kind to use multilevel analyses and dimension scores for the QTI to investigate differences in students' perceptions of teacher-student interpersonal behaviour. The study provides further support for many associations reported in earlier studies, such as those related to student gender, student and class ethnic background, and subject taught.

However, it should be noted that the study also differed from earlier work in a number of ways. Firstly, this study was amongst the first to investigate the effect of student and class attitude on students' perceptions. This variable proved to be of major influence and suggests that researchers ought to include it in future

investigations. The findings with respect to attitude also point to the mutual effect that motivation and perception have on each other supporting the system-oriented nature of communication in the classroom (Watzlawick, Beavin, & Jackson, 1967).

Secondly, the study found an effect of class size on the perception of influence, while earlier studies only reported effects on proximity. While the finding supports expectations that teachers need to be stricter and strong leaders to establish structure and order in a larger class, future research is needed to confirm its importance for influence.

Thirdly, this study managed to explain large amounts of variance in ratings of proximity. This might have been caused by the inclusion of subject-related attitude into the models. On the other hand, the finding is unique in studies using multilevel analyses on QTI scale or dimension scores, and might be related to sample characteristics or context. Future research is needed to confirm the stability of this finding.

Unfortunately, the study was subject to some limitations. First, since most teachers participated with only one class (some participated with more classes), we were not able to distinguish between the teacher and class level. While predictions are that adding an extra level to the analyses would have altered the results only slightly, it might have showed some interesting findings with respect to stability of perceptions across classes of the same teacher. Secondly, in the models used in this study, no teacher variables such as experience, gender and ethnic background were included. Earlier research using the QTI has shown that these variables are also related to students' perceptions, and including them in the analyses may have provided even higher amounts of explained variance. Thirdly, there was a slight concern regarding validity of the QTI in this sample. While prior research showed the

Australian QTI version to display adequate construct validity (Rickards, et al., 2003), in this study some association was found between the two dimensions, probably as a result of dislocation of the Understanding and Admonishing scales. It remains unknown to what extent these irregularities may exert an influence on the outcomes. Finally, the study only used quantitative (questionnaire) data. While such data enable researchers to describe and investigate broader and comprehensive trends, they fail to explain in-depth why these patterns are found, or how they may be caused. In the research from which this data set originated (e.g., Rickards, 1998; Rickards & Fisher, 1997) qualitative data were gathered by means of interviews with teachers and students. However, the interviewing was intended to support construct validity, rather than search for causal relationships with student or class characteristics.

The findings are significant for both researchers and teachers or policy makers. The results indicate that perceptions of the teacher may vary as a result of class size, ethnic composition and gender composition. Since students' perceptions of their teachers' interpersonal behaviour are strongly related to their achievement and motivation, the outcomes of this study suggest that, in order to obtain favourable perceptions (hence: student outcomes) of the classroom environment from all students, it is probably best to evenly distribute students in terms of characteristics such as gender and ethnicity. Also, for teachers, it is important to realise that students from different backgrounds or gender perceive them differently. Knowledge of such differentiated perceptions may help teachers in establishing teaching methods that support all students (e.g., Nieto, 1996). For researchers, this study clearly shows the importance of student and class attitude in predicting students' perceptions of their learning environment and serves as a valuable comparative study for future research.

**Notes**

[1] 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).

[2] No (significant) associations between explanatory variables were found.

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Table 1

*Typical items of the English version 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. |

Table 2

*Reliability (alpha) of QTI scales at the student and class level, and variance at the class level (eta$^2$).*

| Scale | Alpha Student level | Alpha Class level | Eta$^2$ |
|---|---|---|---|
| DC – Leadership | .82 | .93 | .33 |
| CD – Helpful/Friendly | .88 | .96 | .35 |
| CS – Understanding | .85 | .95 | .32 |
| SC – Student Responsibility/ Freedom | .66 | .82 | .26 |
| SO – Uncertain | .72 | .87 | .22 |
| OS – Dissatisfied | .80 | .93 | .23 |
| OD – Admonishing | .76 | .87 | .31 |
| DO – Strict | .63 | .78 | .23 |

Table 3

*Variables used in multilevel analysis.*

| Level | Variable | Description |
|---|---|---|
| Student | Gender | Dummy variable with boys indicated by a '1'. |
| | Attitude | Scale variable (recoded to a score between 0 and 1) indicating the motivation for class. |
| | Achievement | Scale variable indicating recent test score, ranging between 0 and 100 (percentage score). |
| | Language spoken at home | Students indicate which language is spoken at home most of the time. Recoded into dummy variable with '1' indicating English. |
| | Mother's country of birth | Students indicate where their mother was born. Recoded into a series of dummy variables (Europe, Asia, South-East Asia, Oceania, Africa, North America, South America), with a '1' indicating the specific country (Australia is baseline). |
| Class | Grade level | Variable indicating the grade level, ranging between 8 to 12, recoded into a variable running from 1 to 6, with a higher score indicating a higher grade level. |

| | | |
|---|---|---|
| | Class-size | The number of students in the class. |
| | Percentage boys | Variable indicating the ratio of boys in class (between 0 and 1). |
| | Percentage English | Variable indicating the ratio of students in class speaking English at home most of the time (between 0 and 1). |
| | Percentage Australian | Variable indicating the ratio of students in class with their mother born in Australia (between 0 and 1). |
| | Class-achievement | Class average of achievement. |
| | Class-attitude | Class average of attitude. |
| School | Type | Dummy variable indicating if a school is independent ('1') or not. |
| | State | Dummy variable indicating the state of location of the school (with a '1' indicating Tasmania). |

Table 4

*Mean DS and CO scores and percentages of variance at the school, class and student level (empty model).*

|  | Influence (DS) | Proximity (CO) |
|---|---|---|
| Constant/mean (st. error) | .48 (.02) | .71 (.03) |
| Variance |  |  |
| - School | 0.0 % | 1.5 % |
| - Class | 30.1 % | 28.3 % |
| - Student | 69.9 % | 70.2 % |
| -2*Loglikelihood | 2778.46 | 6707.47 |

Table 5

*Variables explaining students' DS and CO perceptions.*

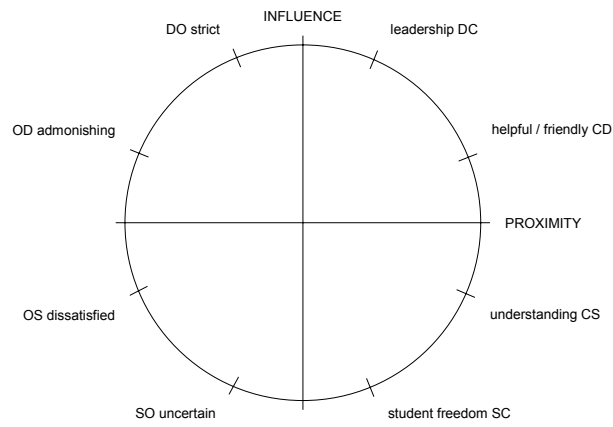|  | Influence (DS) | | Proximity (CO) | |
|---|---|---|---|---|
|  | Coefficients (st. error) | Effect size | Coefficients (st. error) | Effect size |
| Constant | -.69 (.28) | - | -1.24 (.11) | - |
| Student |  |  |  |  |
| - attitude | .33 (.03) | .168 | 1.72 (.04) | .545 |
| - gender | -.05 (.01) | -.058 | -.10 (.01) | -.082 |
| - language at home | .06 (.02) | .033 | .09 (.03) | .030 |
| - Mother born in SE-Asia | .06 (.5) | .030 | - | - |
| Class |  |  |  |  |
| - Percentage boys | - | - | -.17 (.08) | -.048 |
| - Percentage English-sp. | .87 (.29) | .141 | - | - |
| - Percentage Australian | -.22 (.10) | -.108 | - | - |
| - Class attitude | .31 (.16) | .073 | 1.59 (.17) | .230 |
| - Class size | .004 (.002) | .074 | - | - |
| School |  |  |  |  |
| Variance |  |  |  |  |
| - explained | 6.5 % | | 52.7 % | |
| - school | 0.0 % | | 1.5 % | |
| - class | 26.5 % | | 6.5 % | |
| - student | 67.0 % | | 39.3 % | |
| -2*Loglikelihood | 2598.21 | | 4766.93 | |

*Figure 1*. The Model for Interpersonal Teacher Behaviour.